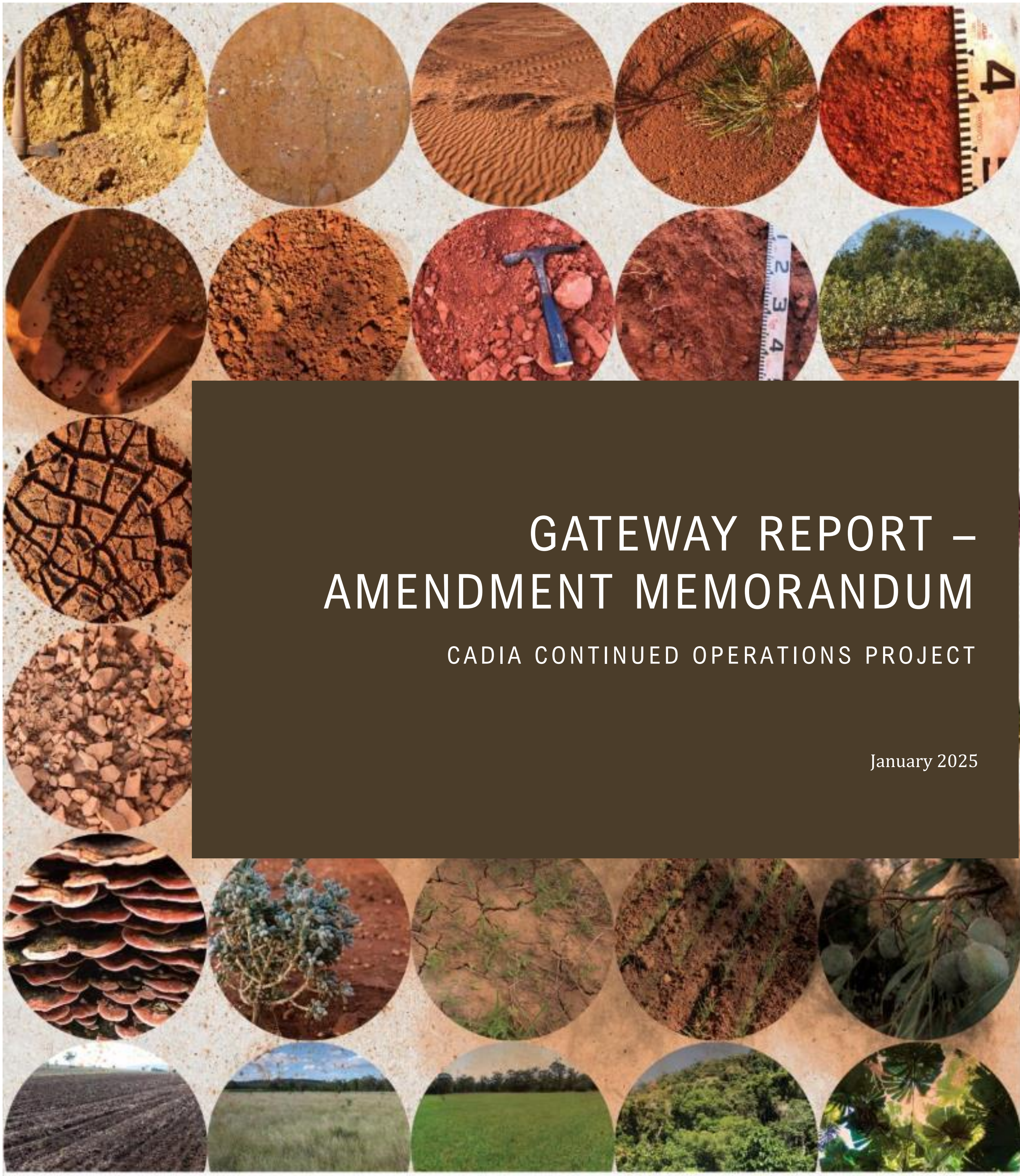

# GATEWAY REPORT – AMENDMENT MEMORANDUM

## CADIA CONTINUED OPERATIONS PROJECT

January 2025

MINESOILS

LAND & REHABILITATION SPECIALISTS

# PREPARED BY

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# DOCUMENT CONTROL

| Reference | Date | Prepared By | Approved |
|---|---|---|---|
| MS-051_ Draft 1 | 6 December 2024 | Matt Hemingway | Clayton Richards |
| MS-051_ Draft Final | 17 December 2024 | Matt Hemingway | Clayton Richards |
| MS-051_ Final | 09 January 2025 | Matt Hemingway | Clayton Richards |
| MS-051_ Final v2 | 30 January 2025 | Matt Hemingway | Clayton Richards |

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## Appendices

# 1. OVERVIEW

## 1.1 OVERVIEW

On 30th July 2024, CHPL applied to the Mining and Petroleum Gateway Panel (the Gateway Panel) for a Gateway Certificate (Gateway Application GA 74105711 – refer to **Appendix A**) to enable and accompany the lodgement of a development application for the Cadia Continued Operations Project (CCOP).

Following detailed assessment of the Gateway Application against the relevant criteria set out in Section 2.31 of the Resources SEPP, on 25 October 2024, the Gateway Panel issued a Conditional Gateway Certificate (refer to **Appendix B**) and an accompanying Conditional Gateway Certificate Report (refer to **Appendix C**).

Since the Gateway Application was submitted and the Gateway Panel determination received, further refinements have been made to improve the CCOP design and respond to environmental and social information obtained through ongoing survey efforts and community consultation undertaken to inform the Environmental Impact Statement (EIS) for CCOP. These refinements have resulted in some minor changes to the project description and layout, and prompted the need to seek an amendment to the Gateway Certificate in accordance with section 2.35 of the Resources SEPP.

Minesoils Pty Ltd (Minesoils) was engaged by Umwelt (Australia) Pty Ltd (Umwelt) on behalf of Cadia Holdings Pty Limited (CHPL), to prepare the original Gateway Report for the CCOP and has been reengaged to prepare this application for an amendment to the Gateway Certificate issued on 25 October 2024.

## 1.2 THE PROJECT

CHPL owns and operates the Cadia mine, located approximately 20 kilometres (km) South-South-West of Orange in the Central Tablelands region of New South Wales (NSW). The mining operation traverses two local government areas (LGAs), Blayney Shire Council and Cabonne Council.

Cadia mine is one of Australia's largest polymetallic mining operations, producing gold, silver, copper and molybdenum products. The mine has been operating continuously since it opened in 1998. Cadia provides an important economic contribution to the region, NSW and is a major regional employer providing direct employment of approximately 1,800 full time equivalent jobs. With confirmed mineable resources extending well beyond the life of the current Project Approval (PA 06_0295) which limits mining of this resource until 30 June 2031, Cadia has commenced planning for the continuation of mining operations beyond 30 June 2031.

This project is known as the Cadia Continued Operations Project (CCOP/the Project). Following lodgement of GA 74105711, further detailed field investigations and technical studies, CHPL has identified additional opportunities to reduce the footprint of the CCOP and improve social and environmental outcomes by removing the South Water Storage and the associated infrastructure and construction related disturbance proposed to be constructed on Cadiangullong Creek. The South Water Storage was initially proposed to support water supplies over the extended operational life, however its removal from the Project reduces the Project disturbance area and avoids associated agricultural, water resource, biodiversity, heritage and amenity impacts.

Cadia will continue to minimise its operational water demands by reusing water held within the mine's surface water management system. As occurs with the current operations, additional water requirements beyond those that can be services through reuse would be sourced from Cadiangullong Dam, Flyers Creek Weir, Cadia Creek Weir, the Belubula River, on-site groundwater bores and treated municipal waste water. As part of Newmont's commitment to minimising operational water usage, further studies into the optimisation of water use on site will continue throughout the Project life.

CHPL has also identified additional opportunities to relocate support services, topsoil stockpile areas and ancillary infrastructure elements to reduce the disturbance footprint for the CCOP and optimise the design of project elements, such as the geometric and intersection design of the realigned section of Panuara Road. While these opportunities provide significant overall improvements in Project outcomes, they require the disturbance of minor additional lands located outside of the existing Gateway Application Area (GAA) for the CCOP (namely, in the north east within Forestry Corporation NSW lands, as well as a minor extent to the east at the convergence of Cadia and Panuara Roads) .

The original Gateway Disturbance Area (GDA), Revised Gateway Application Area (Revised GAA) and Revised Gateway Disturbance Area (Revised GDA) are shown in **Figure 1**. Further discussion of the proposed amendments to the Gateway Certificate areas is provided in **Section 2**.

## 1.3 PURPOSE OF THIS DOCUMENT

The NSW Gateway process provides for an independent scientific assessment of the impact of state significant mining developments that require a new mining lease and coal seam gas proposals on strategic agricultural land and its associated water resources. The Gateway assessment applies to the 2.8 million hectares of strategic agricultural land which has been mapped across NSW and must occur before an applicant can submit a development application. The Gateway process is established through clause 2.29 of the Resources SEPP.

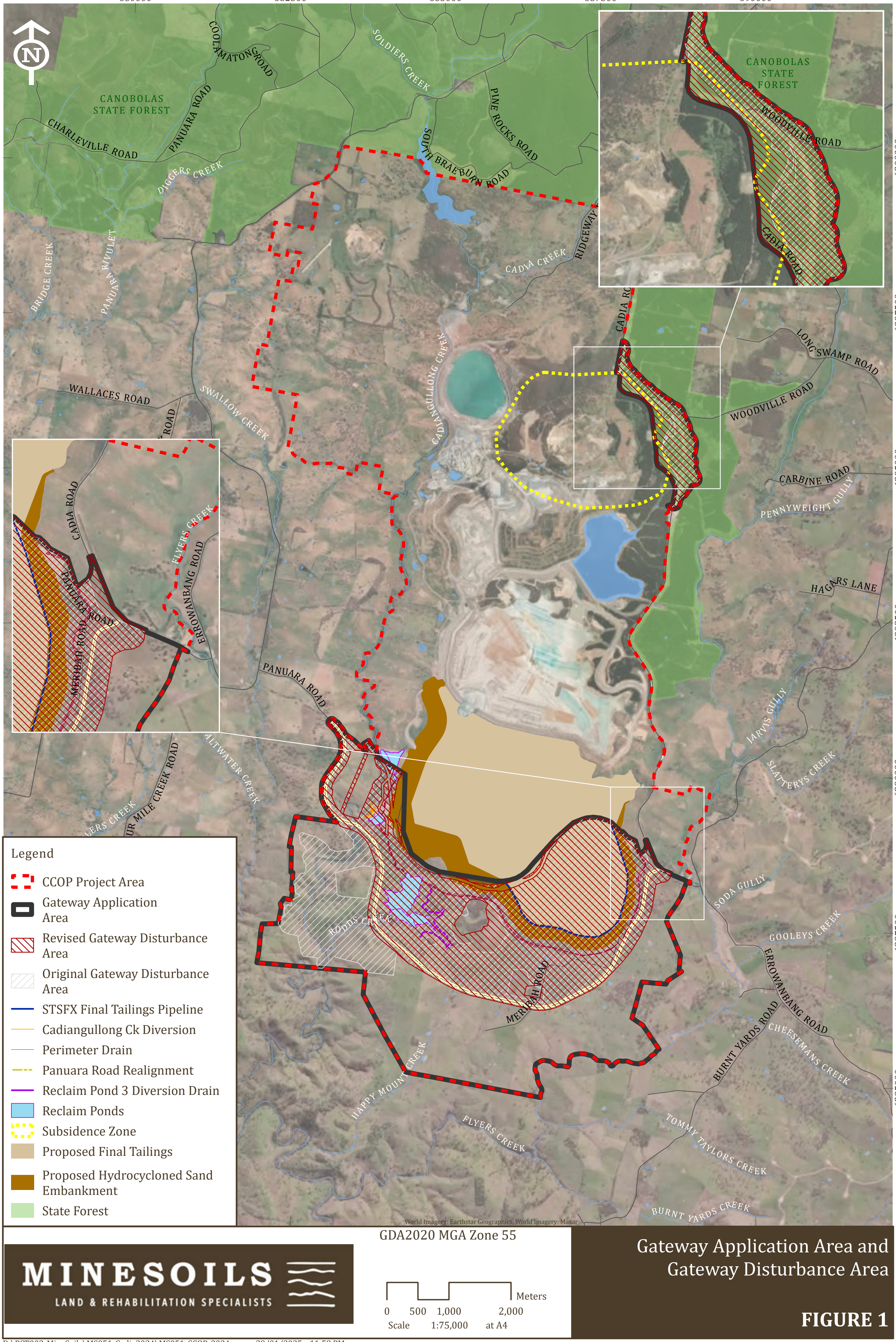
The Resources SEPP requires certain types of developments to verify whether the proposed site is on BSAL and, where BSAL is found, assess the likely significance of impacts on these lands and associated groundwater resources.

The site verification process undertaken to support the CCOP Gateway Application considers the elements of CCOP which are outside of existing mining tenements. The verification program was undertaken in accordance with the Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land (Office of Environment & Heritage [OEH] and Department of Primary Industries - Office of Agricultural Sustainability and Food Security [DPI-OAS&FS], 2013); hereafter referred to as the Interim Protocol. The results of the site verification process confirmed BSAL to be present within the GAA.

Given BSAL was verified as occurring within the GAA, a Gateway Application was lodged with the Gateway Panel on 30 July 2024 (refer to **Appendix A**). The Gateway Panel completed its assessment of the Gateway Application against the relevant criteria set out in Section 2.31(4) of the Resources SEPP on 25 October 2024 and determined to issue a Conditional Gateway Certificate (refer to **Appendix B**) and Conditional Gateway Certificate Report (refer to **Appendix C**).

The Conditional Gateway Certificate noted that GA 74105711 did not meet the relevant criteria in subsections i, ii, iii, iv and vi of section 2.31(4) of the Resources SEPP and included 17 primary recommendations pertaining to the assessment and management of impacts in the EIS. The Gateway Panel's reasons for forming its opinions and recommendations can be found in **Appendices B** and **C**.

This report seeks an amendment to the Development Description and Gateway Certificate issued by the Gateway Panel on 25 October 2024 for GA 74105711. This report has been prepared by Minesoils, on behalf of CHPL, to document and assess the impacts of the revised GAA.




# Gateway Application Area and Gateway Disturbance Area

**FIGURE 1**

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# 2. PROJECT DESCRIPTION

The GAA that was subject to the submitted assessment consists of parts of the CCOP Project Area which represents a broad envelope or perimeter of the site, where new mining leases are required for the activities proposed. The GAA generally lies within the Blayney Shire Council LGA, with the northeast portion of the GAA also partially occurring within the Cabonne Shire LGA.

Not all areas within the CCOP Project Area will be disturbed as part of the Project. Areas that will be subject to direct ground disturbance by the Project within the GAA are referred to as the GDA.

As outlined in **Section 1**, CHPL has identified a range of opportunities and improvements in the design of the CCOP since the submission of the Gateway Application in July 2024. These improvements have led to a range of refinements in the project layout and description. These refinements include the removal of the South Water Storage, minor changes to the boundaries of the GDA between the Southern Tailings Storage Facility Extension (STSFX) and Panuara Road to accommodate operational needs and infrastructure, and a slight increase in the GAA to the southeast to accommodate improved road alignment designs (see **Figure 1**).

While these changes have resulted in some minor adjustments to the total hectares (ha) and verified BSAL that is proposed to be impacted by the CCOP (refer Section 3.1), it does not change the general nature of the existing soil landscapes or the likely impacts of the CCOP on agricultural resources.

All other aspects of the CCOP remain as outlined in the Gateway Application lodged on 30 June 2024. The updated CCOP development description involves:

- Continuation of operations beyond 2031 (for a period of 25 years from the date of approval, nominally to 2050) using existing and approved but not constructed infrastructure and supporting site services.
- Continuation of and extension to underground mining within the Cadia East and Ridgeway mining areas, and associated changes in subsidence surface expression.
- The continued emplacement of tailings from ore processing over the life of the continued operations within existing approved storage facilities and an extension of the existing Southern Tailings Storage Facility (STSF)
- Realignment of portions of Panuara Road and Cadia Road to maintain public safety and account for the above project features.
- Changes to site infrastructure and facilities to enable ongoing mining operations.

As outlined in GA-74105711, a new development consent will be sought for the CCOP, which (if approved) would replace the existing Project Approval (PA 06_0295) and provide for a new and modern consent to govern future operations at Cadia.

# 3. REVISED IMPACTS

## 3.1 BIOPHYSICAL STRATEGIC AGRICULTURAL LAND

The Gateway Application Report (**Appendix A**) states that the Project is anticipated to have a direct surface impact on BSAL over an area of up to 378 ha, within the broader 1,253 ha of the original GDA. As outlined in **Table 1** below, the Revised GDA will result in a direct surface impact on BSAL over an area of up to 411 ha, within the broader 1,101 ha of the Revised GDA.

Therefore, the Revised GDA results in a 33 ha increase in impacted BSAL to that presented in the Gateway Report (refer **Figure 2**).

Opportunities for additional avoidance and reductions in impacts to BSAL will be further investigated and assessed as part of the EIS process.

Table 1: Change in impact to BSAL within GDA

| GDA | Total Area (ha) | Area of Impacted BSAL | |
|---|---|---|---|
| | | ha | % |
| Original GDA | 1,253 | 378 | 30 |
| Revised GDA | 1,101 | 411 | 37 |
| **Net change** | -152 | + 33 | +7 |

## 3.2 SOIL MAPPING UNITS

The Revised GDA will result in a reduction of impact on each of the four Soil Mapping Units identified within the GAA, as outlined in **Table 2** and shown on **Figure 3.** This is most notable for Soil Mapping Units 3:Kandosols and Soil Mapping Unit 4: Tenosols, which see a reduced impact of 83% and 72% respectively.

Table 2: Change in impact to Soil Mapping Units within GDA

| Soil Mapping Unit | Original GDA | Revised GDA | Impact Reduction | |
|---|---|---|---|---|
| | | | ha | % |
| 1. Chromosols | 656 | 650 | 6 | 1 |
| 2. Dermosols | 434 | 408 | 26 | 6 |
| 3. Kandosols | 18 | 3 | 15 | 83 |
| 4. Tenosols | 145 | 40 | 105 | 72 |

All soil that is proposed to be disturbed during the Project will be stripped, with direct placement for progressive rehabilitation used where possible or appropriately stored for re-use in later rehabilitation efforts in order to mitigate long term impacts on soil resources. Soil stripping and storage practices are already in place as part of the existing Cadia operations and existing operational controls are being reviewed with the intention that they be applied to the Revised GDA. A detailed soil stripping strategy and soil balance will be included in assessments as part of the EIS process.

As reported in the Gateway Application Report (**Appendix A**), there will be no direct or indirect impacts to the soil resources of the Project locality outside of the existing consented disturbance areas and the GAA.

## 3.3 LAND AND SOIL CAPABILITY

The Revised GDA will result in a reduction of impact to LSC classes verified within the GAA, as outlined in **Table 3,** and shown on **Figure 4.** This data shows the higher LSC classes (6, 7 and 8) associated with steeper topographic terrain features in the south west of the GAA that were formerly proposed to accommodate the South Water Storage experience the largest impact reductions, with no reduction in impact to LSC classes 3 and 5, and a minor reduction in impact to LSC class 4.

Table 3: Change in impact to baseline LSC classes within GDA

| LSC class | Original GDA | Revised GDA | Impact Reduction | |
|---|---|---|---|---|
| | | | ha | % |
| LSC class 3: high capability land | 23 | 23 | 0 | 0 |
| LSC class 4: moderate capability land | 836 | 824 | 12 | 1 |
| LSC class 5: moderate-low capability land | 11 | 11 | 0 | 0 |
| LSC class 6: low capability land | 246 | 191 | 55 | 22 |
| LSC class 7: very low capability land | 87 | 31 | 56 | 64 |
| LSC class 8: extremely low capability land | 50 | 21 | 29 | 58 |

Due to the nature of the Project which would involve a significant modification to existing landforms in the context of the proposed tailing facility and its embankment, the level of impacts on LSC classes within the GAA are considered to be high, with a general permanent downgrading of LSC classes.

An LSC assessment to determine the LSC classes of the conceptual post-mining landform of the GAA was presented in the Gateway Application Report (see **Figure 17** in **Appendix A**)**.** The final LSC classes for the revised GAA are highlighted in **Figure 5**, and outlined in **Table 4**. These results show that the revised GAA will result in less LSC class 3 – 6, and LSC class 8 lands in the final landform (a reduction of 15 ha and 87 ha respectively), and an increase in LSC classes 4, 6 and 7 (14 ha, 25 ha and 67 ha). Overall, the revised GAA will generally provide better post-Project LSC outcomes as a result of the revisions.

Table 4: Change in post-Project LSC classes within the GAA

| LSC class | Original GAA | Revised GAA | Change | |
|---|---|---|---|---|
| | | | ha | % |
| LSC class 3: high capability land | 39 | 39 | 0 | 0 |
| LSC class 4: moderate capability land | 589 | 603 | +14 | +2 |
| LSC class 5: moderate-low capability land | 11 | 11 | 0 | 0 |
| LSC class 6: low capability land | 308 | 333 | +25 | +8 |
| LSC class 3 – 6: low to high capability lands | 653 | 638 | -15 | -2 |
| LSC class 7: very low capability land | 500 | 567 | +67 | +13 |
| LSC class 8: extremely low capability land | 165 | 78 | -87 | -53 |
| Total Area | 2,265 | 2,269 | +4 | +<1 |

## 3.4 AGRICULTURAL LAND USE

As presented in the Gateway Application Report (**Appendix A**), agricultural lands within the GAA will be temporarily removed from agricultural land use for the duration of the Project. The original GAA of 2,265 ha contained an area of 2,090 ha identified as agricultural land. The revised GAA of 2,269 contains an area of 2,092 ha of land that, for the purpose of this assessment, can be considered agricultural land.

The reduction of 2,092 ha of agricultural land is considered a minor impact in the context of land used for agriculture within the Blayney Shire and Cabonne LGA's (1.4 % and 0.5% respectively).

For the purpose of this assessment, it is assumed that the identified present agricultural lands within the GAA will be returned to an agricultural land use, with the exception of the infrastructure footprint areas presented on **Figure 6. Table 5** identifies the post-Project agricultural land within the original GAA compared to the revised GAA, highlighting the revised GAA will result in an increase in post-Project agricultural land use. The post-Project agricultural land as a result of the design change is 1,761 ha, an increase of 78 ha or 5%.

The design changes would result in the permanent removal of 334 ha of land from agricultural land use (compared to 407 ha as per the original design), which is considered a minor impact in the context of land used for agriculture within the Blayney Shire and Cabonne LGA's (0.2% and 0.1% respectively). The resulting permanent removal of agricultural productivity to the value of $129,191 (compared to $157,427 as per the original design) is also considered minor in context of gross commodity value for Blayney Shire and Cabonne LGA's (0.2% and 0.1% respectively).

Table 5: Land Used for Agriculture within the GAA post-Project

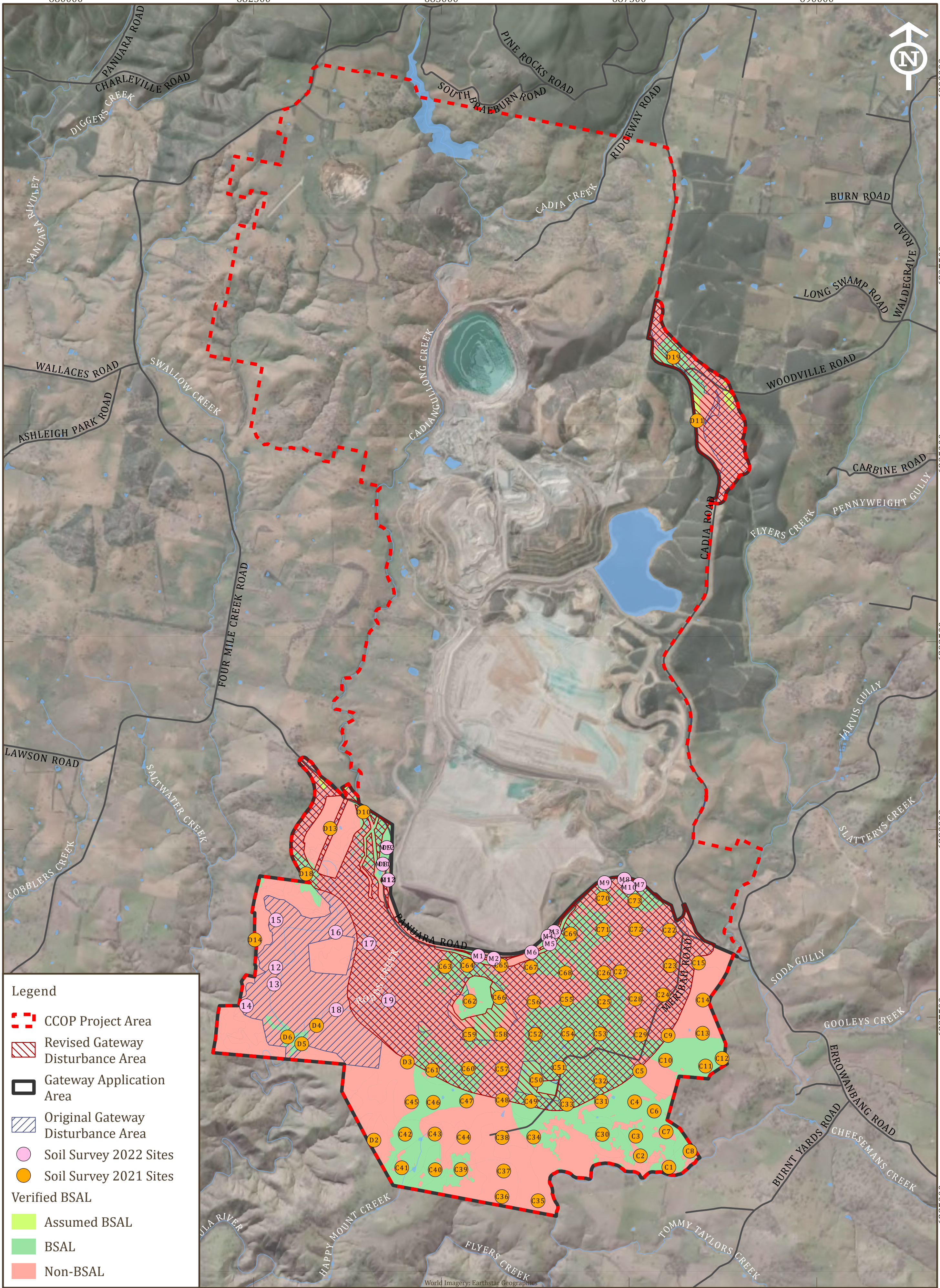
| LSC class | Original GAA | Revised GAA | Change | |
|---|---|---|---|---|
| | | | ha | % |
| Agricultural Land | 1,683 | 1,761 | +78 | 5 |
| Non-Agricultural Land | 489 | 415 | -74 | -15 |
| Forestry | 93 | 93 | 0 | 0 |
| Total Area | 2,265 | 2,269 | +4 | +<1 |

## 3.5 OTHER POTENTIAL IMPACTS

A summary of other potential impacts of the CCOP on agriculture and agricultural resources, including any changes relating to the revised Gateway Application, is provided in **Table 6** below.

Table 6: Summary of Other Impacts

| Risk Item | Original Gateway Application | Amended Gateway Application |
|---|---|---|
| Water Resources including Groundwater | The Project includes the components which have the potential to impact on groundwater and surface water resources. Further assessments being conducted as part of the EIS process. | Whilst the removal of the South Water Storage Area reduces the overall extent of water impacts in this area, there are no consequential changes in predicted impacts to highly productive groundwater resources. |
| Infrastructure | The Project will have a negligible impact on local and regional agricultural infrastructure | No change. |
| Pest Species | Mitigation measures are available to reduce risk of pest species impacts on agriculture. | No change. |
| Biosecurity | Mitigation measures are available to reduce risk of biosecurity impacts on agriculture. | No change. |
| Traffic | A specialist assessment on the potential traffic and transport impacts of the Project is currently being undertaken as part of the EIS process. It is expected mitigation measures will be available to reduce risk of traffic impacts on agriculture. | Reduction in traffic impacts associated with the removal of the South Water Storage Area. |
| Noise and Vibration | A specialist assessment on the potential noise and vibration impacts of the Project is currently being undertaken as part of the EIS process. It is expected mitigation measures will be available to reduce risk of impacts on agriculture. | Reduction in noise impacts associated with the removal of the South Water Storage Area. |
| Air Quality | A specialist assessment on the potential air quality and dust impacts of the Project is currently being undertaken as part of the EIS process. It is expected mitigation measures will be available to reduce risk of impacts on agriculture. | Reduction in ground disturbance and associated air quality and dust impacts associated with the removal of the South Water Storage Area. |




GDA2020 MGA Zone 55

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Scale 1:65,000 at A4

Verified and Assumed BSAL Mapping

**FIGURE 2**

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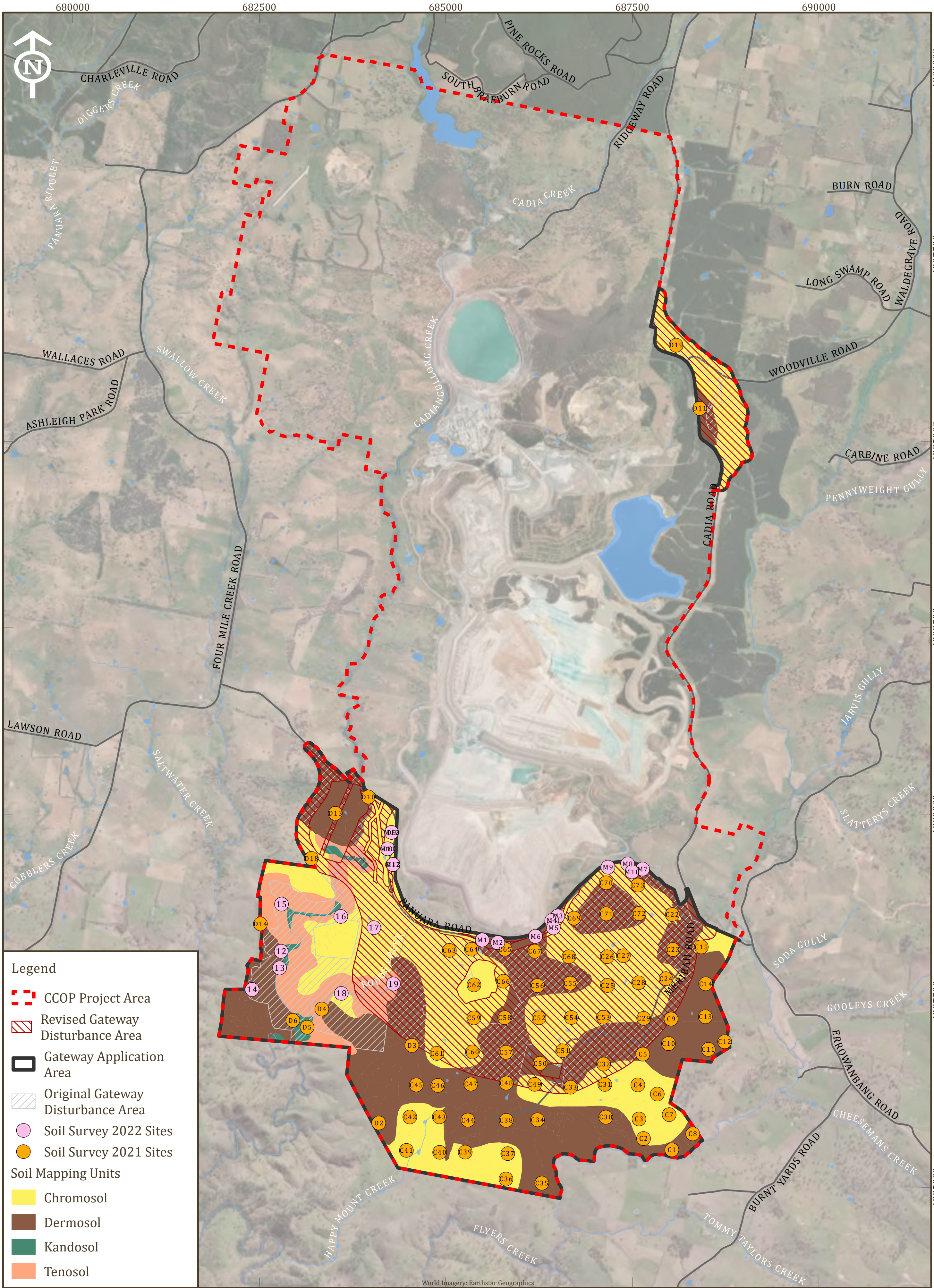


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Soil Mapping Units

FIGURE 3

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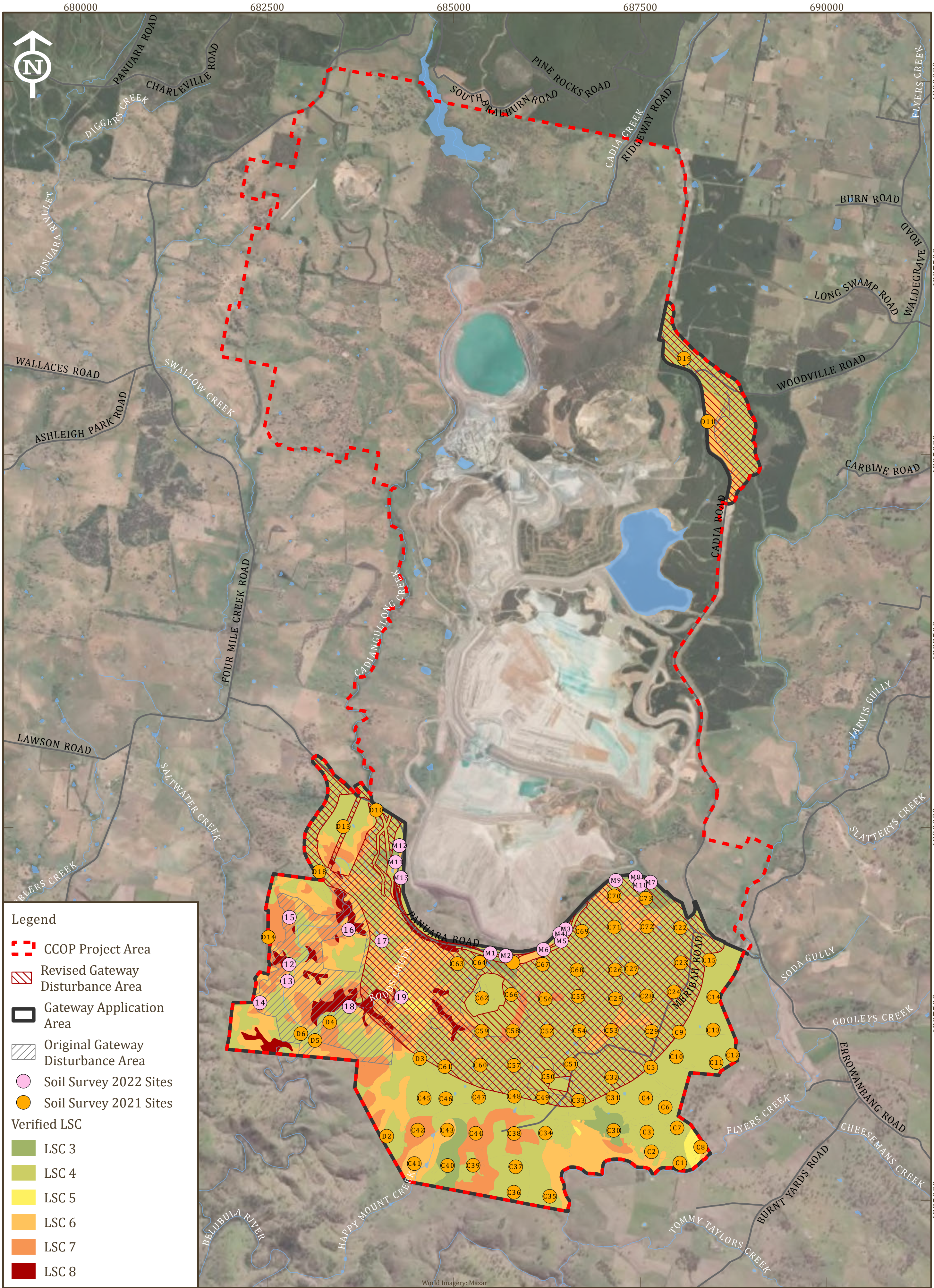


GDA2020 MGA Zone 55

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Scale 1:65,000 at A4

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Verified Land and Soil Capability

FIGURE 4

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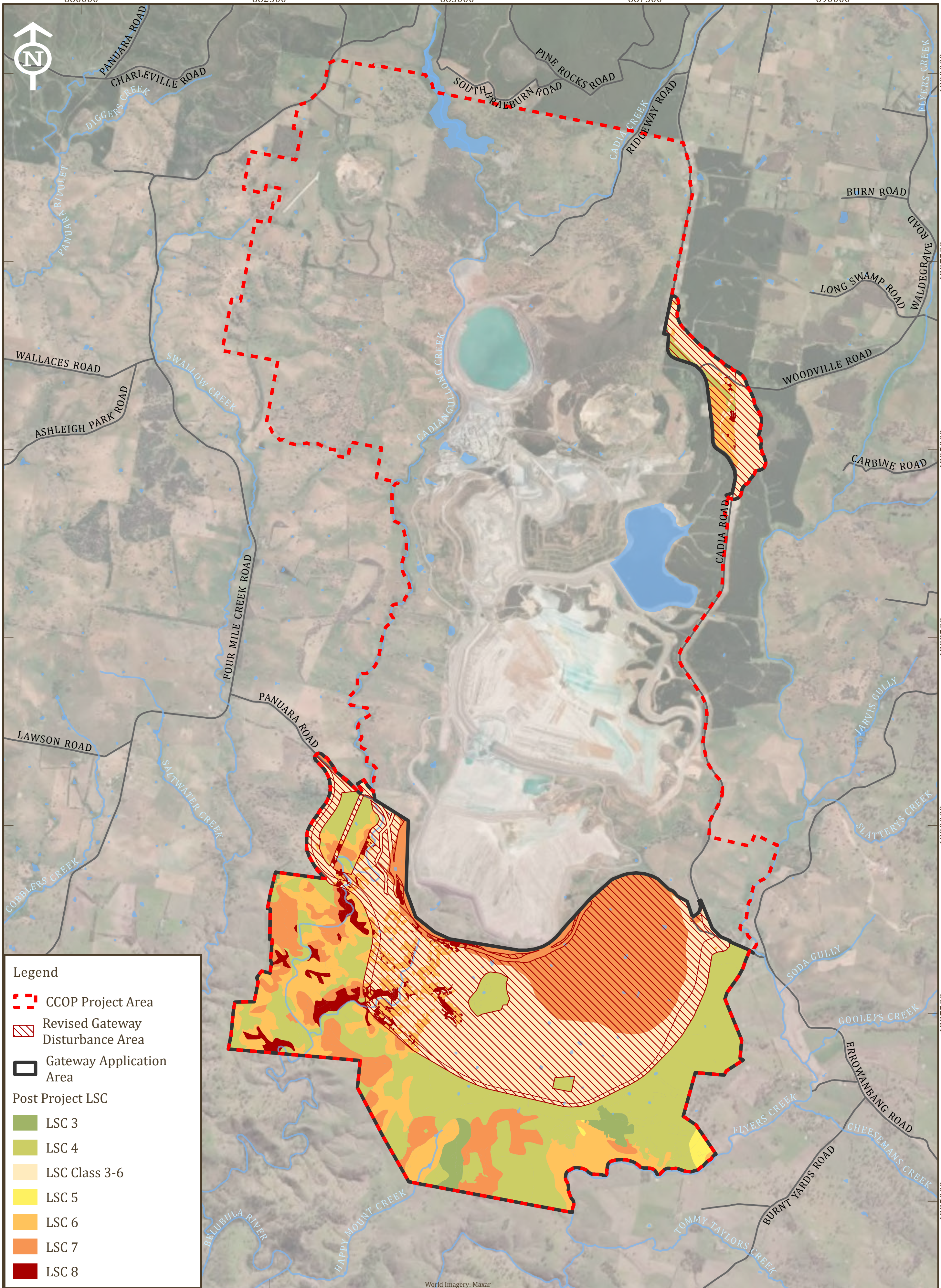


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Conceptual Post Project Land and Soil Capability

**FIGURE 5**

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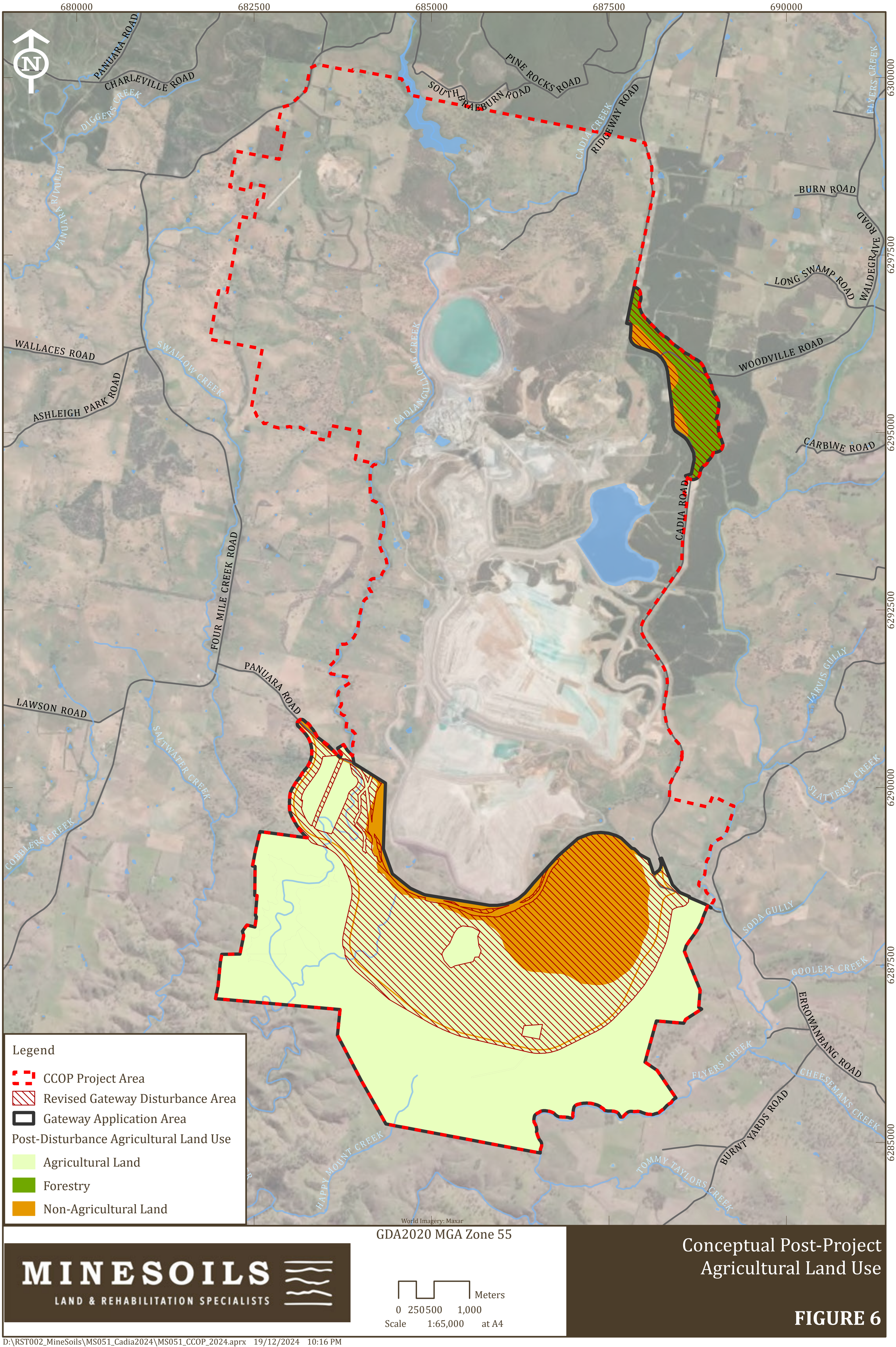


Conceptual Post-Project Agricultural Land Use

**FIGURE 6**

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# 4. GATEWAY CRITERIA REVIEW

Based on the findings outlined in **Section 3**, a summary assessment of the Gateway Criteria comparing the original Gateway Application against the amended Gateway Application is provided in **Table 7** below. This summary assessment has been developed based on conservative scenarios that provide a reasonable worst-case consideration of potential agricultural impacts.

As outlined above, work is continuing to identify opportunities to incorporate further design refinements and measures to mitigate the impacts of the Project. These measures will be incorporated into the EIS and accompanying technical studies for the Project, including but not limited to an Agricultural Impact Statement, Land Use Conflict Risk Assessment, Soils and Land Impact Assessment, Rehabilitation Strategy, Surface Water and Groundwater studies.

## Table 7: Gateway Criteria Review

| Original Gateway Application | Change | Amended Gateway Application |
|---|---|---|
| ***The following matters must be considered in relation to the potential of the proposed development to significantly reduce the agricultural productivity of any biophysical strategic agricultural land:*** | | |
| *(i) any impacts on the land through surface area disturbance and subsidence;* | | |
| The Project is anticipated to have a direct surface impact on BSAL over an area of up to 378 ha, within the broader 1,253 ha of the GDA. | Yes | The Project is anticipated to have a direct surface impact on BSAL over an area of up to 411 ha, within the broader 1,101 ha of the revised GDA. |
| *(ii) any impacts on soil fertility, effective rooting depth or soil drainage;* | | |
| Due to the nature of the Project which will require major landform modification and soil stripping, the risk of impacts on soil resources within the GDA are certain. Permanent impacts to soil fertility, effective rooting depth and soil drainage are anticipated in areas occupied by the permeant features of the Project, including the proposed tailings and its embankments, the south water storage area and the realigned Panuara Road. Temporary impacts are also anticipated throughout other areas within the GDA (including temporary soil stockpile areas, ancillary infrastructure areas and water management systems) however, these impacts may be mitigated by rehabilitation that includes good soil management techniques and the rehabilitation of productive agricultural land. Long term impacts on soil fertility, effective rooting depth and soil drainage as a result of the Project will be assessed as part of the EIS process based on a soil management strategy that is tailored to the final land form and nominated final land use domains. | No | As per original Gateway Application, except for the removal of "the south water storage area" from the description of permanent features. |
| *(iii) increases in land surface micro relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH;* | | |
| Due to the nature of the Project which will require major landform modification, changes to the land surface microrelief and slope are anticipated for the GDA. Post mining changes in land surface micro relief, soil salinity, rock outcrop, slope and surface rockiness and changes to soil pH will be assessed as part of the EIS process based on the final land form and rehabilitation strategy. | No | As per original Gateway Application |
| *(iv) any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy);* | | |

| Original Gateway Application | Change | Amended Gateway Application |
|---|---|---|
| The Project has the potential to change drawdown and groundwater take and recharge rates which may impact areas of mapped highly productive groundwater. Studies undertaken on site to date indicate that the area of the GAA does not align with the criteria for being a highly productive groundwater resource. Notwithstanding, specialist studies will be undertaken to identify and quantify the groundwater systems potentially impacted by the Project. These studies will be incorporated as part of the EIS process and be undertaken in accordance with the relevant considerations under the Aquifer Interference Policy and the comprehensive requirements for the assessment of Water Resources outlined in the Project SEARs. | No | As per original Gateway Application<br><br>(Whilst the removal of the South Water Storage would reduce extent of overall water impacts in this area, there is no predicted change in impact on highly productive groundwater resources) |
| *(v) any fragmentation of agricultural land uses; and* | | |
| Agriculture will cease over an area of up to 2,090 ha of land within the GAA currently used for agriculture for the duration of the Project. Following the life of the Project, an area of 1,688 ha would be returned to agriculture. The reduction in land used for agriculture within the GAA would not result in the fragmentation or isolation of any existing agricultural land use, as it immediately adjoins Cadia's existing operational areas. The land is entirely owned by CHPL, with the exception of a small portion to the north east which is owned by FCNSW. Regardless no additional fragmentation of agricultural use of land by a third party will occur as a result of CCOP. | Yes | Changes relate to area of agricultural land being removed and returned to agriculture only. No change to commentary regarding fragmentation.<br><br>Agriculture will cease over an area of up to 2,092 ha of land within the GAA currently used for agriculture for the duration of the Project. Following the life of the Project, an area of 1,761 ha would be returned to agriculture. |
| *(vi) any reduction in the area of biophysical strategic agricultural land.* | | |
| The total area of verified/assumed BSAL anticipated to be directly disturbed by the Project is 378 ha. Opportunities for additional avoidance and reductions in impacts to BSAL will be further assessed as part of the EIS process. | Yes | The total area of verified/assumed BSAL anticipated to be directly disturbed by the Project is 411 ha. Opportunities for additional avoidance and reductions in impacts to BSAL will be further assessed as part of the EIS process. |

# 5. GATEWAY CERTIFICATE RECOMMENDATIONS REVIEW

Schedule 2 of **Appendix B** includes recommendations from the Gateway Panel in relation to the relevant criteria of the Resources SEPP. These recommendations will be incorporated into the CCOP, and applied to the amended GAA and GDA, to ensure the Project's impact on the environment and community is as small as practicable.

**Table 8** provides a relevancy review of the Gateway Certificate Recommendation in the context of the amended Project Description and its anticipated impacts for the panels consideration. Importantly, the amended Project Description and GAA do not manifestly change the nature of the proposed activities under CCOP, and all Gateway Certificate recommendations are considered to be relevant to the amended application.

Table 8: Relevancy Review of Gateway Certificate Recommendations

| Relevant Criteria | Gateway Certificate Recommendation | Relevant to Amended Application? |
|---|---|---|
| *(i) any impacts on the land through surface area disturbance and subsidence* | The Gateway Panel recommends that the EIS:<br>• gives consideration to the long-term monitoring and maintenance of the STSFx with respect to the potential for settling/subsidence to influence water flows, potentially causing water to concentrate in defined flow paths and reducing the overall stability of the landform;<br>• establishes a baseline to allow any subsidence in the northeastern area over the life of the Project to be determined; and<br>• considers opportunities for additional avoidance and reductions in impacts to BSAL. | Yes |
| *(ii) any impacts on soil fertility, effective rooting depth or soil drainage* | The Gateway Panel recommends that the EIS includes a management plan to ensure that the land proposed to be temporarily disturbed by the Application is rehabilitated to the highest practically achievable Land and Soil Capability (LSC) class appropriate for agriculture at the end of the Project. | Yes |
| *(iii) increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH* | The Gateway Panel recommends that the EIS addresses the matters identified in the above recommendations. | Yes |
| *(iv) any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy)* | The Gateway Panel recommends that the EIS:<br>• demonstrates an improved understanding of surface water and groundwater resources, surface water-groundwater interactions and groundwater dependent ecosystems (GDEs), including:<br>- relevant baseline information on water quality, hydrological connectivity and flow regimes;<br>- the results of site-specific investigations to confirm the presence and groundwater-dependence of aquatic, terrestrial and/or subterranean GDEs in and near the Project area;<br>• describes proposed Project activities in more detail so that potential impact pathways to water resources can be determined with greater certainty;<br>• includes an impact pathway diagram to refine and communicate understanding of how and where the Project may impact water resources;<br>• identifies and quantifies potential surface and groundwater impacts, including:<br>- the likely extent and magnitude of groundwater level and water quality changes from underground mining, tailings deposition and water management infrastructure, including construction and operation of the STSFx and creek diversion;<br>- changes to hydraulic connection between aquifers, especially in the subsidence zones;<br>- additional water take requirements during and post mining; | Yes |

| Relevant Criteria | Gateway Certificate Recommendation | Relevant to Amended Application? |
|---|---|---|
| | - impacts to GDEs, landholder bores and licensed water users;<br>- demonstrates the ability to obtain additional water entitlements where required;<br>• assesses the Project against the minimal impact considerations of the AIP for highly productive aquifers including drawdown and water quality impacts to high priority GDEs, high priority culturally significant sites and water supply works;<br>• sets out proposed impact avoidance and mitigation measures<br>• includes a detailed description of a monitoring program to assess the effectiveness of the avoidance and mitigation strategies and detect any residual impacts; and<br>• includes a cumulative impact assessment that explicitly considers the existing Cadia Valley Operations project and other relevant land and water uses in and near the Project area. | |
| *(vi) any reduction in the area of biophysical strategic agricultural land* | The Gateway Panel recommends that the EIS addresses the matters identified in above recommendations | Yes |
| *Section 2.31(5)*<br>*(a) the duration of any impact referred to in subsection (4)* | The Gateway Panel recommends that the EIS addresses the matters identified in above recommendations | Yes |
| *Section 2.31(5)*<br>*(b) any proposed avoidance, mitigation, offset or rehabilitation measures in respect of any such impact* | The Gateway Panel recommends that the EIS:<br>• includes a management plan to ensure that the land proposed to be temporarily<br>disturbed by the Application is rehabilitated to a Land and Soil Capability (LSC) class appropriate for agriculture at the end of the Project.<br>• includes management/mitigation plans for<br>groundwater and connected surface water systems consistent with Aquifer Interference Policy requirements. | Yes |

# 6. SUMMARY

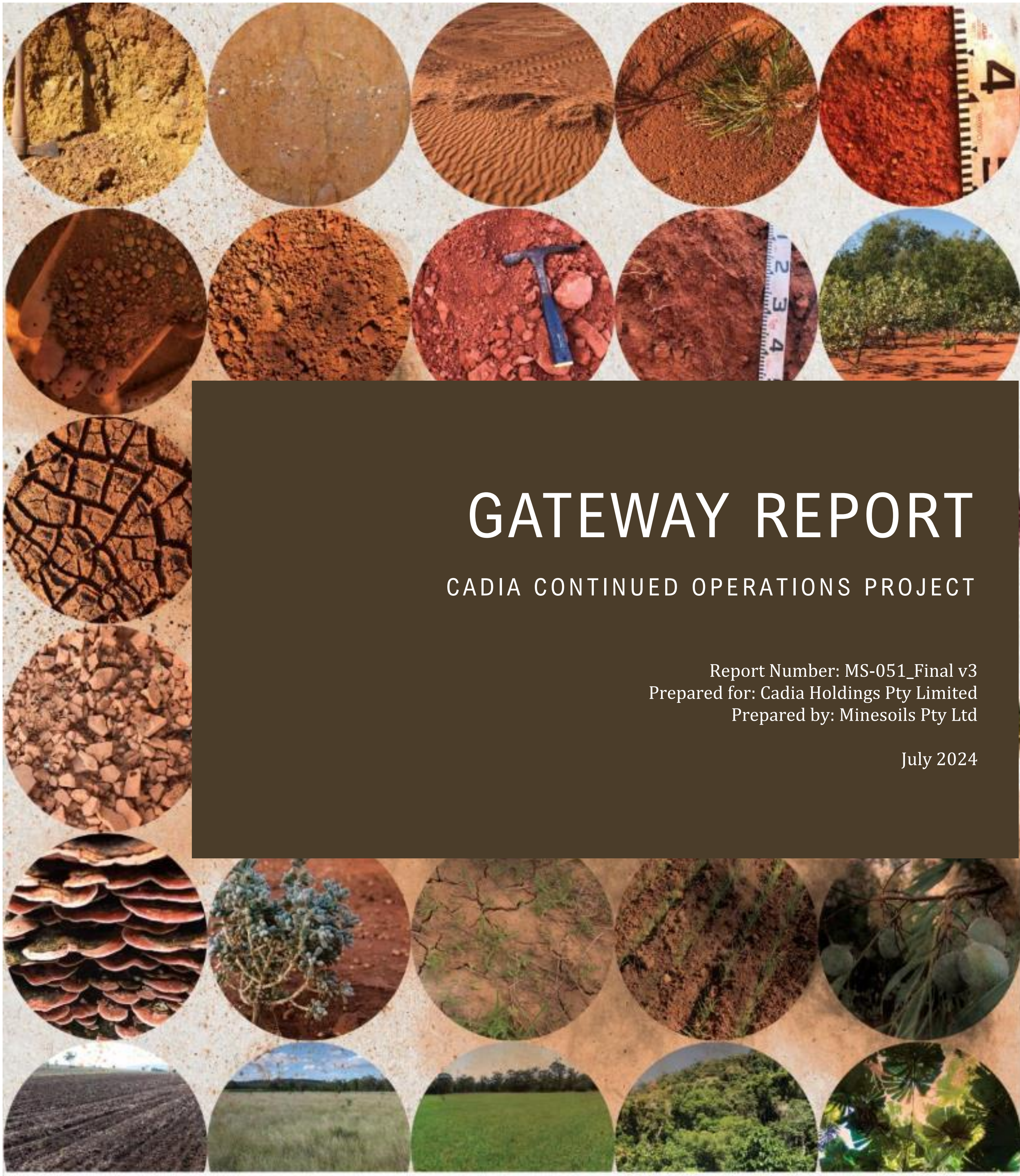
This report has been prepared as an addendum to the Gateway Application for the CCOP (GA 74105711). Its purpose is to document recent project design changes and assess their impacts. The project design changes include the removal of the South Water Storage and minor changes in disturbance areas to optimise the design of project elements, and support an application to amend the Development Description and Gateway Certificate issued by the Gateway Panel on 25 October 2024 for the CCOP.

The proposed amendments to the Gateway Application are not anticipated to result in any significant or material impacts on agriculture, from that already assessed. Any potential impacts, management and mitigation measures that may be appropriate to the CCOP will be considered in detail as part of the EIS for the CCOP. The recommendations provided by the Gateway Panel will also be addressed within the EIS to ensure comprehensive consideration and assessment and adherence to best practice standards are achieved.

Overall, the proposed amendments have been designed to maintain the integrity of the project while ensuring that environmental, agricultural and socio-economic factors are proactively addressed.

CHPL is seeking confirmation that the panel's recommendations remain valid for the updated Project as described within this report.

# Appendix A
Cadia Continued Operations Gateway Application Report



# GATEWAY REPORT

## CADIA CONTINUED OPERATIONS PROJECT

Report Number: MS-051_Final v3
Prepared for: Cadia Holdings Pty Limited
Prepared by: Minesoils Pty Ltd

July 2024

MINESOILS
LAND & REHABILITATION SPECIALISTS

# PREPARED BY

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# DISCLAIMER

This report has been prepared by Minesoils Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with 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.

This report is for the exclusive use of Umwelt Australia Pty Ltd and Cadia Holdings Pty Limited. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Minesoils. Minesoils disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

# DOCUMENT CONTROL

| Reference | Date | Prepared By | Approved |
|---|---|---|---|
| MS-051_ Draft 1 | 27 January 2023 | Matt Hemingway | Clayton Richards |
| MS-051_ Draft 2 | 11 April 2024 | Matt Hemingway | Clayton Richards |
| MS-051_Final | 9 July 2024 | Matt Hemingway | Clayton Richards |
| MS-051_Final v2 | 22 July 2024 | Matt Hemingway | Clayton Richards |
| MS-051_Final v3 | 24 July 2024 | Matt Hemingway | Clayton Richards |
| MS-051_Final v4 | 25 July 2024 | Matt Hemingway | Clayton Richards |

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## Appendices

# 1. INTRODUCTION

## 1.1 OVERVIEW

Minesoils Pty Ltd (Minesoils) was engaged by Umwelt (Australia) Pty Ltd (Umwelt) on behalf of Cadia Holdings Pty Limited (CHPL), the owner of Cadia mine (Cadia), to prepare a Gateway Report for the proposed Cadia Continued Operations Project located in the Central West region of New South Wales (NSW).

## 1.2 THE PROJECT

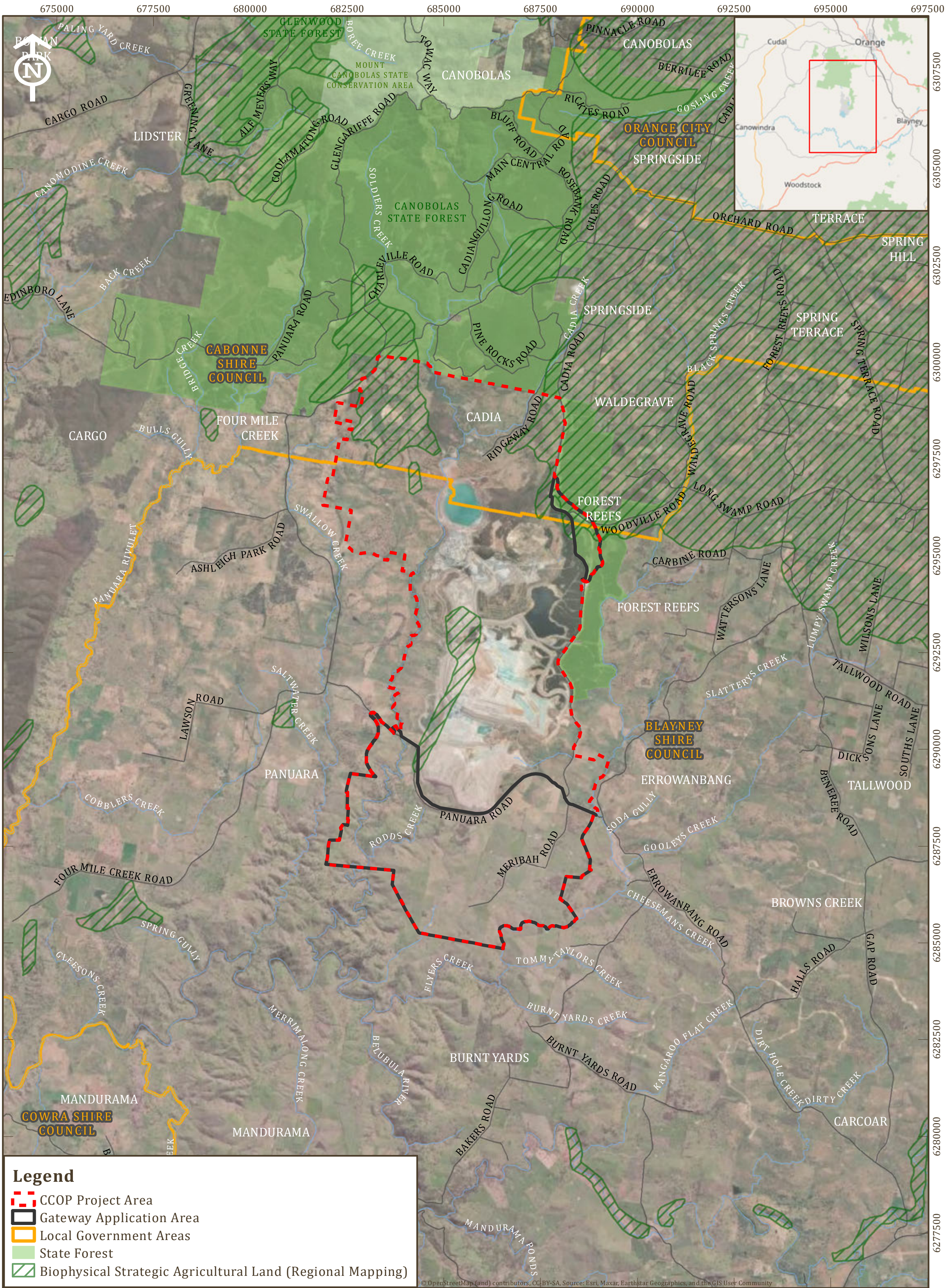
CHPL owns and operates the Cadia mine, located approximately 20 kilometres (km) South-South-West of Orange in the Central Tablelands region of New South Wales (NSW) (refer **Figure 1**). The mining operation traverses two local government areas (LGAs), Blayney Shire Council and Cabonne Council.

Cadia mine is one of Australia's largest polymetallic mining operations, producing gold, copper and molybdenum products. The mine has been operating continuously since it opened in 1998. Cadia provides an important economic contribution to the region and NSW and is a major regional employer providing direct employment of approximately 1,800 full time equivalent jobs. With confirmed mineable resources extending well beyond the life of the current Project Approval (PA 06_0295) which provides for mining until 30 June 2031, Cadia has commenced planning for the continuation of mining operations.

This project is known as the Cadia Continued Operations Project (CCOP/the Project). The CCOP Project Area, Gateway Application Area (GAA) and Gateway Disturbance Area (GDA) is shown on **Figure 2**, and further defined in Section 1.4. The Project involves:

- Continuation of operations beyond 2031 (for a period of 25 years from the date of approval, nominally to 2050) using existing and approved but not constructed infrastructure and supporting site services.
- Continuation of and extension to underground mining within the Cadia East and Ridgeway mining areas, and associated changes in subsidence surface expression.
- The continued emplacement of tailings from ore processing over the life of the continued operations within existing approved storage facilities and an extension of the existing Southern Tailings Storage Facility (STSF)
- Development of an additional water storage on Cadiangullong Creek (known as the South Water Storage) to provide improved security of water supply.
- Realignment of portions of Panuara Road and Cadia Road to maintain public safety and account for the above project features.
- Changes to site infrastructure and facilities to enable ongoing mining operations.

A new development consent will be sought for CCOP, which will replace the existing Project Approval (PA 06_0295) and provide for a new and modern consent to govern future operations at Cadia.

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Regional Context

FIGURE 1

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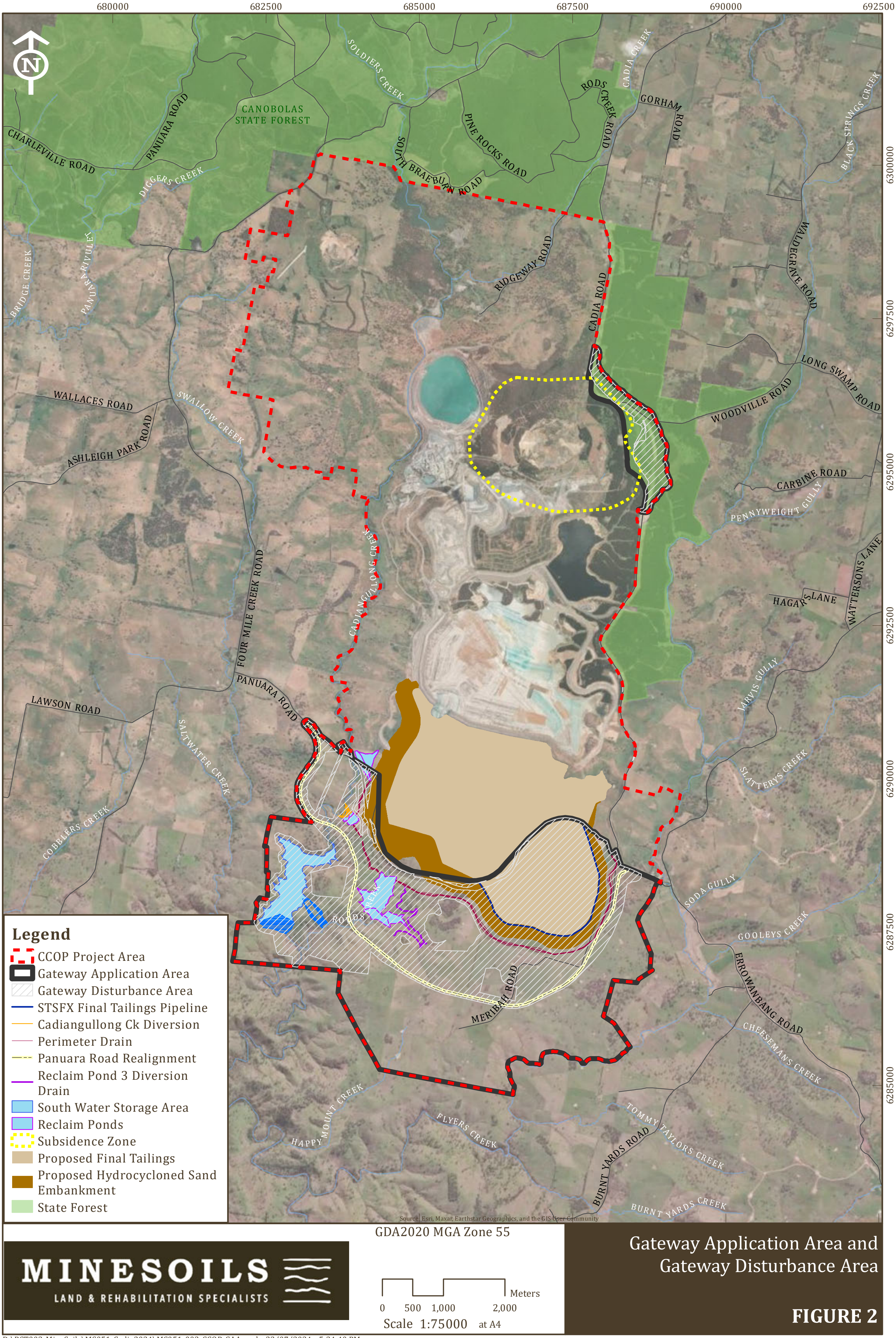


Gateway Application Area and Gateway Disturbance Area

**FIGURE 2**

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## 1.3 REPORT PURPOSE AND OBJECTIVE

The NSW Gateway process provides for an independent, scientific assessment of the impact of state significant mining developments that require a new mining lease and coal seam gas proposals on strategic agricultural land and its associated water resources. The Gateway assessment applies to the 2.8 million hectares of strategic agricultural land which has been mapped across NSW and must occur before an applicant can submit a development application. The Gateway process is established through clause 2.29 of the State Environmental Planning Policy (Resources and Energy) 2021 (the SEPP).

The SEPP requires certain types of developments to verify whether the proposed site is on biophysical strategic agricultural land (BSAL) and, where BSAL is found, assess the likely significance of impacts on these lands and associated groundwater resources.

The site verification process undertaken to support the CCOP Gateway Application considers the elements of CCOP which are outside of existing mining tenements[1]. The verification program was undertaken in accordance with the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (Office of Environment & Heritage [OEH] and Department of Primary Industries - Office of Agricultural Sustainability and Food Security [DPI-OAS&FS], 2013); hereafter referred to as the Interim Protocol. The results of the site verification process confirmed BSAL to be present within the GAA.

No land mapped as equine critical industry cluster or viticulture critical industry cluster in the SEPP is located in the GAA. The equine and viticulture critical industry clusters are limited to areas within the Upper Hunter region of NSW. Accordingly, the equine and viticulture industries are not considered further.

Given BSAL has been verified as occurring within the GAA, a Gateway certificate must be obtained before a development application can be lodged for the CCOP.

This document is a Gateway Certificate Application Technical Overview in support of an application for a Gateway Certificate (Gateway Certificate Application), pursuant to clause 2.29 of the SEPP and in accordance with the *Strategic Regional Land Use Policy Guideline* for Gateway Applicants.

The Gateway Application will be subject to the Gateway assessment by an independent expert panel – the Mining and Petroleum Gateway Panel (the Gateway Panel) - comprising independent scientific experts in the fields of agricultural science, hydrogeology and mining and petroleum development. The Gateway Panel will assess the proposal against the criteria set out in clause 2.31(4) of the SEPP.

Upon completion of its assessment, the Gateway Panel will either:

1. Issue an unconditional Gateway Certificate, without recommendations, if the Gateway Panel determines that the proposal meets the criteria relating to agricultural and water impacts; or
2. Issue a conditional Gateway Certificate if the Gateway Panel determines that the proposal does not meet the criteria. The recommendations of the conditional Gateway certificate must be addressed in the development application for the proposal and considered by the relevant consent authority when determining the development application.

---

[1] It is noted that following the completion of BSAL assessment, the Project Area was revised and now covers a reduced overall area to that presented in the BSAL report. The assessment approach for verifying BSAL within the GAA is presented in Section 2.9.

## 1.4 GATEWAY APPLICATION AREA

The GAA that is subject to this assessment consists of parts of the CCOP Project Area which represents a broad envelope or perimeter of the site, where new mining leases are required for the activities proposed. This broader CCOP Project area is shown on **Figure 2**. Not all areas within the CCOP Project Area will be disturbed as part of the Project. Areas that will be subject to direct ground disturbance by the Project within the GAA are referred to as the GDA and cover 1,253 ha. These areas are also shown on **Figure 2**.

The GAA generally lies within the Blayney Shire Council LGA, with the north east portion of the GAA also partially occurring within the Cabonne Shire LGA.

## 1.5 REPORT SCOPE AND LIMITATIONS

The scope of this supporting document is to describe the Project's impact in terms of the relevant Gateway criteria and the mitigation measures that may be implemented to address these impacts. The Gateway criteria is as follows (Section 2.31 (4) of the SEPP):

*"In relation to biophysical strategic agricultural land – that the proposed development will not significantly reduce the agricultural productivity of any biophysical strategic agricultural land, based on a consideration of the following:*

> *(i) any impacts on the land through surface area disturbance and subsidence;*
>
> *(ii) any impacts on soil fertility, effective rooting depth or soil drainage;*
>
> *(iii) increases in land surface micro, relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH;*
>
> *(iv) any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy);*
>
> *(v) any fragmentation of agricultural land uses; and*
>
> *(vi) any reduction in the area of biophysical strategic agricultural land."*

The baseline soil and agriculture resources are detailed within this report in accordance with relevant regulatory requirements and guidelines.

A description of the Project's anticipated impacts to soils and agriculture, along with mitigation measures to address these impacts, are discussed in Sections 5 and 6.

The Project's predicted impacts on groundwater sources are described in Section 5.4. As described in this section, the GAA does not align with the criteria for being a highly productive groundwater resource. Notwithstanding, specialist studies are being undertaken to inform the EIS process and will be prepared in accordance with the relevant considerations under the *Aquifer Interference Policy* and the comprehensive requirements for the assessment of Water Resources outlined in the Project SEARs (refer to Section 5.4).

Cadia will continue to review and improve elements of the conceptual final land use prior to lodgement of the CCOP Environmental Impact Assessment (EIS). These refinements would consider the potential impact on the overall post-mining agricultural land use and where practicable improve the overall post-mining agricultural land use outcomes whilst also giving consideration to the minimisation, mitigation and management of the impacts for all environmental impact assessment aspects. Any subsequent refinements to the Project will be assessed further and detailed in the EIS.

## 1.6 REPORT STRUCTURE

This report is structured as follows:

**Section 1** Introduction – outlines the Project and presents the purpose of this report.

**Section 2** Existing Physical Environment – provides contextual information on the GAA, its locality, and the wider regional setting.

**Section 3** Baseline Soils and Land Assessment – describes the results of the field survey including soil mapping units and verified land and soil capability (LSC) classes.

**Section 4** Baseline Agricultural Assessment – provides contextual information on agriculture within the GAA, its locality, and the wider regional setting.

**Section 5** Potential Impacts – summarises potential impacts of the Project.

**Section 6** Mitigation Measures – provides measures to mitigate the potential impacts of the Project.

**Section 7** Gateway Criteria Summary – provides an overview of the impacts and mitigation measures of the Project against the Gateway Criteria.

**Section 8** References

# 2 EXISTING PHYSICAL ENVIRONMENT

## 2.1 CLIMATE CONDITIONS

The closest Commonwealth Bureau of Meteorology (BoM) weather stations to the GAA are the Orange Airport Automatic Weather Station (AWS) (063303) and Orange Agricultural Institute (063254).

The warmest months within the region are November though to March, with cooler temperatures occurring from May to September (BoM, 2024).

Mean annual rainfall is approximately 881.9 mm at the Orange Airport AWS and approximately 906.5 mm at the Orange Agricultural Institute. Records at the Orange Airport AWS indicate that December is the wettest month with a mean rainfall 87.0 mm and the least amount of rainfall occurring in April with a mean rainfall 39.2 mm (BoM, 2024). This rainfall is above the criteria threshold of 350 mm per year, and therefore the site can be considered to have access to a reliable water supply.

Relative humidity is variable and temperature dependent. Relative humidity at 9.00 am at the Orange Airport AWS varies from 63% in December, to 89% in June. Relative humidity at 3.00 pm varies from 40% in December to 70% in July (BoM, 2024).

Cadia operates two on-site meteorological stations, being the Ridgeway and Southern Lease Boundary (SLB) stations. These stations monitor temperature, rainfall, solar radiation, relative humidity, barometric pressure, wind speed and wind direction. Rainfall and temperature conditions at these stations are generally consistent with the aforementioned Orange Airport AWS. Windroses from the two on-site meteorological stations show that on an annual basis winds are predominantly from the north to northeast or west to southwest.

## 2.2 HYDROGEOLOGY

The GAA is located within the eastern portion of the Lachlan Fold Belt of NSW. The surface geology of the region consists of andesite, tuff, limestone, siltstone, shale, feldspathic greywacke, chert and diorite, with coarse-grained intermediate rocks including syenite and monzonite, and in-situ and alluvial/colluvial materials derived from above parent rock on lower slopes and in drainage depressions (Source: Murphy & Lawrie (1989) and Department of Regional NSW (2022) (refer **Figure 3**).

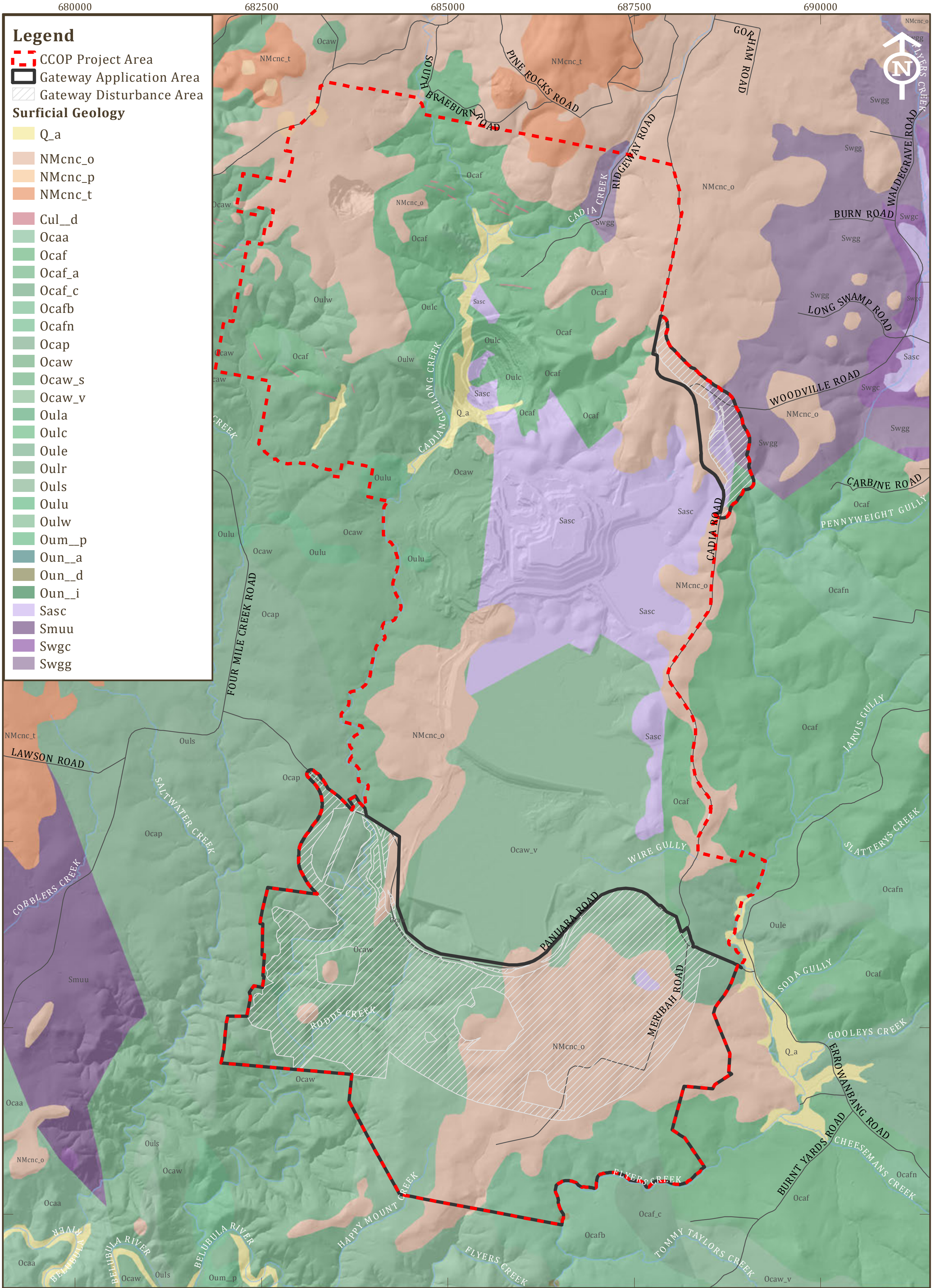
Groundwater resources within the region are generally associated with three geological formations; the Tertiary Basalt, Ordovician Volcanics and Silurian Sediments formations. A summary of characteristics of these groundwater resources is provided below, as described by Advisian (2023):

### Tertiary Basalt

The Tertiary basalt comprises of the Canobolas Volcanics, which consists primarily of olivine-basalt and trachyte emplaced by several explosive and effusive magmatic events originating from the nearby Mount Canobolas. The texture of the basalt varies from aphanitic to vesicular with cooling related fracturing. In places, the Canobolas Volcanics have weathered into orange to brown saprolite with thicknesses exceeding 10 m noted in the Cadia region.

North of Cadia, the basalt was emplaced extensively and comprises most of the surface geology around Mount Canobolas. Within Cadia and south of Cadia the basalt forms disconnected surficial emplacements.

Basalt lava generally has a low viscosity and would have followed paleochannels or low-points to flow radially from the Mount Canobolas vent. Prior to weathering, the basalt in the south of Cadia would have been connected to the larger basalt emplacement by "arms" of basalt that had cooled and crystallised within the flow pathways of the lava.

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Surficial Geology

FIGURE 3

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The remanent sections of basalt are disconnected from the massive basalt emplacement as sections have progressively weathered out, exposing the underlying Ordovician Volcanics or Silurian sediments.

Advisian notes that the geological mapping upon which the Orange Basalt Aquifer Source is based is not accurate in places proximal to Cadia. There are areas that do not contain basalt, whereas the Department of Primary Industries (DPI) NSW groundwater productivity mapping indicates it underlies the entire area. Advisian presents other datasets that indicate the Tertiary basalt coverage is patchy in proximity to the GAA, and suggest that where there was likely previous connection between the Tertiary Basalt in the north around Mount Canobolas (i,e. prior to the weathering described above), and areas proximate to the GAA, now the Silurian Sediments or Ordovician Volcanics are exposed at surface where the basalt has weathered away.

Advisian concludes that while the mapping of the Tertiary Basalt produced by the DPI can be used as a guide, it does not accurately represent the actual geology present in the south of Cadia region.

### Ordovician Volcanics

The Ordovician lithology within the region is comprised of two conformable units and an intrusive complex: the conformable Forest Reefs Volcanics and Weemalla Formation, and the intrusive Cadia Intrusive Complex. Much of the rock exposed at the surface is comprised of Ordovician volcanics, where they have not been covered by the Silurian sediments, or the Tertiary basalt.

The Forest Reefs Volcanics are comprised of volcaniclastic sedimentary rocks, volcanic igneous rocks of various compositions, and intrusive igneous rocks of various compositions. The Forest Reefs Volcanics have been altered by both localised hydrothermal sericite alteration, and regionally variable chloritehematite and feldspathic alteration. The Weemalla Group is comprised of low energy turbiditic, volcaniclastic sediments with minor primary volcanics including pillow basalts.

The Cadia Intrusive Complex intruded in the Late Ordovician to Early Silurian into the Forest Reefs Volcanics and the Weemalla formation and induced the emplacement of the Cadia deposits within the Forest Reefs Volcanics and Weemalla Formation. The Cadia Intrusive Complex is comprised of shoshonite, porphyritic monzodiorite to quartz monzonite.

### Silurian Sediments

The Silurian sediments are comprised of units from both the Ashburnia Group (previously known as the Cadia Group) to the south of the Cadia Pit and the Waugoola Group to the east of the Cadia Pit. Both groups are generally comprised of low-energy marine sediments with evidence of both transgressive and regressive depositional conditions (AGE, 2021).

The Ashburnia Group is the dominant group with surficial exposure within the Cadia region, as much of the previously exposed parts of the Waugoola Group were covered by the emplacement of the Tertiary Basalt to the North of the Cadia Pit. The Ashburnia Group and Waugoola Group have typically been reported on as a single unit having a combined thickness averaging between 100 m and 300 m with a notable exception in exploration drill hole NC599 (located north east of the Project) that reportedly intersected about 1000 m of Silurian sediments (AGE, 2021).

### Highly Productive Groundwater

In 2013, the Department of Industry, Lands and Water (DILW, now part of the Department of Climate Change, Energy, the Environment and Water) produced mapping that describes aquifers in NSW as either “highly productive” or “less productive” (DILW, 2013). To be considered highly productive an aquifer must:

- Have a Total Dissolved Solids (TDS) less than 1,500 milligrams per litre.
- Be capable of yielding water at a rate greater than 5 litres per second (L/s).

Regionally mapped groundwater productivity modelling indicates the GAA is subject to a combination of "highly productive groundwater" as well as areas of "less productivity groundwater" (refer **Figure 4**).

Of the geological formations outlined above, the Orange Basalt Aquifer Source is considered a highly productive aquifer and therefore must be managed under row 4 in Table 1 of the NSW Aquifer Interference Policy. The Lachlan Fold Belt Groundwater Source is considered a "less productive" fractured groundwater source due to the relatively high TDS and generally low extraction rate from the management area. The regulatory requirements for a less productive groundwater sources are stipulated in row 6 of Table 1 within the NSW Aquifer Interference Policy.

In considering impacts on these mapped groundwater sources, it should be noted that the mapped regulatory extent and continuity of the Orange Basalt Aquifer Source and the actual extent of the Tertiary Basalt differ significantly, particularly in the centre and south of Cadia and the area underlying the GAA (Advisian, 2023). The Tertiary Basalt in the GAA to the south are disconnected from that to the north and therefore disconnected from the main Orange Basalt Aquifer Source located to the north of the site towards Orange. Furthermore, bores within the Tertiary Basalt within the southern parts of the GAA indicate yields of significantly less than 5L/s with most well below 1L/s (Advisian, 2023). This would indicate that the groundwater aquifers present in at least the part of the area mapped as being highly productive in the 2013 DILW mapping do not meet the criteria for being highly productive aquifers and would therefore not meet the criteria outlined in the SEPP for consideration of impacts on highly productive water resources that support the agricultural productivity of BSAL.

## 2.3 GROUNDWATER LICENCES

As an active mining operation, Cadia has an extensive groundwater monitoring network consisting of 224 bores, of which 148 are active, with additional bores recently installed. Cadia conducts routine groundwater monitoring, with 124 bores monitored on a quarterly basis and 53 bores monitored monthly. Groundwater quality samples are taken from 67 of the quarterly monitoring bores and 21 of the monthly monitoring bores.

This extensive monitoring network provides a good understanding of the local groundwater environment including groundwater levels and quality. The GAA is located to the south and east of the existing Cadia operations as shown in **Figure 1**.

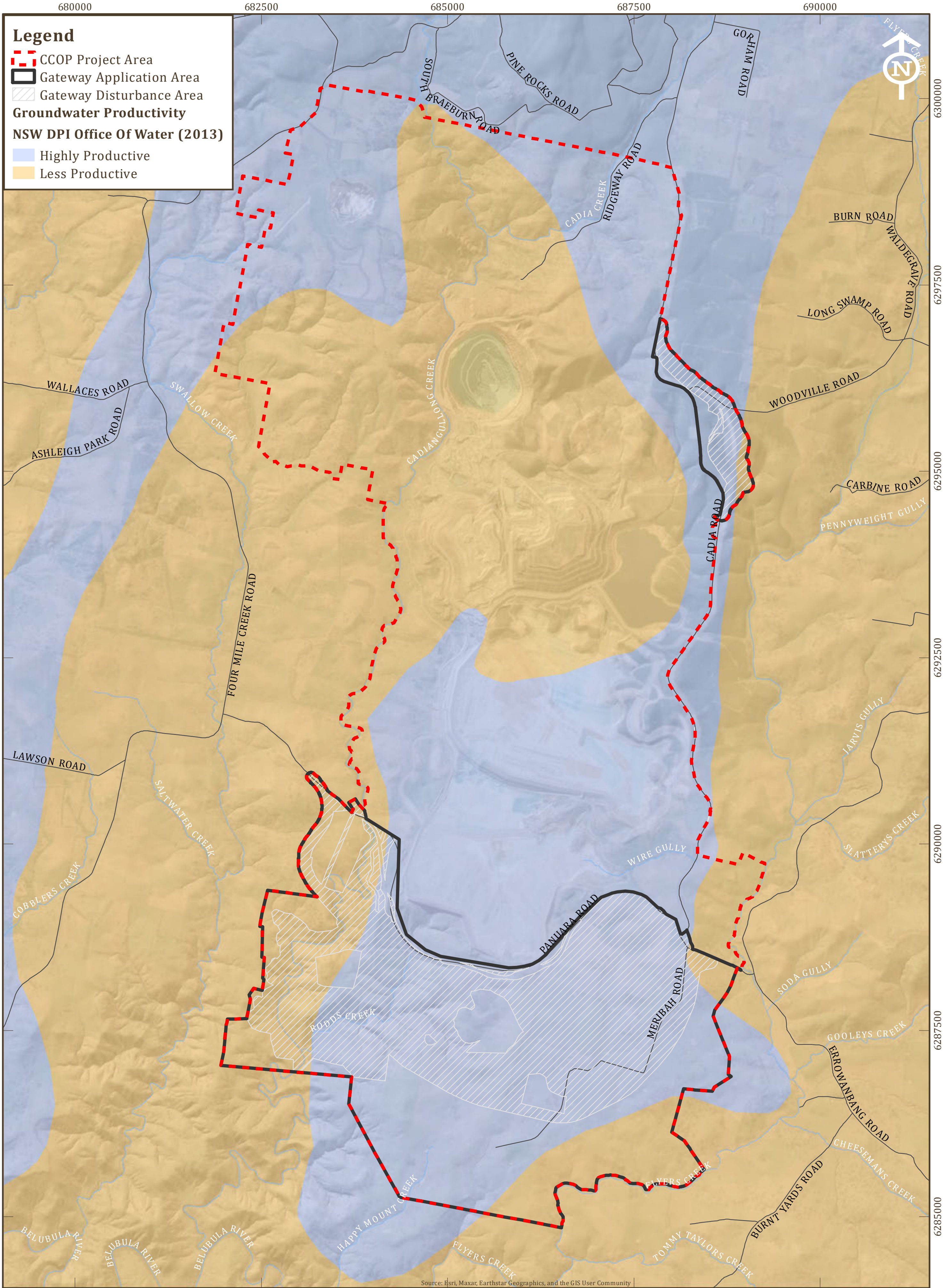
Detailed groundwater modelling and impact assessments are currently being prepared to inform the CCOP EIS. These studies will include a review of the adequacy of the existing groundwater monitoring network and if necessary, recommend rationalisation and / or additional bores be installed as part of this extensive monitoring network.

Groundwater resources in the GAA are managed under the Water Management Act 2000 and the Water Sharing Plan (WSP) of the NSW Murray Darling Fractured Rock Groundwater Source 2020. In addition to Cadia's existing and proposed operations, it is understood that local landholders use groundwater for a range of purposes including stock water supply, irrigation and domestic water supply.

While there are more than 300 registered bores within 10km of the CCOP, only four Cadia-owned groundwater bores exist within the broader GAA. All other bores occur at a considerable distance from the GDA. With the exception of bores owned by Cadia, the dominant use for private bores is household use, followed by irrigation and stock water supply. Bores used for large-scale irrigation purposes were identified on a small number of properties with relatively high yields. **Figure 5** provides an illustration of groundwater bores in the vicinity of the CCOP.

In terms of extractive water use, Cadia currently holds four water access licences (WALs) within NSW Murray Darling Fractured Rock Groundwater Source 2020, being:

- Lachlan Fold Belt MDB Groundwater Source
    - WAL31702 for 371 units

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Groundwater Productivity

FIGURE 4

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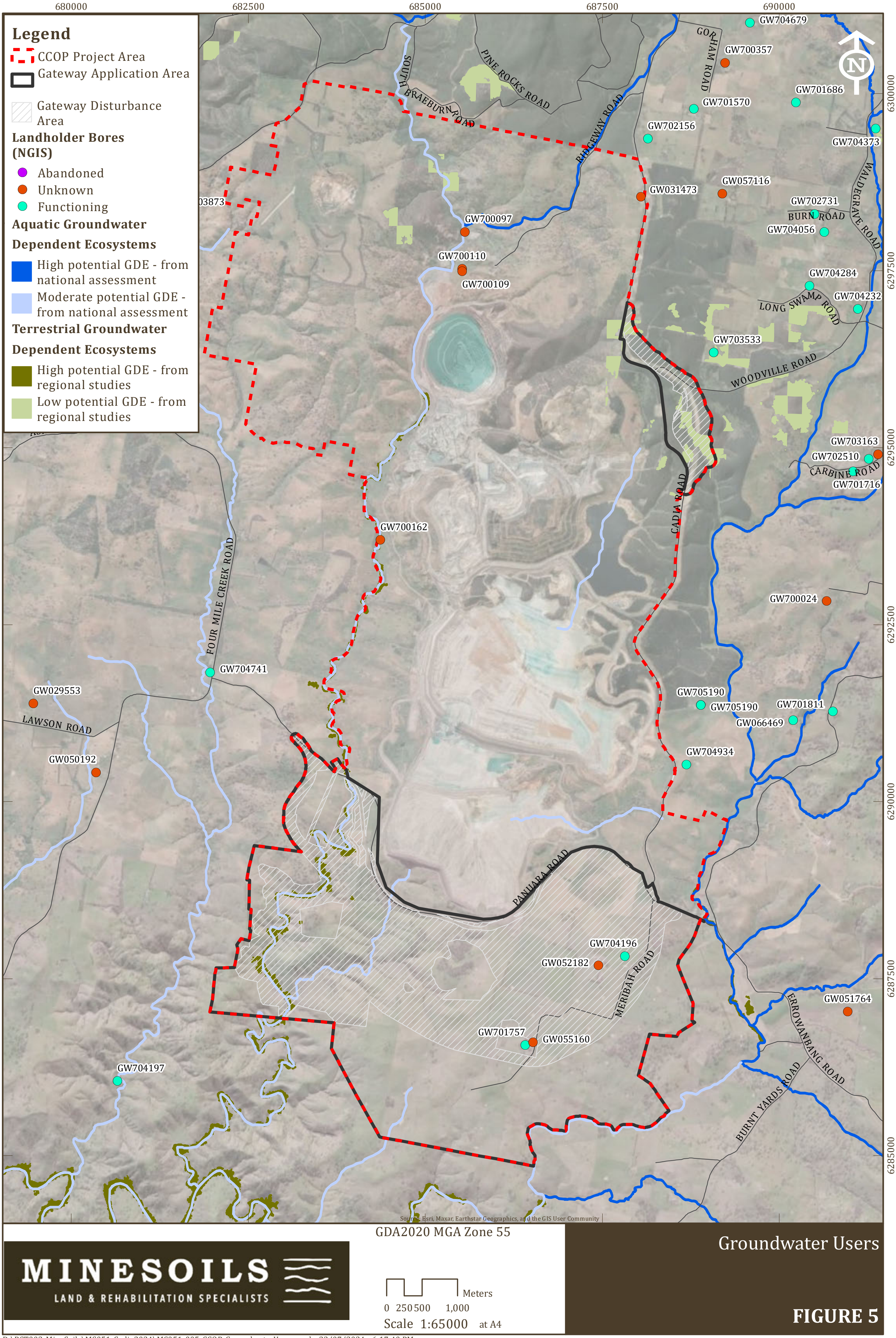


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Groundwater Users

**FIGURE 5**

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  - WAL36229 for 931 units
- Orange Basalt Groundwater Source
  - WAL 31062 for 286 units
  - WAL 28099 for 68 units

It is anticipated that these licences will continue to service the requirements of the CCOP, however if the groundwater assessment identifies any additional take, this take will need to be accounted for under the WSP.

## 2.4 TOPOGRAPHY AND SURFACE WATER

The landscape within the GAA ranges from low lying gullies and creeks into low hills and smooth, undulating slopes to steep, rocky hillslopes and high plateaus, ranging from 450m Australian Height Datum (AHD) in the southwest areas of the GAA, up to 950m AHD in the northwestern areas of the GAA (refer **Figure 6**). Slopes within the GAA range from 0 - 1% along the open drainage lines and flats with gentle inclines, to gently inclined rolling hills that characterise the southeastern portion of the GAA, to steep inclines, rocky upper slopes and crest rises. High slope areas are concentrated in the southwest of the GAA portion, with terrain containing land with slopes > 50% (refer **Figure 7**).

The GAA is located in the Lachlan River Catchment. Rodds Creek and Cadiangullong Creek are located within the GAA, and Flyers Creek is located immediately to the east of the GAA. These flow in a generally southerly direction into the Belubula River, which eventually flows into the Lachlan River to the west. Several un-named first and second order ephemeral streams occur within the GAA.

## 2.5 REGIONALLY MAPPED SOIL LANDSCAPES

Soil Landscape units are areas of land that have recognisable and specific topographies and soils that can be presented on maps and described by concise statements. Murphy, Kovac and Lawrie (1989) described the *Soil Landscapes of the Bathurst 1:250,000 Sheet* through a classification of landscape assemblages and their associated soil characteristics (NSW and Department of Planning, Industry and Environment, (NSW DPIE) 2022). The materials used to form the soil landscape definitions included cadastral data, geological, landform, soil, vegetation, and water resource studies. The classification also takes into account the limitations each unit poses to rural or urban development. The GAA consists of the Panuara, Quarry, Razorback, Stoke-Burnt Yards and Vittoria Blayney Soil Landscapes (refer **Figure 8**), which are described below.

### Panuara Soil Landscape

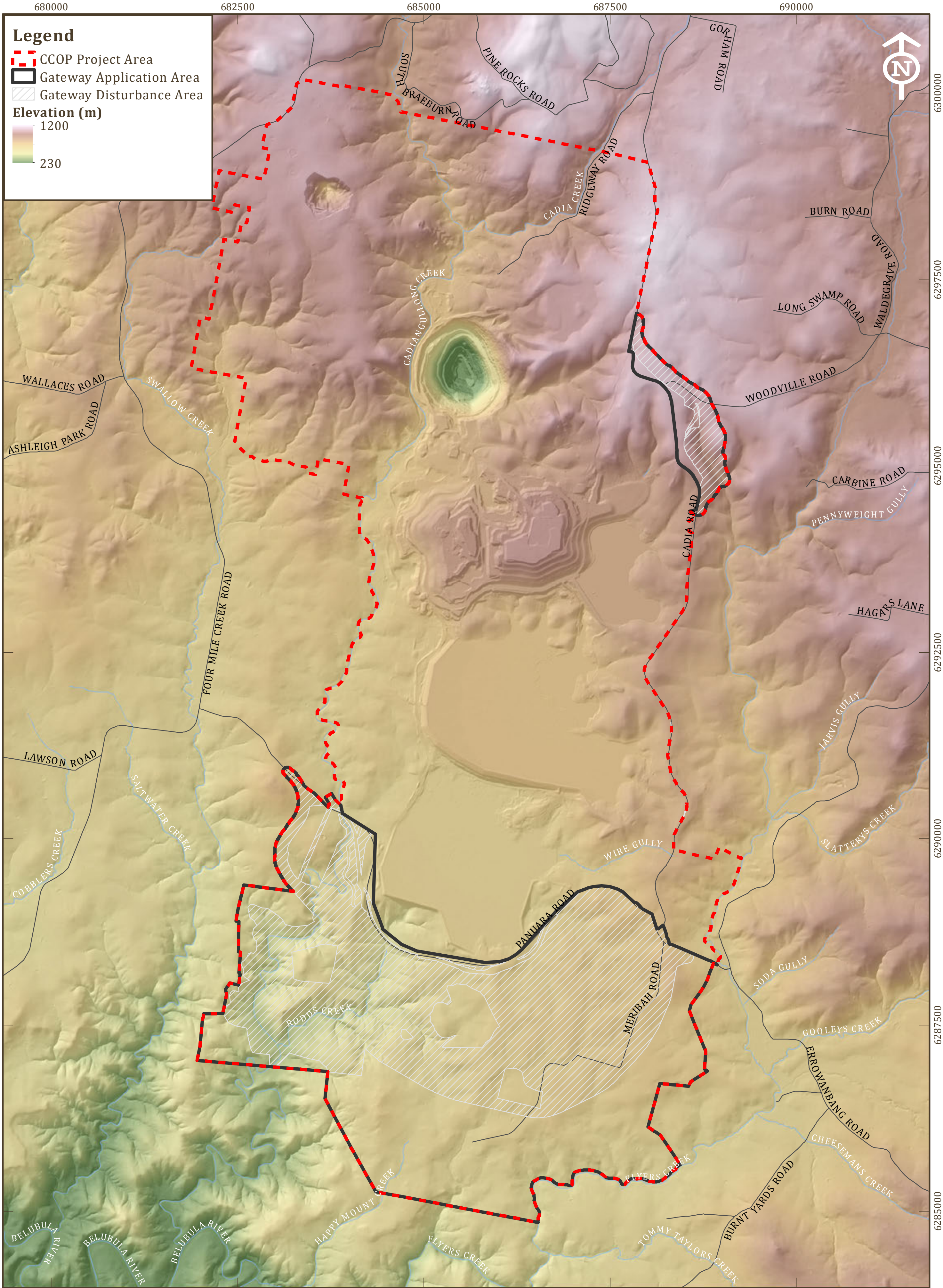
Undulating low hills to rolling hills, 500 –965 m above sea level. Local relief is usually between 100–120 m, although it can be as low as 60 m for undulating slopes around Panuara. Slopes vary from 5–8% but are up to 15% in the steeper terrain. Slope lengths vary from 500–800 m. Drainage lines run west and are spaced from 500–800 m apart.

Woody vegetation has been extensively cleared, leaving grasslands. Areas of remnant native vegetation consists of dry sclerophyll forest dominated by mountain gum and manna gum.

Soil distribution consists of Red Podzolic Soils on mid to upper slopes, Yellow Solodic Soils occur in drainage lines. Yellow Podzolic Soils occur on lower slopes with Red Earths or Brown/Red Earths. Chocolate Soils or Euchrozems occur on remnants of basaltic mesas.

### Quarry Soil Landscape

Rolling low hills, 860–980 m in elevation with slope lengths ranging from 500–900 m, and slopes in the 12–15% range. Local relief is between 60–100 m.

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Topography

FIGURE 6

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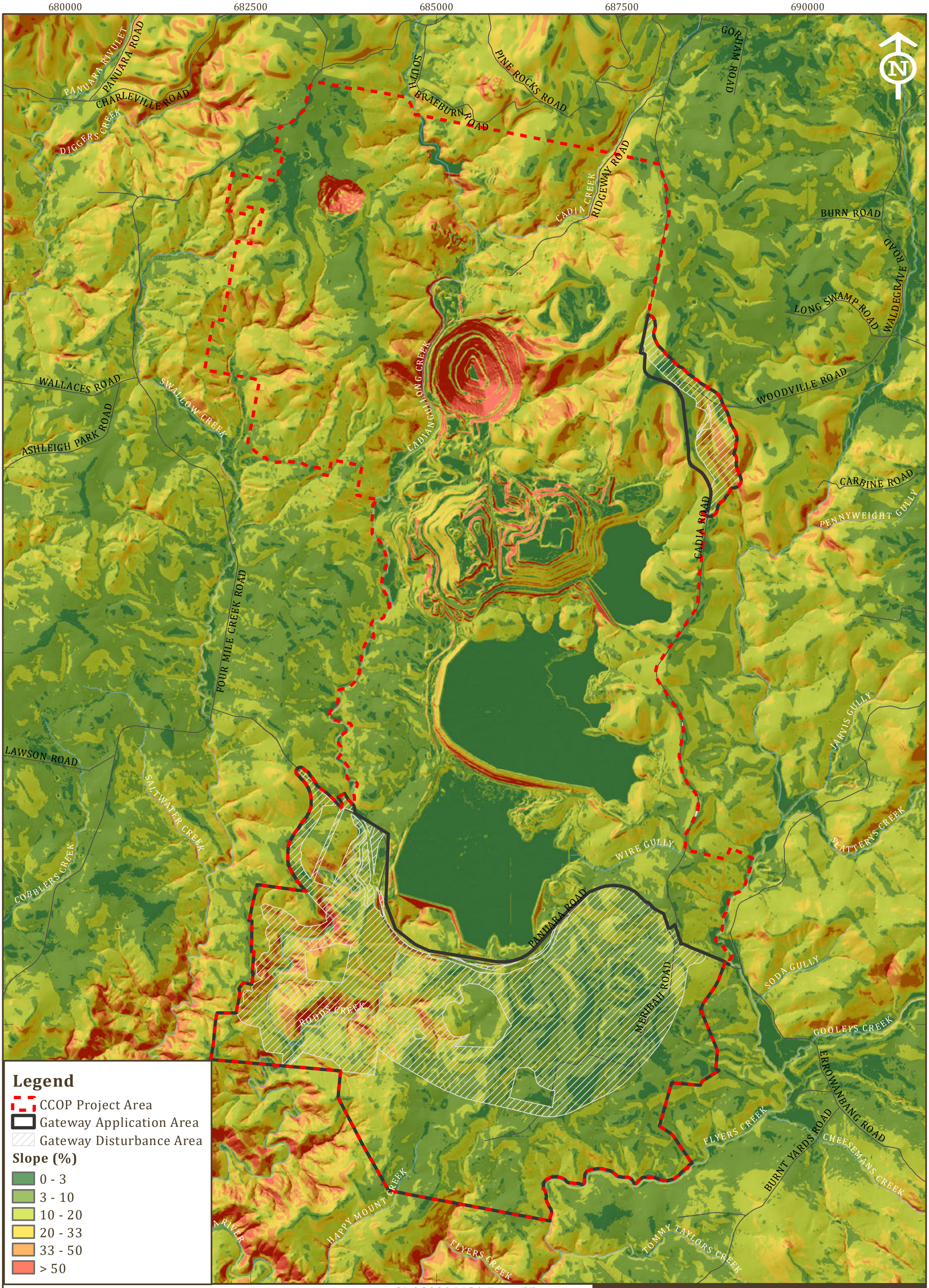


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Slope Analysis

**FIGURE 7**

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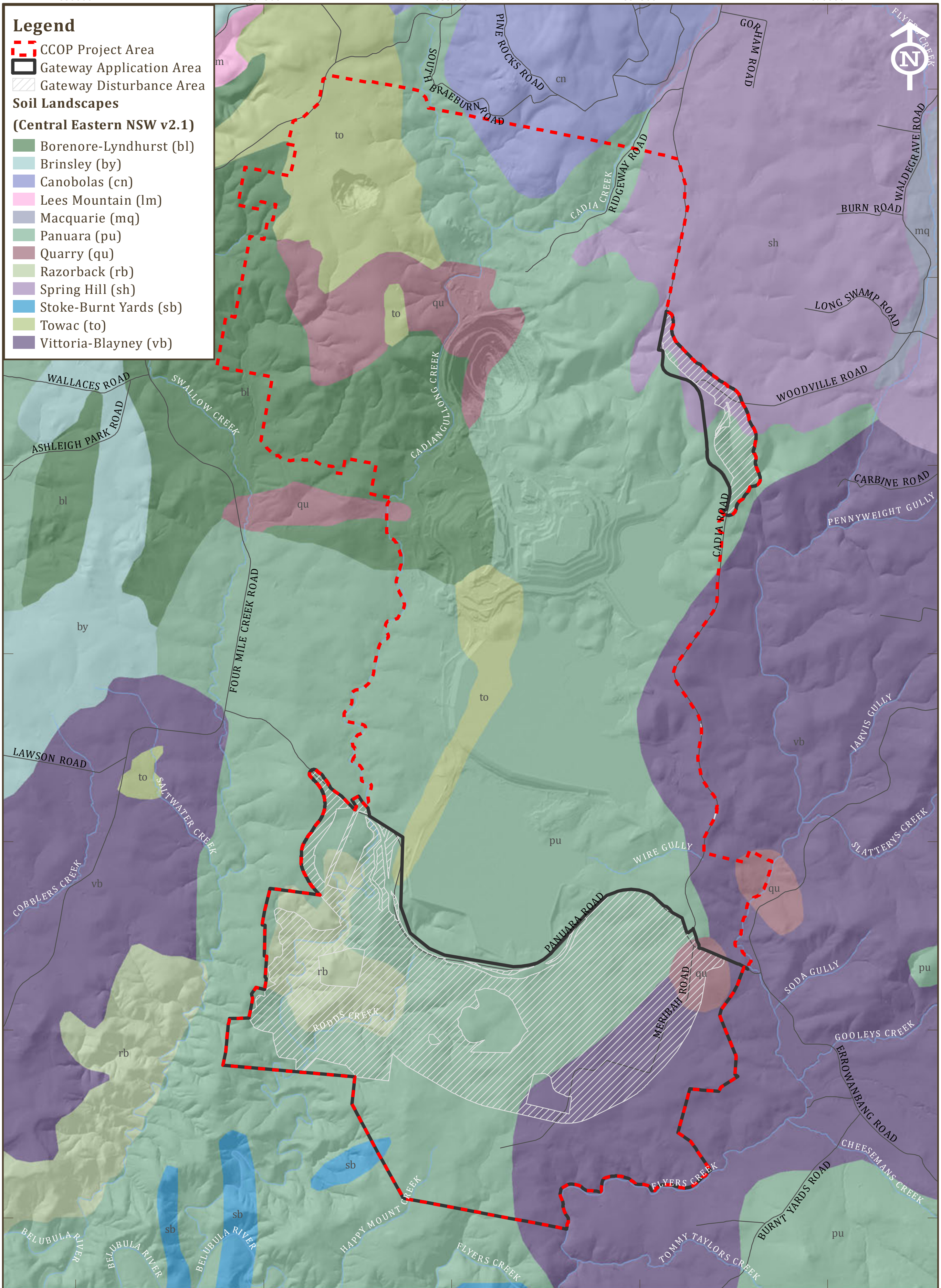


GDA2020 MGA Zone 55

0 250 500 1,000 Meters

Scale 1:65000 at A4

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Regionally Mapped Soil Landscapes

**FIGURE 8**

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Remnant native vegetation consists of savannah woodland of yellow box with Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on slopes.

Soil distribution consists of pale Siliceous Sands on midslopes with Yellow Earths and Yellow Podzolic Soils on lower slopes. Shallow Sands and Red Podzolic Soils occur on upper slopes.

### Razorback Soil Landscape

Rolling to steep hills, from 660–1,000 m elevation with average slopes from 20–25%, with some ranging between 30–50%. Slope lengths vary from 400–700 m, with some up to 1,000 m. Local relief varies from 140–220m.

A white box-red stringybark community is found extensively on this landscape, mainly on the slopes and ridges, with yellow box and apple box in valleys and on midslopes. Tumbledown red gum grows on some stony ridges, in place of red stringybark.

Shallow Red Podzolic Soil/Krasnozem intergrades are common, with Red Earths also on slopes. Large outcrops of rocks are present. Shallow skeletal soils are dominant and are formed on most upper slopes.

### Stoke-Burnt Yards Soil Landscape

Rolling low hills with elevations ranging from 640–840 m. Slopes vary from 8–15%, but near Carcoar they are up to 20%. Slope lengths range from 400–900 m, with most local relief from 40–80 m, but up to 100 m. Drainage lines are from 300–900 m apart, converging into the Belubula River.

Vegetation has been extensively cleared, however remnant native vegetation consists of yellow box occurring in valleys, while brittle gum and white box grow on midslopes in association with red box and broad-leaved peppermint. Red stringybark occurs on higher slopes.

Soil distribution consists of Krasnozems, Euchrozems and Red Clays. Yellow Soloths occur in drainage lines on lower slopes.

### Vittoria Blayney Soil Landscape

Undulating to rolling hills with 800–1,050 m elevation, and local relief from 30–80 m but most to 50–60 m. Slopes are from 6–10%, with lengths averaging 600 m but ranging from 200–1,500 m. Fixed drainage channels are spaced from 800–1,000 m apart. The catchment boundary between the Macquarie and Lachlan River systems bisects this landscape. Upland drainage depressions have slopes from 4–5%, but in lower areas slopes are less than 2%. Broad drainage depressions (500 m wide) have plains with 1–2% slopes.

Remnant native vegetation consists of savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on lower slopes.

Red Earths occur on well-drained crests and sideslopes, with Yellow Earths on moderately to imperfectly drained footslopes. Yellow Soloths/Yellow Podzolic Soil intergrades are found in imperfectly to poorly drained drainage depressions. Other soils include red and yellow structured earths midslope, with shallow sands and loams on crests and upper slopes.

### Spring Hills

Gently undulating to undulating rises with broad flats. Elevation is between 900–980 m. Slopes are from 2–5% and slope lengths from 500–700 m, with local relief normally to 10 m, but up to 30 m. Drainage depressions form broad flats to 1,000 m wide, with slopes <1% and often <0.5%. Drainage channels are fixed and spaced 600–800 m apart.

Remnant native vegetation includes savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint are on lower areas.

Krasnozems are the dominant soils. Yellow Podzolic Soils occur on the lower slopes with Yellow Solodic Soils in drainage lines.

### Towac Soil Landscape

Undulating hills to rolling low hills, from 980–1,080 m in elevation. Local relief varies from 40–60 m, with some to 100 m. Slopes are between 6–10% but can be up to 20%. Slopes in drainage depressions range from 8% on higher areas to 1–2% in the lower lands. Drainage lines are fixed and moderately spaced, flowing north to Molong and Heifer Station Creeks.

Remnant native vegetation consists of savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on lower areas.

Krasnozems occur on the upper to midslopes and are dominant. Red Podzolic/Krasnozem intergrades are found on upper slopes, with Yellow Podzolic/Solodic Soils in drainage depressions.

## 2.6 SOIL TYPES

Statewide mapping of soil types as per the Australian Soil Classification (ASC) indicates the GAA is primarily dominated by Kurosols, with some Ferrosols, Kandosols and Dermosols, and a limited extent of Tenosols (refer to **Figure 9**) (NSW DPIE, 2022).

### Kurosols

Kurosols are defined as soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2t horizon (or the major part of the entire B2t horizon if it is less than 0.2 m thick) is strongly acid.

### Ferrosols

Ferrosols are defined as soils that:

- Have B2 horizons in which the major part has a free iron oxide content greater than 5% Fe in the fine earth fraction (<2 mm), and
- Do not have a clear or abrupt textural B horizon or a B2 horizon in which at least 0.3 m has vertic properties.

### Dermosols

Dermosols are defined as soils which:

- Have B2 horizons that have grade of pedality greater than weak throughout the major part of the horizon, and
- Do not have clear or abrupt textural B horizon.

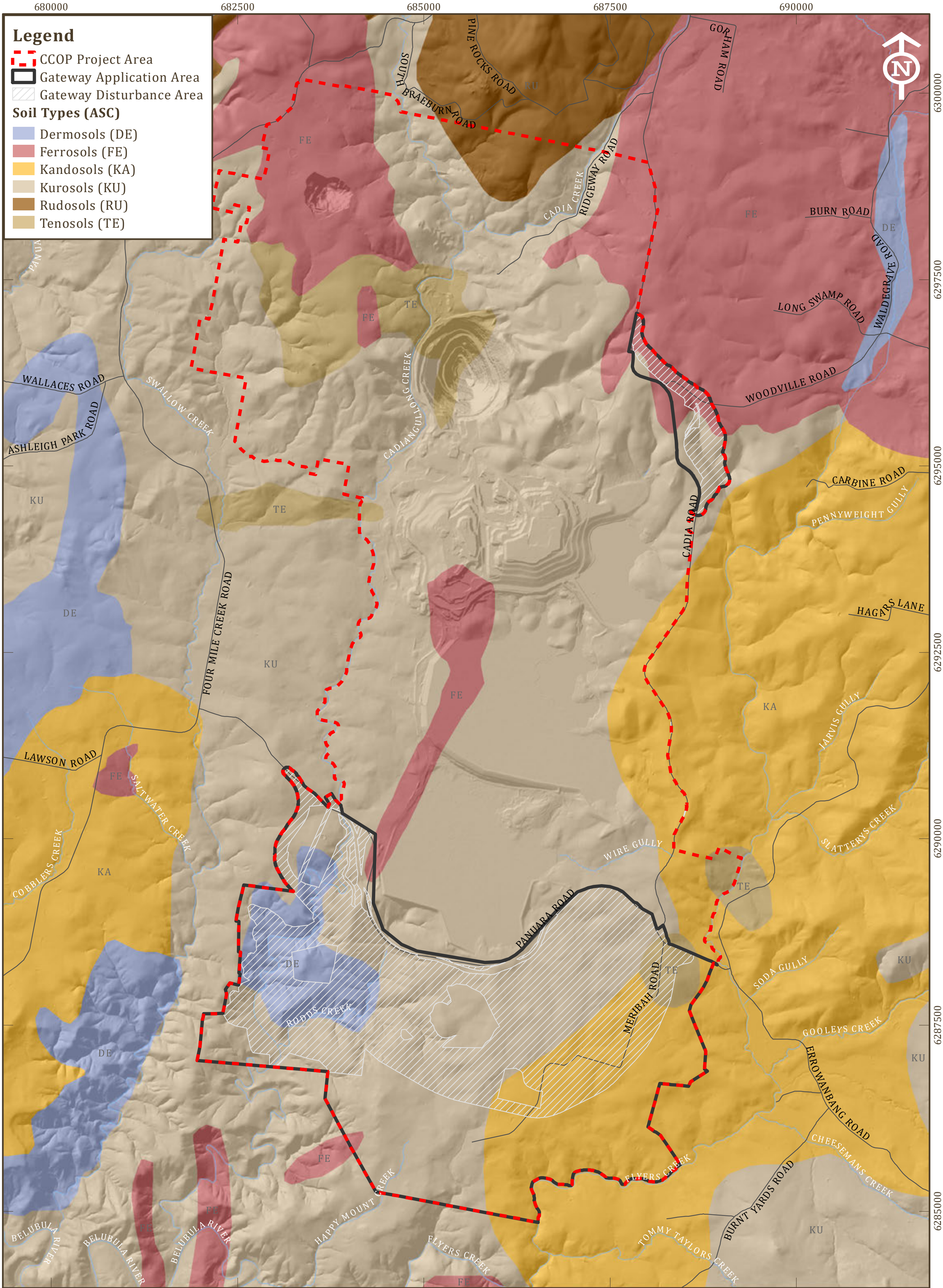
### Kandosols

Kandosols are defined as soils which have all of the following:

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

### Tenosols

Tenosols are defined as soils that do not fit the requirements of any other soil orders and generally have one or more of the following features:

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Meters
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Scale 1:65000 at A4

Regionally Mapped Soil Types

FIGURE 9

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

## 2.7 INHERENT FERTILITY

Inherent fertility is based on the physical and chemical features of soils in their natural, undegraded condition and correlates to ASC mapping. Regional soil inherent fertility has been mapped at a broad scale over the entirety of NSW and indicates the GAA contains soils with 'Low', 'Moderately Low', 'Moderate' and 'Moderately High' inherent fertility (NSW DPIE, 2022) (refer to **Figure 10**).

Soils with 'Low' fertility, due to their poor physical and/or chemical status, only support limited plant growth. Soils with 'Moderately Low' fertility can generally only support plants suited to grazing; large inputs of fertiliser are required to make the soil suitable for arable purposes. Soils with 'Moderate' fertility usually require fertilisers and/or have some physical restrictions for arable use. Soils with 'Moderately High' fertility have a high level of fertility in their virgin state which is significantly reduced after a few years of cultivation (Murphy et al 2007).

## 2.8 LAND AND SOIL CAPABILITY

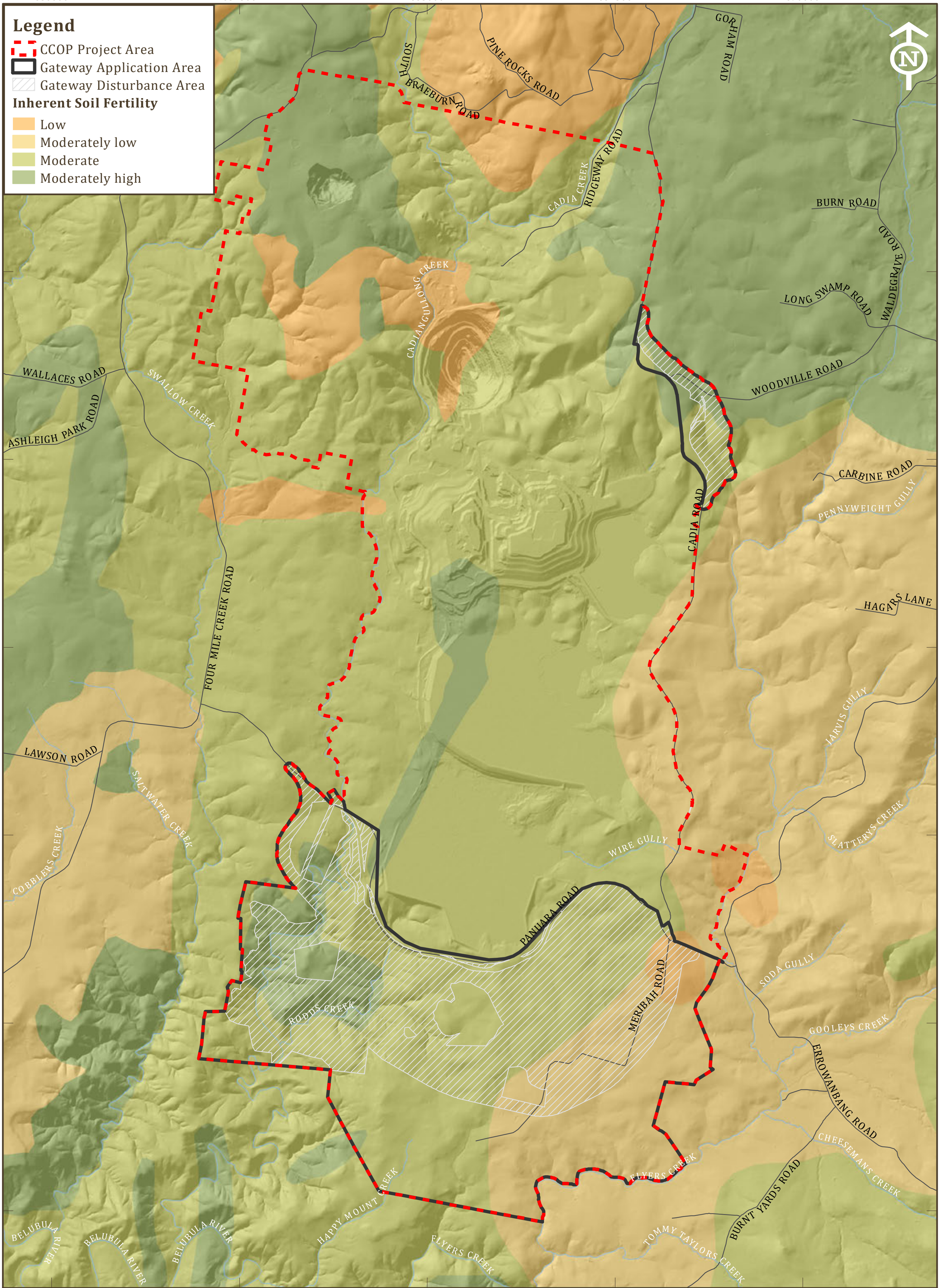
Land and Soil Capability (LSC) Mapping uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations. Regional mapping indicates the GAA contains Class 3, Class 4 and Class 7 land (refer to **Figure 11**).

### Class 3

This classification indicates land that 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.

### Class 4

This classification indicates moderate capability land that 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.

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Regionally Mapped
Inherent Soil Fertility

FIGURE 10

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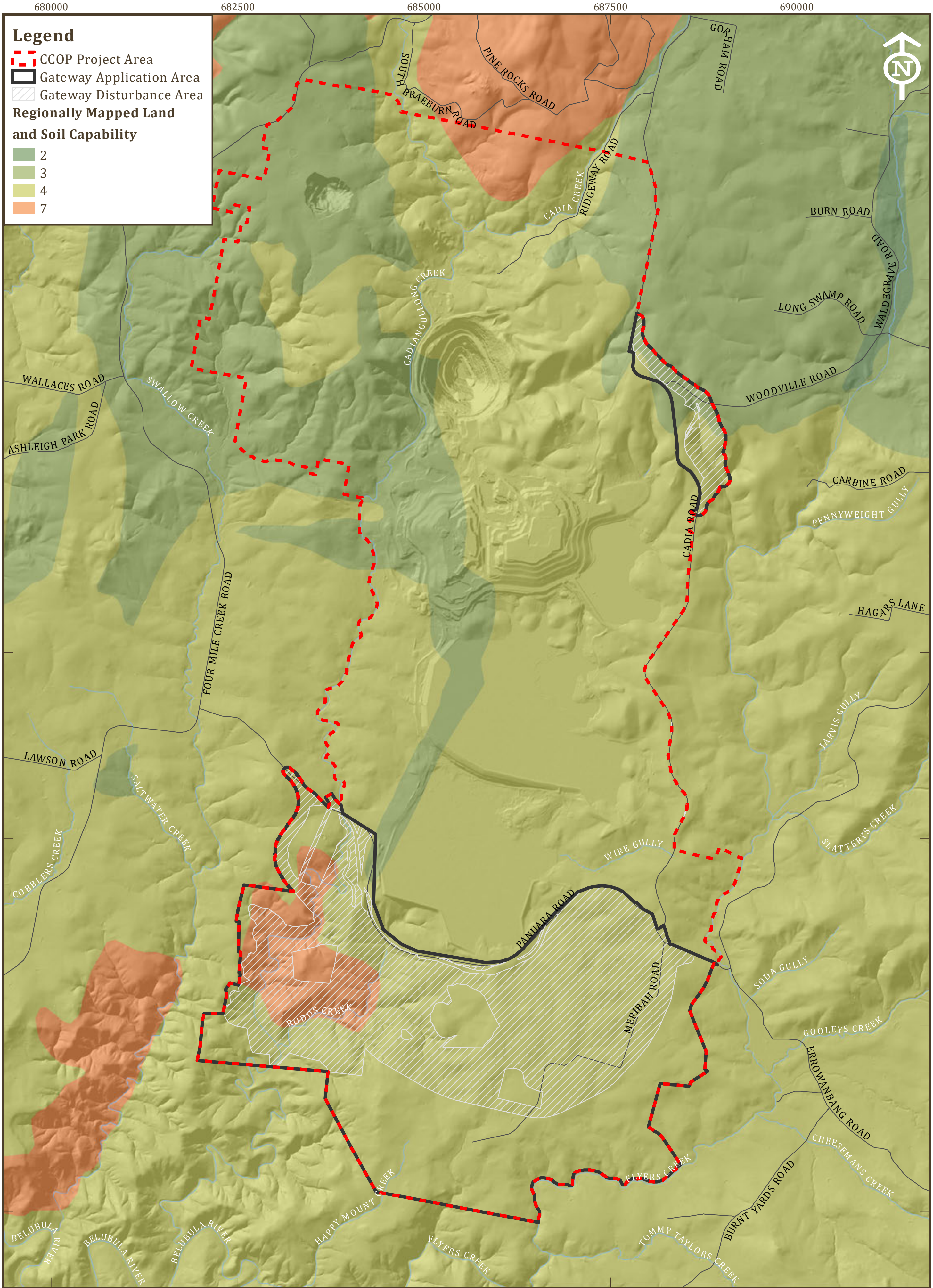


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Regionally Mapped Land and Soil Capability

FIGURE 11

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### Class 7

This classification indicates very low capability land that 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.

## 2.9 BIOPHYSICAL STRATEGIC AGRICULTURAL LAND

### Regional Mapping

Broad regional scale mapping contained in the SEPP indicates the presence of BSAL sporadically in the locality surrounding the Project, with significant extents of regionally mapping BSAL located to the north and north east of the Canobolas State Forest in the region between Orange and Cadia. This regional mapping also indicates the potential presence of two separate areas of BSAL within the GAA (refer to **Figure 1**). These areas align with approximately 6 ha of land to the west of the existing STSF and approximately 25 ha in the northeast section of the Cadia East subsidence zone and Cadia Road realignment corridor.

### Site Verification

A BSAL Site Verification Assessment was undertaken in March – July 2021 by Minesoils' Clayton Richards (CPSS 2) to support the assessment of continued operational opportunities at Cadia (refer **Appendix 1**). Through the process of progressive design and refinement of the CCOP, the study area assessed in 2021 is significantly larger than the GDA. The Site Verification Assessment study area totals 3,516 ha, focusing on areas that lie outside existing mining leases, plus a 100m buffer for BSAL Assessment purposes. Of this area, a total of 2,130 ha was discounted during desktop analysis due to the presence of slopes >10% and <20 ha contiguous area and/or areas surrounded by slopes >10%, leaving 1,386 ha to be assessed. A total of 93 sites were assessed in accordance with the Interim Protocol to obtain suitable representative soil profiles to determine soil type and characteristics. Of these sites, a total of 52 sites satisfied the BSAL criteria and verified BSAL was confirmed to be present over approximately 825 ha of the Site Verification Assessment study area.

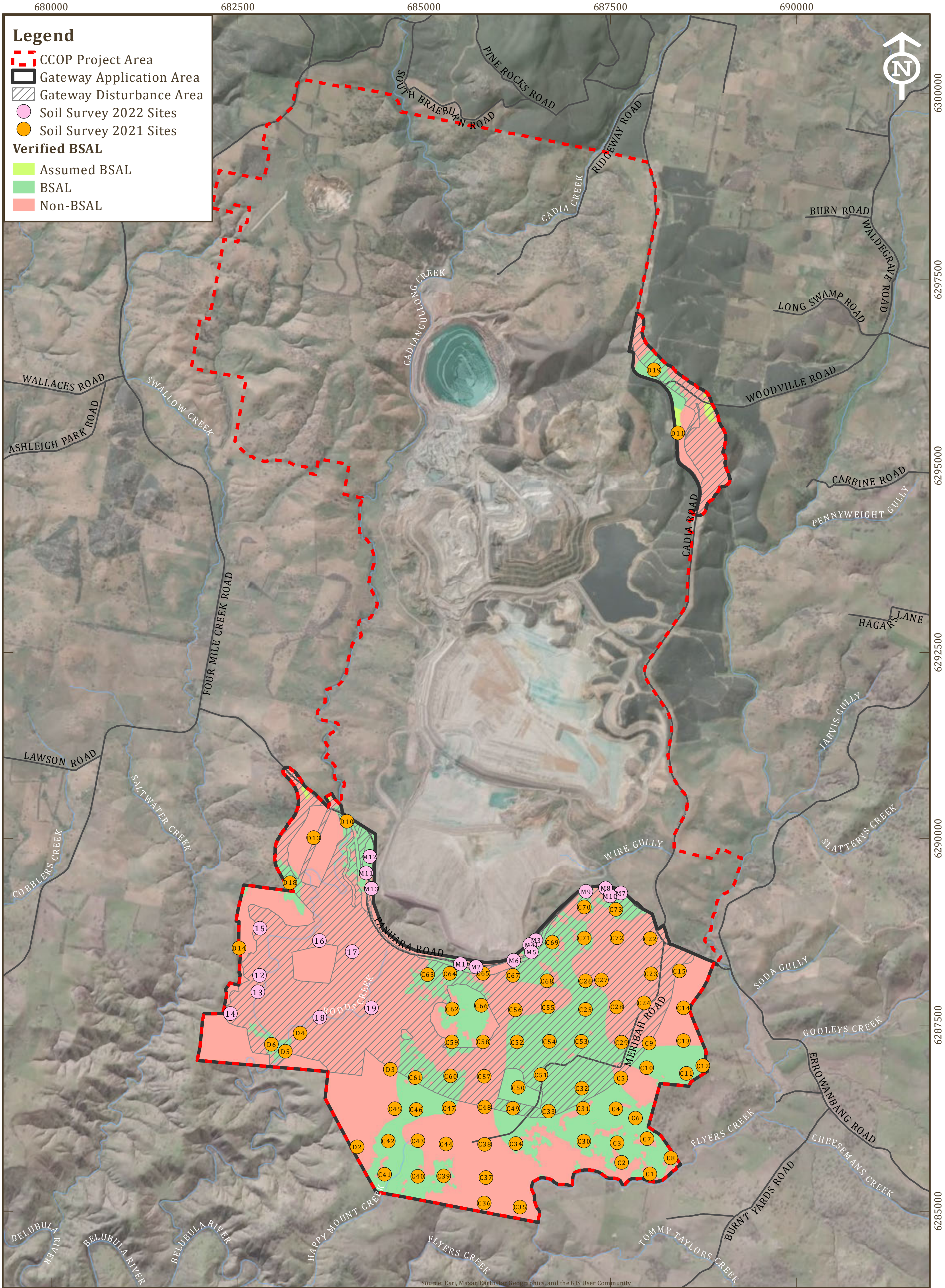
Following the identification of verified BSAL, CHPL initiated a range of further refinements to the CCOP to relocate key infrastructure assets and further reduce the total impact on verified BSAL, where possible. While some areas of verified BSAL have now been omitted from the GAA, some areas of potential BSAL have been added. For the purpose of this Gateway Assessment, all additional areas of disturbance outside of the 2021 BSAL Assessment study area were subjected to a conservative desktop assessment and any contiguous areas >20 ha with slopes <10% have been conservatively assumed to be BSAL, as shown on **Figure 12**. This approach is likely to overestimate potential areas of BSAL but provides for a conservative assessment of worst-case potential impacts.

As a result of the assessment and additional assumptions relating to BSAL, a total of 750 ha of verified / assumed BSAL occurs within the GAA. Following refinements made to the CCOP to reduce impacts on BSAL, a total of 378 ha of verified / assumed BSAL exists within the GDA, as presented on **Figure 12**.

## 2.10 LAND USE

The southern and western portion of the GAA is generally used for agricultural production purposes, primarily grazing and with occasional cultivation/ cropping. As a result, the majority of the GAA is characterised by previously disturbed and largely cleared agricultural land. Some sparse patches of remnant woodland vegetation are located on low hills, with scattered paddock trees occurring across the land in these areas.

The north eastern portion of the GAA lies within the Canobolas State Forest, which is wooded for timber production or contains remnant native vegetation.

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Scale 1:65000 at A4

Verified and Assumed BSAL Mapping

**FIGURE 12**

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# 3 BASELINE SOIL AND LAND ASSESSMENT

## 3.1 SOIL SURVEY METHODOLOGY

The objective of Minesoils fieldwork program was to satisfy the field assessment, sampling and testing requirements related to soil and land resources assessment for the BSAL assessment and the forthcoming EIS. The fieldwork plan outlined below was designed to satisfy the following requirements:

- Soil survey and mapping: This was undertaken at a 1:25,000 for BSAL verification and between a 1:50,000 and 1:100,000 scale for other areas (i.e., areas >10% slope) and requires collection of landform pattern and element information, soil profile data, and taxonomic parameters to distinguish soil types according to the ASC criteria, within the GAA.
- Land and soil capability (LSC): The information required for the LSC assessment was collected during both the desktop assessment and verified on the ground during the field program. The LSC system requires data on biophysical features from in situ measurements and regional mapping.
- Soil qualities: Additional information was recorded in the field on erosion and evidence of potentially erosive soils including tunnelling, rill, gully and sheet erosion, which may require specific handling and management techniques during stripping and rehabilitation. Observations were made on risks of acid sulphate soils and salinity.

The field program was designed as an integrated free survey. An integrated survey assumes that many land characteristics are interdependent and tend to occur in correlated sets (NSCT, 2008). 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 gradual variation. Soil pits were excavated by a backhoe to a maximum of 1.2m.

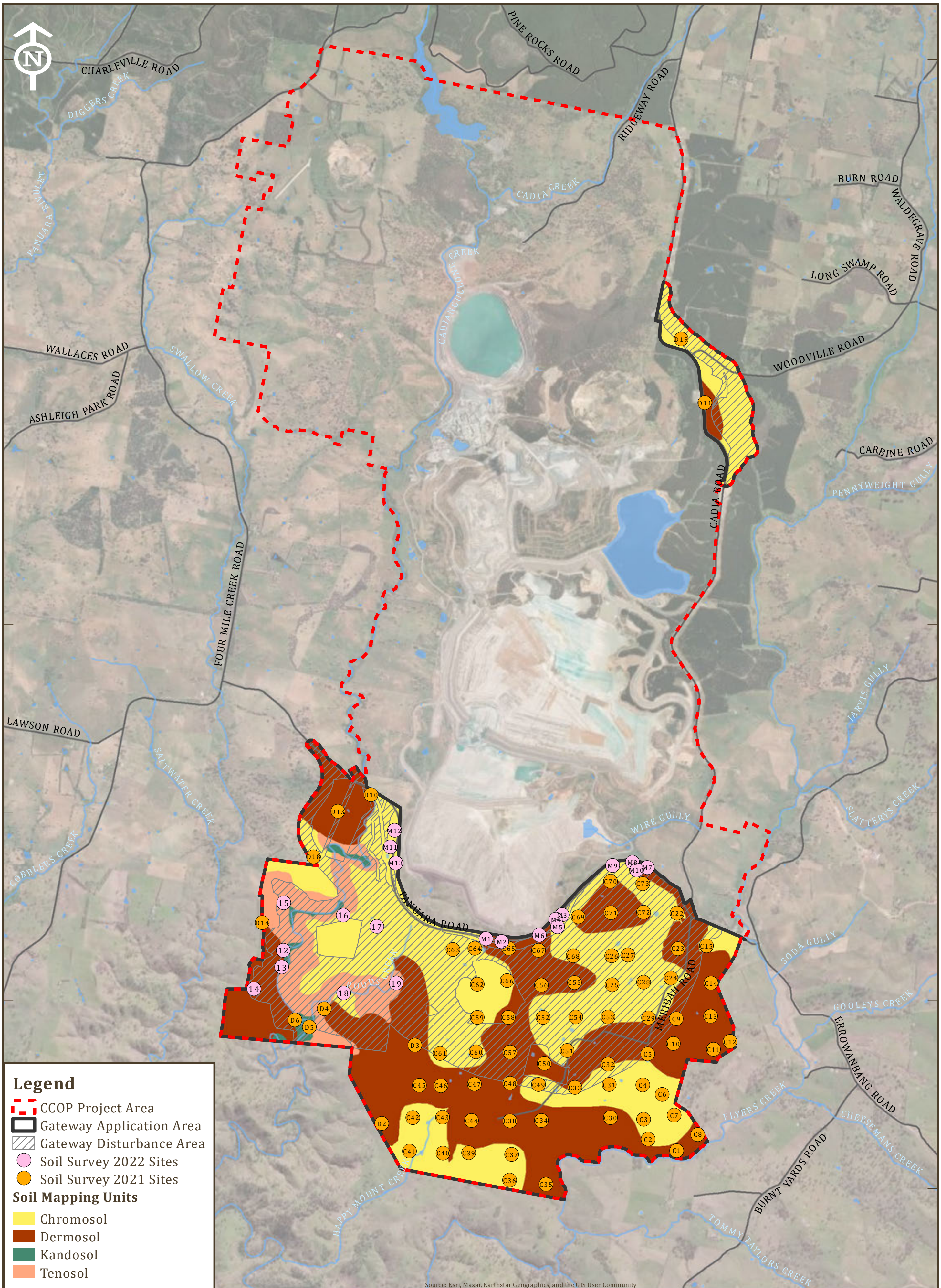
For the purpose of this assessment, the soil survey information relevant to the GAA (2,265 ha) includes 99 soil investigation sites, which equates to approximately 1 site per 23 ha. Soil survey assessment sites relevant to the GAA were collected over two periods, as shown on **Figure 13**:

- 2021 soil survey by Clayton Richards includes relevant sites C1 – C16, C22 – C73, D1 – D6, D10, D13, D14, D18 – D20. This survey consisted of the initial BSAL verification assessment, as presented in **Appendix 1**. LSC information was also collected at the time of survey.
- 2022 soil survey by Matt Hemingway includes relevant sites M1 – M13, 12 – 19. This supplementary survey consisted of a BSAL assessment for the Cadia Modification 15 Project, as well as a LSC assessment of areas of >10% slope that were not assessed as part of the initial survey.

Samples were collected and tested at representative sites. Four samples were collected from each site included in the BSAL assessment with depths typically at 0-10 cm, 20-30 cm, 40-50cm and 65-75 cm. For areas outside the BSAL assessment area (i.e., >10% slope), representative samples of each soil horizon were collected, ranging between two and four samples per site.

Soil profiles within the GAA (refer to **Figure 13**) were assessed in accordance with the Australian Soil and Land Survey Field Handbook soil classification procedures (NCST, 2009). Detailed soil profile descriptions were recorded covering the major parameters specified in **Table 1**. Soil profile logging was undertaken in the field using Minesoils soil data sheets, including GPS recordings and photographs of the landforms and soil profiles. Soils were keyed out in accordance with the ASC Third Edition (2021).

The laboratory testing suite for representative sites is detailed in the **Table 2**.

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Scale 1:65000 at A4

Soil Mapping Units

FIGURE 13

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### Table 1: Detailed soil profile description parameters

| Detailed Field Assessment Parameters | |
|---|---|
| Horizon depth including distinctiveness and shape | Pan presence and form |
| Field texture grade | Permeability and drainage |
| Field colour (Munsell colour chart) | Field pH |
| Pedality structure, grade and consistence | Field moisture |
| Soil fabric and stickiness | Surface condition |
| Stones (abundance and size) | Landform pattern / element |
| Mottles (amount, size and distinctiveness) | Current land use and previous disturbance |
| Segregations (abundance, nature, form and size) | Vegetation |

### Table 2: Soil Sample Laboratory Analysis

| Lab Analysis | |
|---|---|
| **Analyte** | **Methodology** |
| pH (1:5 water & CaCl) | Rayment & Lyons 2011-4A1 |
| Electrical Conductivity (EC) and Chloride | Rayment & Lyons 2011-3A1 |
| Cation Exchange Capacity (CEC) & ESP and Ca:Mg Ratio | Rayment & Lyons 2011-15J1 |
| Particle Size Analysis (PSA) (Selected samples only) | ISSS Hydrometer plus 0.2 and 2.0 mm Sieving (CSIRO 'Yellow Book') |

## 3.2 SOIL MAPPING UNITS

The soil mapping units of the GAA consist of the following:

- Soil Unit 1: Chromosols – covering 1,033 ha;
- Soil Unit 2: Dermosols – covering 1,025 ha;
- Soil Unit 3: Kandosols – covering 23 ha; and
- Soil Unit 4: Tenosols – covering 184 ha.

These soil mapping units are presented on **Figure 14**. A summary of all soil profiles assessed as well as the full soil profile descriptions of profiles assessed are presented in **Appendix 2**. An overview of each mapping unit is presented below.

### Soil Mapping Unit 1: Chromosols

Chromosols are soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2t horizon (or the major part of the entire B2t horizon if it is less than 0.2 m thick) is not sodic and not strongly acid. Soils with strongly subplastic upper B2t horizons are also included even if they are sodic.

These soils are the most spatially dominant throughout the GAA and occur widespread across the site and the areas mapped as verified/ assumed BSAL.

These soils are characterised by coarser textured topsoils overlying clay subsoils, with consistently strong subsoil structure (occasionally with vertic properties), that is consistently non-saline and which generally trends from acidic in the topsoil to alkaline at depth. Soils are deep, are moderately well to imperfectly drained, have low coarse fragment presence.

These soils are generally non-sodic; however a subdominant Sodosol soil type occurs within this unit sporadically where subsoils are sodic.

### Soil Mapping Unit 2: Dermosols

This soil mapping unit is characterised by Dermosols, albeit with a strong presence of sub-dominant Vertosols. The Dermosols and Vertosols within Soil Mapping Unit 2 are intermixed and very closely associated. These soils are generally very similar albeit for subtle variances in vertic properties and clay percentage.

As described in Section 2.6, Dermosols are soils other than Vertosols, Hydrosols, Calcarosols and Ferrosols which:

- Have B2 horizons that have grade of pedality greater than weak throughout the major part of the horizon, and
- Do not have clear or abrupt textural B horizon.

Meanwhile, Vertosols are soils with the following:

- A clay field texture of 35% or more clay throughout the solum except for thin, surface crusty horizons 30 mm or less thick and
- When dry, open cracks occur at some time in most years. These are at least 5 mm wide and extend upward to the surface or to the base of any plough layer, peaty horizon, self-mulching horizon, or thin, surface crusty horizon; and
- Slickensides and/or lenticular peds occur at some depth in the solum.

These soils are widespread across the GAA and the areas mapped as verified / assumed BSAL.

These soils are characterised by topsoil that range from sandy to loam to heavy clay, which overlie well-structured clay subsoils, occasionally with vertic properties. They are consistently non-saline, non-sodic and generally trend from acidic in the topsoil to neutral or alkaline at depth. Soils range from shallow to deep, are generally moderately well drained, and have low coarse fragment presence.

### Soil Mapping Unit 3: Kandosols

As described in Section 2.6, Kandosols are soils which have all of the following:

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

Soil mapping unit 3 consist of deep soils with a coarse texture fraction and occasional stratified coarse fragment presence and are non-saline and non-sodic. This mapping unit is the least spatially extensive across the BSAL field assessment area of the GAA and are associated with the limited depositional flats and alluvial benches associated with Rodds Creek.

### Soil Mapping Unit 4: Tenosols

As described in Section 2.6, Tenosols are soils that do not fit the requirements of any other soil order and generally have one or more of the following features:

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

Soil mapping unit 4 consist of shallow, rocky soils with minimal development past an A1 horizon and thin B2/ BC horizons, which occur on steeply inclined sloped and gullied landform in the south west of the GAA.

There is an association between this mapping unit and verified non-BSAL, based on slope, soil depth and soil fertility.

## 3.3 LAND AND SOIL CAPABILITY ASSESSMENT

The LSC classification applied to the GAA was in accordance with the OEH guideline *The Land and Soil Capability Assessment Scheme; Second approximation* (OEH 2012a) (referred to as the LSC Guideline). 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 3** 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 3: Land and Soil Capability Classification

| Class | Land and Soil Capability |
|---|---|
| **Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature 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. |

## Methodology

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 GAA lies within the Eastern and Central 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 10-20%, which may be designated LSC Class 4 or 5 depending on the presence of gully erosion and/or sodic/dispersible soils.

***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:

- Wind erosive power for the GAA has been mapped as ‘High’ by the LSC Guideline;
- Exposure of the land to wind was also determined to range from Low to High depending on the landform pattern and landform element in the proximity of the sites throughout the GAA; and
- The average rainfall for the locality is 881.9 mm (as per closest BOM data (BOM, 2024) which is generally consistent with rainfall data from site weather stations)), and therefore the GAA lies within the “greater than 500 mm rainfall” category.

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 surface soil texture; surface soil pH and a regional mean annual rainfall > 550mm.

***Hazard 5: Salinity***

The salinity hazard is determined through a range of data and criteria. The recharge potential for the site was determined based on an average annual rainfall of 881.9 mm, with annual evaporation of 1400-1600 mm (BOM 2021). This would suggest a moderate recharge potential and a moderate discharge potential.

Laboratory tested EC values were used to determine salt store. Salinity ranges from non-saline over the majority of the GAA, to highly saline on limited extents of alluvial flats, based on electrical conductivity results.

***Hazard 6: Water Logging***

Water logging was determined by the soil 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.

### Results

All soil assessment sites have been subject to a LSC site verification assessment in accordance with the LSC Guideline. Based on the results of this assessment, it is concluded that the GAA contains six LSC classes:

- LSC class 3: high capability land – covering 67 ha.
- LSC class 4: moderate capability land – covering 1,450 ha.
- LSC class 5: moderate-low capability land – covering 21 ha.
- LSC class 6: low capability land – covering 443 ha.
- LSC class 7: very low capability land – covering 219 ha.
- LSC class 8: extremely low capability land – covering 65 ha.

The spatial extent of each LSC class is shown in **Figure 14**. The LSC verification assessment outcomes for the eight hazards group for the soil profiles assessed is presented in **Appendix 4**.

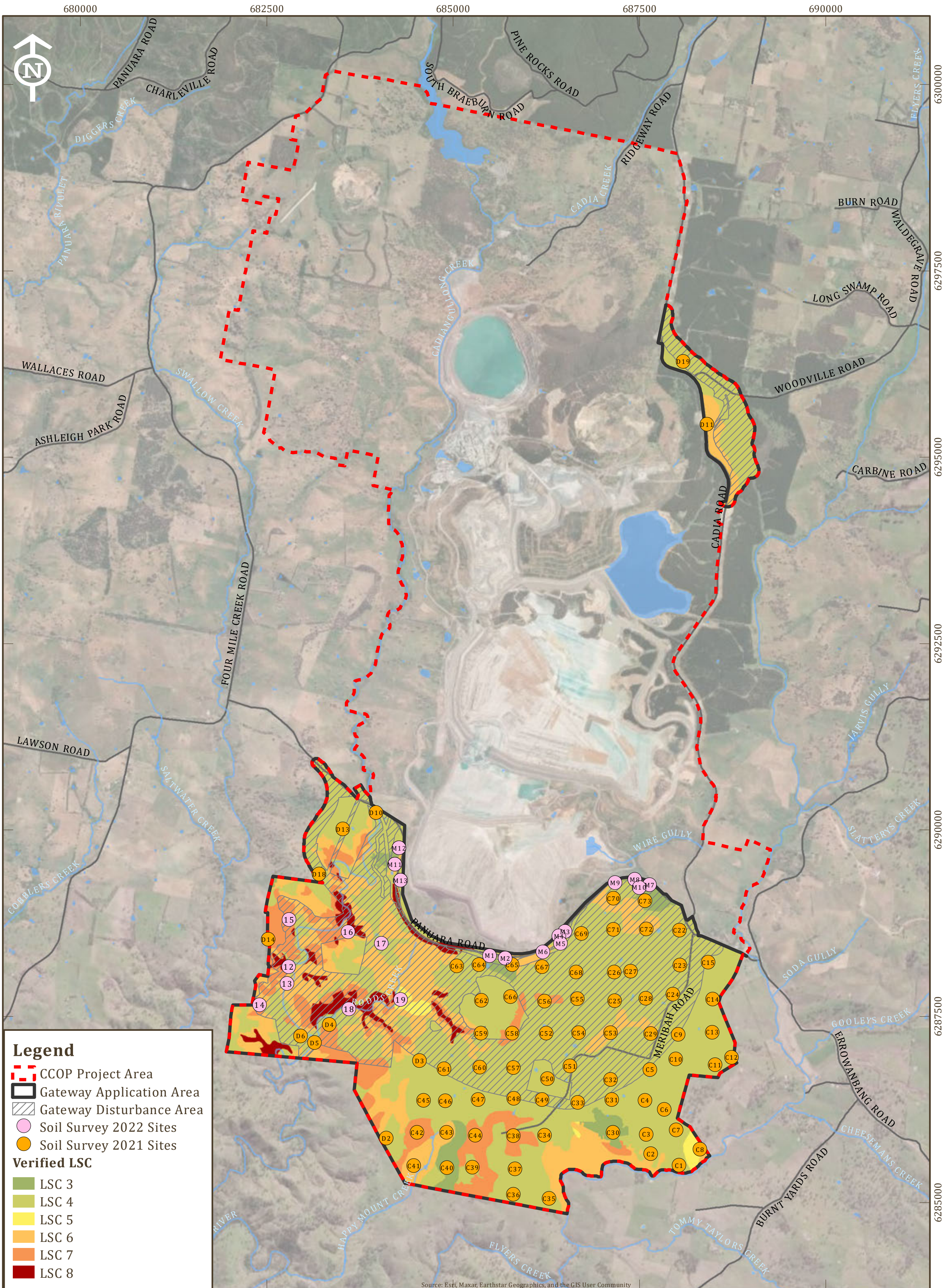
The limitations associated with each land class are discussed below:

***Class 3 Land***

Class 3 land occurs to a limited and sporadic extent within the GAA, generally associated with Soil Mapping Units 1 and 2 and lands verified as BSAL. This classification indicates 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. The primary constraints to this land class are soil acidity, soil salinity and soil structure decline. These sites are surrounded by poorer quality LSC classes and are therefore influenced by the small scale of area considered LSC class 3. The likelihood of these lands being utilised for more intensive, high-impact land uses are therefore inhibited.

***Class 4 Land***

Class 4 land is the most spatially extensive LSC class within the GAA, and largely corresponds with Soil Mapping Units 1 and 2. This classification indicates 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. The primary constraints to this land class are soil acidity, soil structure decline and shallow soil depth.

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0 250 500 1,000 Meters

Scale 1:65000 at A4

FIGURE 14

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***Class 5 Land***

Class 5 land is the least spatially extensive LSC class and occupies minor sections of Soil Mapping Units 1 and 2. Land has high limitations for high-impact land uses. Constraints 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. The primary constraints to this land class are soil acidity and wind erosion.

***Class 6 Land***

Class 6 land occurs widespread throughout the GAA. 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. The primary constraints to this land class are soil depth and water erosion, encompassing shallow soils and soils on slopes above 20%.

***Class 7 Land***

Class 7 land occurs on crests and steep slopes throughout the GAA. 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 are not managed. There should be minimal disturbance of native vegetation on Class 7 land. The primary constraint to this land class is shallow soils with soil depth of <0.25m.

***Class 8 Land***

Class 8 land occurs on very steep slopes throughout the south western portion of the GAA. 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 on this land class. Class 8 land has been mapped where slope exceeds 50% due to water erosion hazard.

# 4 BASELINE AGRICULTURAL CHARACTERISTICS

## 4.1 OVERVIEW

The baseline agricultural assessment has been developed in accordance with Sections 2 and 3 of the *Strategic Land Use Policy Guideline for Agricultural Impact Statements* (NSW Department of Trade, Investment, Regional Infrastructure and Services [DTIRIS], 2012) and in consideration of the agricultural impact risk ranking methodology outlined in *Agricultural Impact Statement technical notes* (NSW Department of Primary Industries, 2013) to present a broad assessment of potential impacts to agricultural resources and industries.

As part of the existing Cadia mine operations, CHPL has developed a range of intended final land uses, landform establishment and ecosystem development procedures, rehabilitation principles and completion criteria that are detailed in its existing Rehabilitation Plan and forward program. CHPL is committed to the development of appropriate post mining land use outcomes and is continuing to investigate opportunities to increase the productivity and maximise the potential future land use options for the final landform under the CCOP.

Work is underway to expand upon these objectives in the Rehabilitation Strategy and Agricultural Impact Statement accompanying the EIS for the Project. For the purposes of this Gateway application, a conservative scenario has been developed to provide a reasonable worst-case consideration of agricultural impacts. It is anticipated that further mitigation measures will be incorporated into the EIS and that the proposed impacts would be a subset of those presented below on the basis of conservative land use design parameters.

## 4.2 AGRICULTURE IN THE LOCALITY

### Agricultural Land Use

The GAA totals an area of 2,265 ha, 2,153 ha of which lies within the Blayney Shire Council LGA (representing 1.4% of the total LGA area of 152,400 ha) and 112 ha of which lies within the Cabonne Shire LGA (representing 0.02% of the total LGA area of 602,600 ha).

Changing agricultural focus, practices and rural settlement patterns are a key historical characteristic of the region surrounding the GAA, responding to changes in short to medium term environmental conditions and to changes in economic, social and policy frameworks, at a scale well beyond the Project Locality.

According to the Australian Bureau of Statistics (2022a), for the last agricultural census year of 2020 – 2021, lands mainly used for agricultural production covered an area of 151,758 ha (or 99.6%) of the Blayney Shire LGA, and 427,438 ha (or 71%) of the Cabonne Shire LGA. Grazing was undertaken on 93% of the area subject to agricultural land use in Blayney Shire LGA, and 78% of the area subject to agricultural land use in Cabonne Shire LGA (refer **Table 4**).

Table 4: Agricultural Land Use for Blayney Shire LGA and Cabonne Shire LGA 2020 - 2021

| Agricultural Land Use | Blayney Shire LGA | | Cabonne Shire LGA | |
|---|---|---|---|---|
| | Area of Agricultural Land Use (ha) | Percent of Agricultural Land Use (%) | Area of Agricultural Land Use (ha) | Percent of Agricultural Land Use (%) |
| Grazing | 140,486 | 93 | 335,012 | 78 |
| Cropping | 10,027 | 6 | 89,384 | 21 |
| Forestry | 1,243 | <1 | 1,835 | <1 |
| Other | 2 | <1 | 1,207 | <1 |
| Total Area (ha) | 151,758 | 100 | 427,438 | 100 |

### Agricultural Enterprises

The 2020 – 2021 Agricultural Census, run by the Australian Bureau of Statistics, calculated the total value of agricultural commodity values in Blayney Shire LGA and Cabonne Shire LGA was $64m and $287m respectively. Livestock slaughters was the dominant agricultural enterprise, representing 65 percent of the total agricultural value for Blayney Shire LGA, and 32 percent of the total agricultural value for Cabonne Shire LGA (refer **Table 5**).

Table 5: Agricultural Commodity Value for Blayney Shire LGA and Cabonne Shire LGA 2020 – 2021

| Commodity | Blayney Shire LGA | | Cabonne Shire LGA | |
|---|---|---|---|---|
| | Value ($) | % | Value ($) | % |
| Livestock slaughtering's | 41,699,992 | 65 | 91,985,383 | 32 |
| Livestock products | 10,507,963 | 16 | 58,445,615 | 20 |
| Broadacre Cropping | 6,538,102 | 10 | 63,374,788 | 22 |
| Hay | 4,309,068 | 7 | 21,696,501 | 8 |
| Fruit, nuts and vegetables | 770,012 | 1 | 48,626,005 | 17 |
| Nurseries, flowers or turf | 126,021 | <1 | 2,226,700 | 1 |
| Total | 63,951,157 | 100 | 286,354,992 | 100 |

Source: ABS Value of Agricultural Commodities Produced, Australia, 2020-21 (ABS, 2022b)

Further analysis highlights that cattle and calves for slaughter are the dominant regional enterprise, representing 78 per cent of the value of all livestock for slaughter in Blayney Shire LGA and 59 per cent of the value for all livestock for slaughter in Cabonne Shire LGA (refer **Table 6**). Sheep and lambs are also shown to be a significant enterprise in each LGA.

The above data highlight beef cattle as the prevalent established agricultural industry in the LGAs. The industry defines the rural character of the locality and broader region, contributes significantly to the economy and facilitates the ongoing management of rural resource lands.

Table 6: Agricultural Commodity Value for Livestock Slaughtering by Type for Blayney Shire LGA and Cabonne Shire LGA 2020 - 2021

| Commodity | Blayney Shire LGA | | Cabonne Shire LGA | |
|---|---|---|---|---|
| | Value ($) | % | Value ($) | % |
| Cattle and calves | 32,392,157 | 78 | 45,741,351 | 50 |
| Sheep and lambs | 9,269,240 | 21 | 35,790,956 | 39 |
| Poultry | 26,473 | <1 | 9,991,055 | 10 |
| Other | 11,081 | <1 | 420,574 | <1 |
| Pigs | 1,041 | <1 | 41,447 | <1 |
| Total | 41,699,992 | 100 | 91,985,383 | 100 |

Source: ABS Value of Agricultural Commodities Produced, Australia, 2020-21 (ABS, 2022b)

Factors in favour of cattle grazing and the region's beef industry include the:

- Suitability of the climate, pasture types and landscape.
- Available service suppliers (eg, produce merchants, contractors).
- Proximity to infrastructure (abattoirs, saleyards, transport etc) and a range of markets.
- Potential for higher returns from group marketing activities.

Much like the wider locality, the prevailing agricultural land use of the neighbouring properties immediate adjacent to the GAA is cattle and sheep grazing. This is undertaken on areas cleared of native vegetation as a result of historic agricultural use. In the wider locality, areas to the west and south of the Project site also feature cropping activity as a primary land use, along with livestock grazing.

A number of agricultural properties in proximity to the Project, particularly to the east, have also diversified their income streams by leasing land for the purposes of renewable energy production (such as wind and solar farms). These properties are evidence of the ability to manage the co-existence of multiple industries and land uses in a complementary way.

### Infrastructure

Agricultural industries within the NSW Central West region are diversified and are primarily associated with beef cattle, wool and prime lamb enterprises, cropping, and fruit production (Department of Primary Industries [DPI], 2012). The region's agricultural industries are well serviced by key supporting infrastructure including irrigation systems, livestock sale yards, livestock agents and cropping infrastructure such as silos and rail systems (DPI, 2012).

The main agricultural service centres in proximity to the GAA are the towns of Orange and Blayney, with local businesses providing agricultural equipment and supplies, including animal fencing, animal vaccinations, livestock ID, stock supplements, seed, fertiliser and crop protection.

The GAA and surrounds are well serviced for support infrastructure being located proximal to the Mid-Western Highway and Mitchell Highway. Access to regional road transport routes is readily available from the GAA via the local road network.

The Central Tablelands Livestock Exchange (CTLX)(**Plate 1**), located 15 km from the GAA at Carcoar on the Mid Western Highway, provides the region with a state-of-the-art livestock auction facility. The CTLX opened in 2008 to replace outdated council saleyards at Orange, Bathurst and Blayney.

General agricultural improvements (e.g. stock fences and existing access tracks) are in place within the broader locality (including surrounding CHPL-owned land) which reflects the historical and current development of the local lands for cropping and livestock grazing.

Other infrastructure critical to agricultural production include energy needs (gas and electricity), telecommunications services, irrigation water infrastructure and urban water and wastewater services. General agricultural improvements such as stock fences, shedding, dams and access tracks are widespread throughout the Project locality which reflects the historical and current development of the local lands for livestock grazing.

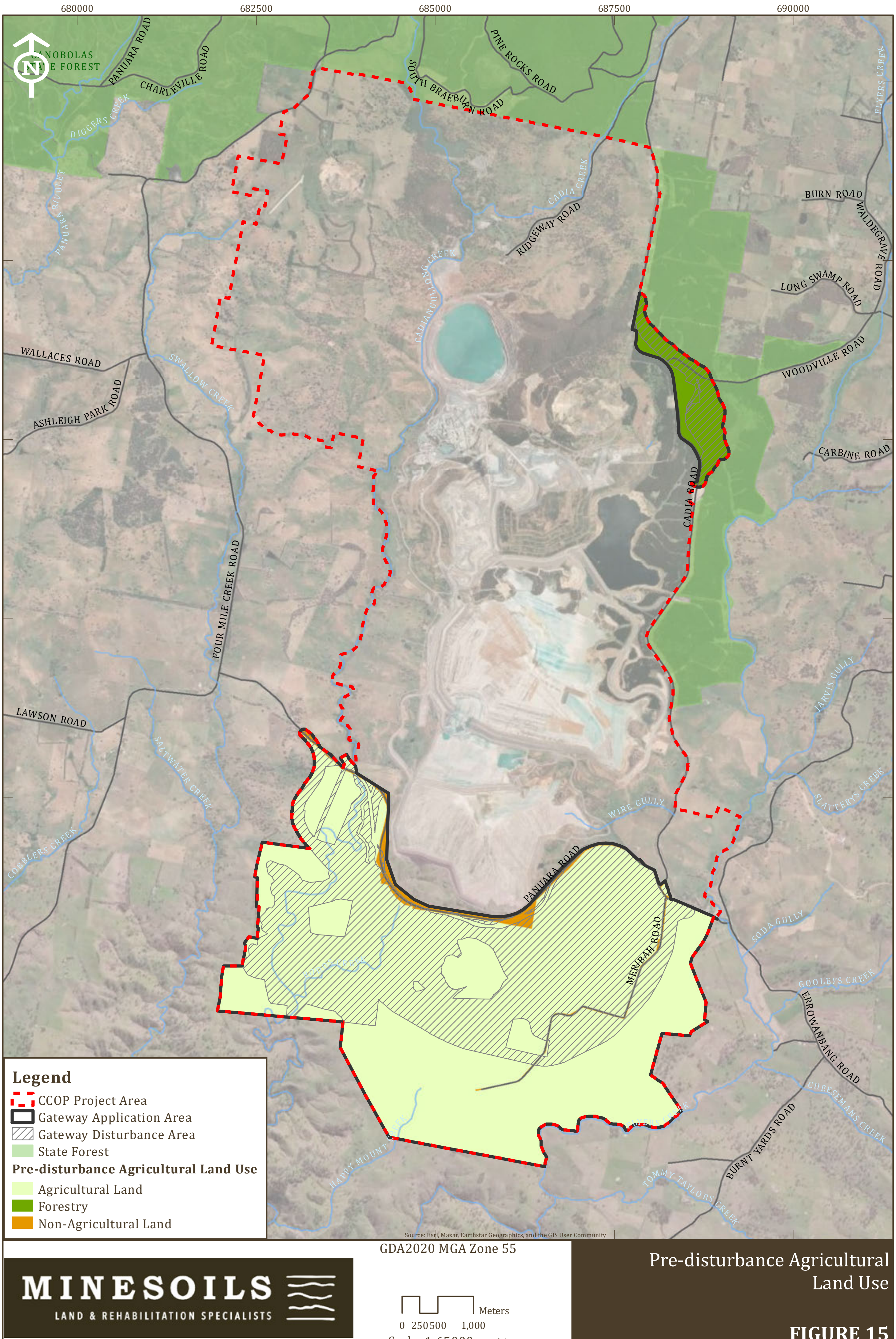

Plate 1: Cattle being sold at the Central Tablelands Livestock Exchange, located 15km from the GAA.
(Photo Source: Central Western Daily, 2018)

## 4.3 AGRICULTURE IN THE GAA

### Current Status

The GAA is wholly owned by CHPL, and is characterised by previously disturbed and largely cleared agricultural land (approximately 2,090 ha), which dominates the southern portion of the GAA, and land subject to forestry (approximately 112 ha) covering the north eastern portion of the GAA, as presented in **Figure 15**. Limited extents of area within the GAA associated with road easements are considered non-agricultural land and cover 62 ha. Some sparse patches of remnant woodland vegetation are located on low hills, with scattered paddock trees occurring across the land, however the southern portion of the GAA are generally considered agricultural land.

The areas of the GAA subject to agriculture are used for the grazing of beef and lamb on a rotational grazing method, with the primary activities being the breeding and fattening of steers. Cattle are watered through surface dams or pumped groundwater. No additional intensive feeding is carried out in years with normal climate conditions. Annual cropping for fodder (hay and sileage) is also undertaken over a portion of the area. Fertilisers and soil improvements are applied as needed based on agronomist advice, with broad leaf herbicides used widely and spot sprays targeting Blackberry (Rubus fruticosus agg. spp.), St John's wort (Hypericum perforatum) and Sticky Nightshade (Solanum sisymbriifolium).

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Pre-disturbance Agricultural Land Use

FIGURE 15

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A site inspection was undertaken by Minesoils' Clayton Richards in March – April 2021 and Matt Hemingway in July 2022. The GAA was determined to be a stable, free draining landform with a 90 - 100% surface cover, with grazing of cattle as the primary agricultural land-use at the time of each inspection. Built features within the GAA include occupied dwellings, farm and machinery sheds, shearing sheds and buildings, cattle yards, numerous farm dams, 11 kilovolt electricity transmission lines to the dwellings, paddock fences, unsealed property and mine access tracks, an unsealed local road (Meribah Road) and two sealed roads (Cadia Road and Panuara Road). No sensitive agricultural activities such as intensive plant or livestock agriculture are being undertaken within the GAA, with the exception of forestry activities in the north east portion of the GAA.

Photographs of existing land use conditions across the GAA are provided in **Plates 2 - 7**.

### History of Agricultural Enterprise

The agricultural land use of cleared sections of the GAA has been primarily used for cattle and sheep grazing, with occasional cropping on lands within the southern and eastern portions of the GAA. Pine (*Pinus radiata)* plantation, the dominant land use of the Canobolas State Forest within the GAA, dates to the 1990's. Historical aerial photography shows that these areas were largely cleared of native vegetation and used for grazing prior to being planted.

Based on aerial photography, site observations, soil and agricultural suitability, together with anecdotal evidence collected during site inspections, this assessment has concluded that the GAA has historically not been capable of sustaining agriculture more intensive than infrequent cropping. The only exception to this is an area of approximately 800 ha in the central southern area of the GAA, which indicates some potential for cropping. For the most part, changes made to the Project design have reduced the project disturbance footprint such that a significant proportion of this area with higher potential cropping value is able to be avoided and is no longer in the proposed GDA.

### Estimated Primary Productivity

Agricultural productivity is subject to long term climate and rainfall variables, as well as changes in economic, social and policy frameworks, at a scale well beyond the GAA. There is no set agricultural productivity value for land under agricultural use.

The NSW Department of Primary Industries (2023) Gross Margin Budgets for Livestock can be used to provide a broad estimation of the productivity of the land for grazing within the identified agricultural land within the GAA. For the purpose of this assessment, the productivity for the agricultural land within the GAA is modelled on a cattle grazing enterprise based on the LSC and historical land use of the GAA, including areas currently subject to forestry. Based on enterprises including inland weaners and growing out steers (240 – 460 kgs), the estimated potential productivity of the GAA ranges from $348,032 - $832,780 per annum as summarised in **Table 7**.

### Table 7: Estimated Productivity of Grazing Land within the GAA

| Enterprise | Estimated Gross Margin ($/ha/year) | Agricultural land within the GAA (ha) | Gross Margin ($/year) |
|---|---|---|---|
| Inland Weaners | 161.65 | 2,153 | 348,032 |
| Growing-out Steers 240 – 460kg | 386.8 | 2,153 | 832,780 |

An alternative method by which to estimate the productivity of the GAA is by analysing the information presented from the last agricultural census of 2020 – 2021, as further outlined in in Section 4.2 (ABS 2022a and 2022b). This information shows that within the Blayney Shire LGA 140,486 ha of land was used for livestock grazing activities, of which the gross commodity value of livestock slaughtered (cattle and calves, sheep and lambs) and livestock products (milk and wool), totalling $52,207,955, can be attributed that area (refer Section 4.2). This results in an annual $/ha ratio of $372/ ha, equating to an estimated potential agricultural productivity of $800,916 per year for the GAA.

Note: Blayney Shire LGA used as representative for modelling purposes due to all livestock grazing activities within the GAA occurring within the Blayney Shire LGA.

### Estimated Secondary Productivity

The related economic activity arising from the primary productivity is referred to as the secondary productivity. The value of secondary productivity can be calculated using an economic multiplier. Agricultural economic multipliers provide annual estimates of employment and output effects of trade in agricultural products on the economy. When expressed as multipliers, these effects reflect the amount of economic activity and jobs generated by agricultural exports.

There are a range of upstream and downstream employment roles associated with agricultural production in the Project locality and wider region. These include:

- Agronomy services.
- Input providers (chemical, fertilisers, etc).
- Machinery sales and mechanical support.
- Grain and livestock transport.
- Production marketing.
- Fencing, harvest and other contractors.

Upstream activities for the current GAA enterprises include contractors, farm input and service providers. Downstream activities for the current landowners' enterprises include distribution and processing (value adding). The related economic activity from the proposed area can be calculated using the economy multiplier of 2.1788, as used by ABS (DPI, 2016).

By applying the economic multiplier of 2.1788 to the estimated productivity of the agricultural land within the GAA, the value to the broader economy equates to an estimated $758,292 to $1,814,461 per year of the Project.

Plate 2: Grazing cattle on undulating grassland representative of the land use of the GAA.

Plate 3: Example of land with greater slopes, typical of the south western portion of the GAA.

Plate 4: Example of land with moderate undulation, typical of the proposed TSF domain.

Plate 5: Example of a gently undulating slope with capabilities for cropping or cultivation.

Plate 6: Infrastructure for grazing enterprise within the GAA.

Plate 7: Pine (*Pinus radiata)* plantation, dominant land use of the Canobolas State Forest within the GAA.

# 5 POTENTIAL IMPACTS

## 5.1 OVERVIEW

Mining operations have the potential to impact land resources and agricultural productivity in a variety of ways, from short and medium term temporary impacts to longer term and permanent impacts. Temporary impacts vary in their significance and can include short term disturbance such for construction activities or the storage of soil resources and operational impacts such as noise and air quality. Temporary impacts can also involve medium term impacts over several years or decades, such as the destocking and removal of areas of land from agricultural productivity over the life of a mining operation or the creation of temporary infrastructure areas and water management systems that can be removed and remediated following the closure of a project. Permanent impacts are usually more significant in scale and may include changes to the topography of a landform, water availability and future land and soil capability. Permanent impacts are irreversible and may not allow the reinstatement of the pre-mining land and soil capability or agricultural uses. They can include final voids, emplacements and significant changes to the pre-mining landform, drainage patterns or groundwater quality and quantity.

This section assesses the potential impacts of the Project on agricultural resource, enterprises and agricultural related socio-economic impacts based on baseline data and current knowledge of the Project, and indicates where additional assessments will be undertaken as part of the EIS process.

## 5.1 IMPACTS ON AGRICULTURAL RESOURCES

### Soils

All soil that is proposed to be disturbed during the Project will be stripped and direct placements for progressive rehabilitation where possible or stored for re-use in later rehabilitation efforts in order to mitigate long term impacts on soil resources. Soil stripping and storage practices are already in place as part of the existing Cadia operations and existing operational controls are being reviewed with the intention that they be applied to the GDA. A detailed soil stripping strategy and soil balance will be included in assessments as part of the EIS process.

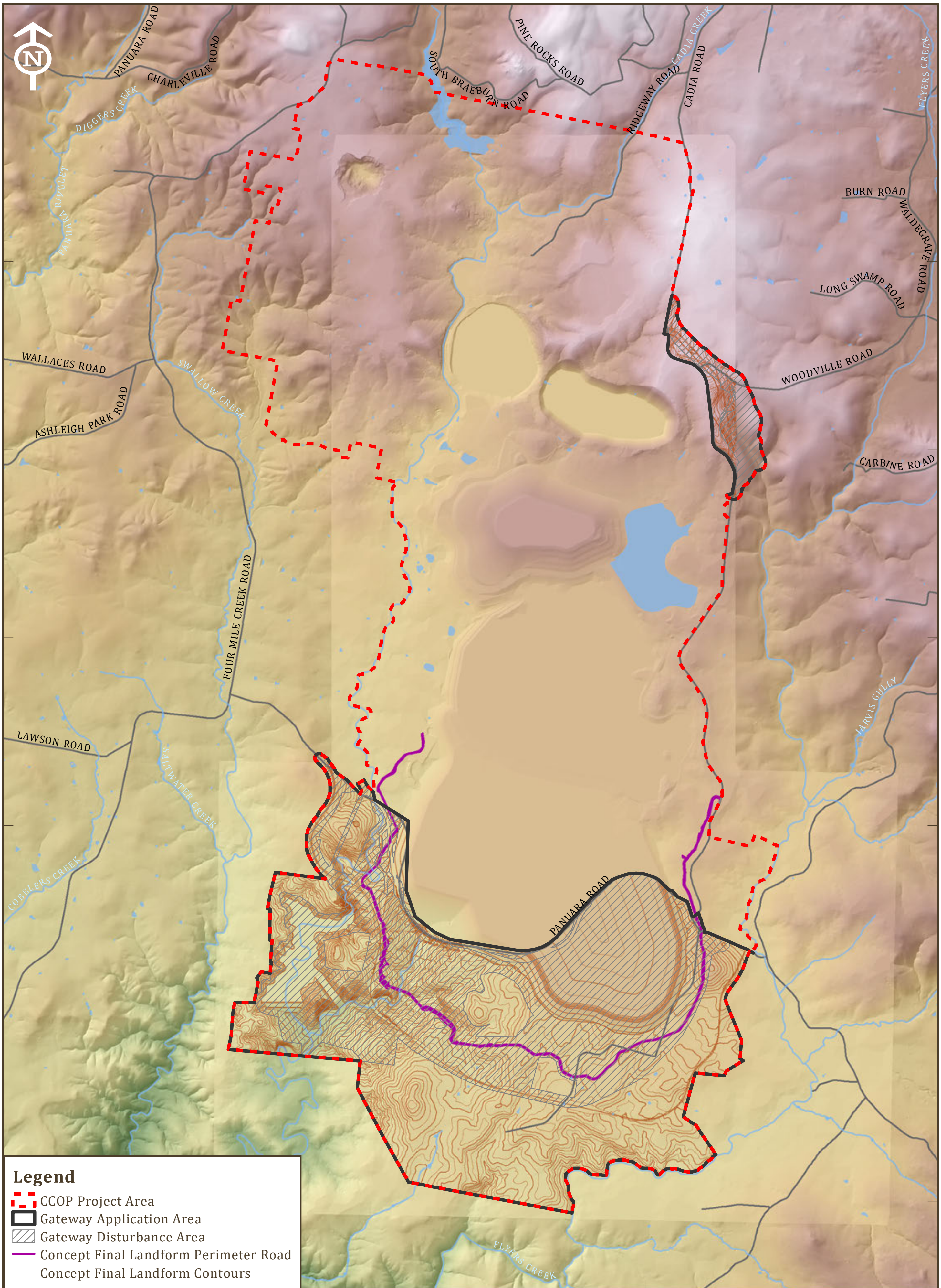
There will be no direct or indirect impacts to the soil resources of the Project locality outside of the existing consented disturbance areas and the GAA.

### Land and Soil Capability

Due to the nature of the Project which will require major landform modification and soil stripping, the level of impacts on LSC classes within the GAA will be high, with general permanent downgrading of classes. The LSC of land within the operational site boundary would be temporarily classed as LSC 8 during operations, as these areas will be fenced off and would not be available for agriculture.

The final landform for the GAA is presented in **Figure 16**, which shows significant landform modification in context of the proposed tailing facility and its embankment. An LSC assessment to determine the LSC classes of the conceptual post-mining landform has been undertaken and presented in **Figure 17**. To inform this application and provide a conservative assessment of the potential LSC impacts of the Project on the post mining landform, it has been assumed that the retention of the realigned Cadia Road, realigned Panuara Road and South Water Storage Area in the landform would result in the permanent removal of this land from agricultural productivity and generate a LSC class 8.

Alterations to the landform topography, surface water flows, topsoil depth and rooting depth of the proposed tailing facilities and embankments is also expected to present challenges to future agricultural land uses and has been conservatively assessed as LSC 7.

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Scale 1:65000 at A4

Conceptual Final Landform

FIGURE 16

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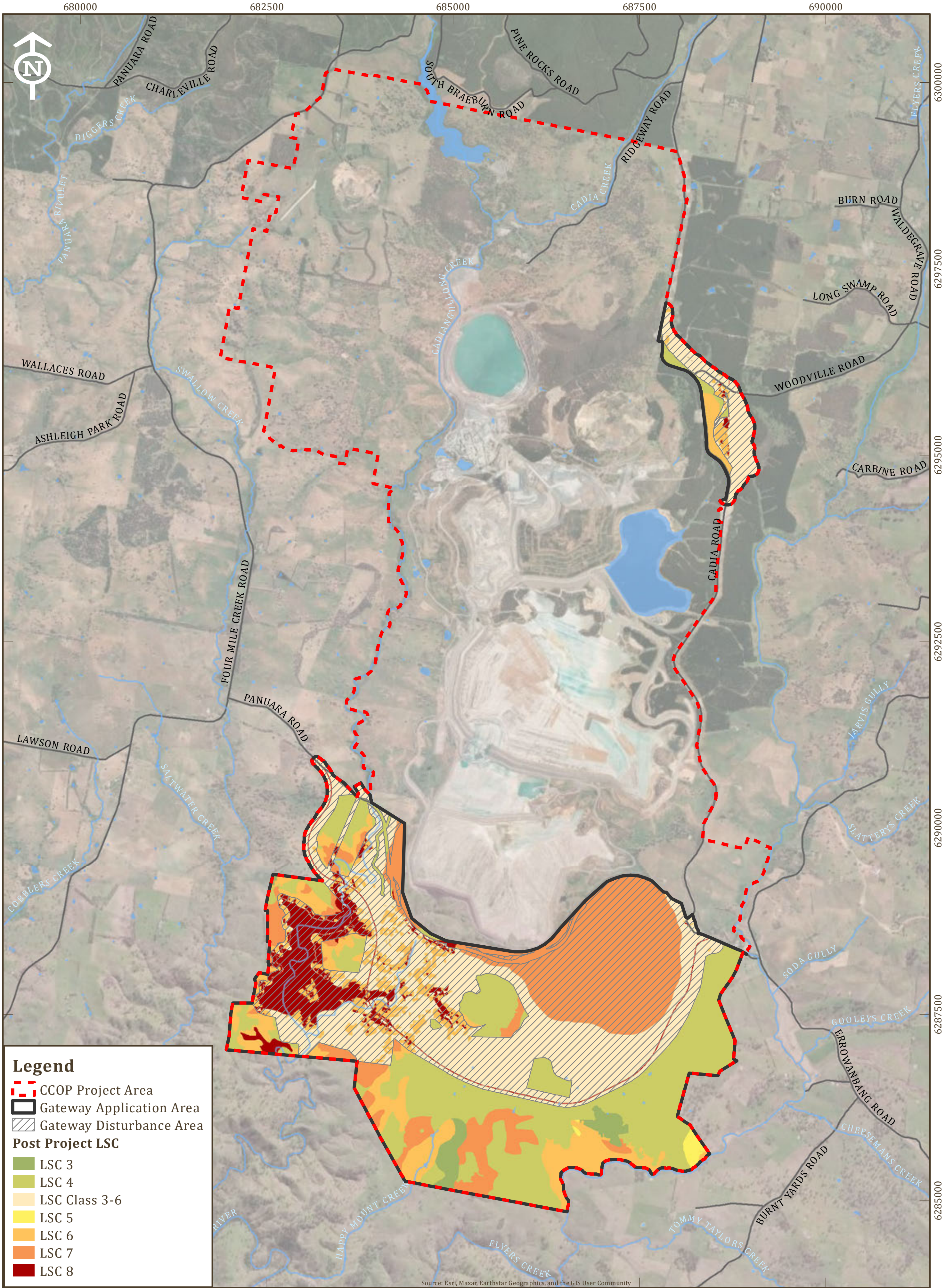


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Scale 1:65000 at A4

Conceptual Post Project
Land and Soil Capability

FIGURE 17

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Other areas within the GDA (including temporary soil stockpile areas, ancillary infrastructure areas and water management systems) will be returned to a productive agricultural land use post-mining. As the current LSC in these areas varies between LSC 3 and LSC 6, this assessment has anticipated that these areas would be returned to a similar LSC 3 to LSC 6 range, subject to final land rehabilitation strategies and planning currently being undertaken for the EIS.

A comparison of pre-Project and post-Project LSC classes within the GAA is presented in **Table 8**.

### Table 8: Land Used for Agriculture within the GAA prior to and following the Project

| LSC | Pre-Project | | Post-Project | |
|---|---|---|---|---|
| | ha | % | ha | % |
| LSC class 3 | 67 | 3 | 39 | 2 |
| LSC class 4 | 1,450 | 64 | 589 | 26 |
| LSC class 5 | 21 | 1 | 11 | 1 |
| LSC class 6 | 443 | 20 | 308 | 14 |
| LSC class 3 - 6 | 0 | 0 | 653 | 28 |
| LSC class 7 | 219 | 10 | 500 | 22 |
| LSC class 8 | 65 | 3 | 165 | 7 |
| Total Area | 2,265 | 100 | 2,265 | 100 |

#### BSAL

As outlined in Section 2.9, following the completion of a detailed soil survey program and verification of BSAL within the GAA, CHPL has made a number of refinements to the Project to relocate key infrastructure assets and reduce impacts on verified BSAL, where possible. As it currently stands, the Project is anticipated to have residual direct impacts on up to 378 ha of BSAL (refer **Figure 12**).

Opportunities for additional avoidance and reductions in impacts to BSAL will be further investigated and assessed as part of the EIS process.

#### Infrastructure

Where necessary to facilitate operations, certain agriculture improvements such as stock fences, farm dams, cattle yards, shedding access tracks and other farm infrastructure may be removed or relocated by the Project.

The Project will have a negligible impact on local and regional agricultural infrastructure. CCOP will require some road realignments (Cadia and Panuara Roads), but is not predicted to materially impact access to or use of the existing road or railway networks that connects the agricultural industry to markets, services and suppliers. A separate detailed traffic assessment is being undertaken as part of the EIS process to ascertain potential impacts to road users and measures required to maintain acceptable road safety standards and levels of service.

## 5.2 IMPACTS ON AGRICULTURE

### Land Use

As is typical of mining projects, the CCOP will require the establishment of appropriate site management boundaries and procedures to protect public safety and ensure the maintenance of efficient operational controls. This is typically achieved through the exclusion of other activities and operations within a prescribed operational (or site) boundary. As a result, some areas of existing agricultural productivity (as well as certain forestry activities) may cease in the GAA for part or the duration of the Project.

The significance of these changes in agricultural land uses varies across the CCOP depending on the nature of activities under the Project and extent of predicted impact. Some impacts may be short lived, such as the temporary restriction or cessation of certain forestry activities during the development of the Cadia Road realignment. Others may be longer lived extending over the life of the Project or into the post-mining landform. It is expected that agricultural activities will cease within the entire GDA area for the duration of the Project. Agricultural activities may also be restricted or cease in some parts of the GAA, including some paddocks that have existing fences that facilitate the establishment of an operational site boundary and some fragmented areas of land that, while not identified for disturbance, lie within the operational boundary of the site. While these areas would be suitable to be returned to agricultural productivity post mining, there is a high likelihood that they would be removed from active production in the medium term.

As part of the continued development of the CCOP, CHPL has identified a number of opportunities to reduce the operational site boundary requirements, including through a revision to the Panuara Road alignment. These changes assist in retracting the operational site boundary requirements and mean that areas of the GAA (particularly those areas to the south and east of the Panuara Road alignment) will be able to maintain agricultural productivity over the life of the Project.

However, for the purposes of this assessment, the agricultural lands within the GAA, as identified in Section 4.3 and **Figure 15**, will be temporarily removed from agricultural land use for the duration of the Project. This is a reduction of 2,090 ha, which is considered a minor impact in the context of land used for agriculture within the Blayney Shire and Cabonne LGA's (1.4 % and 0.5% respectively).

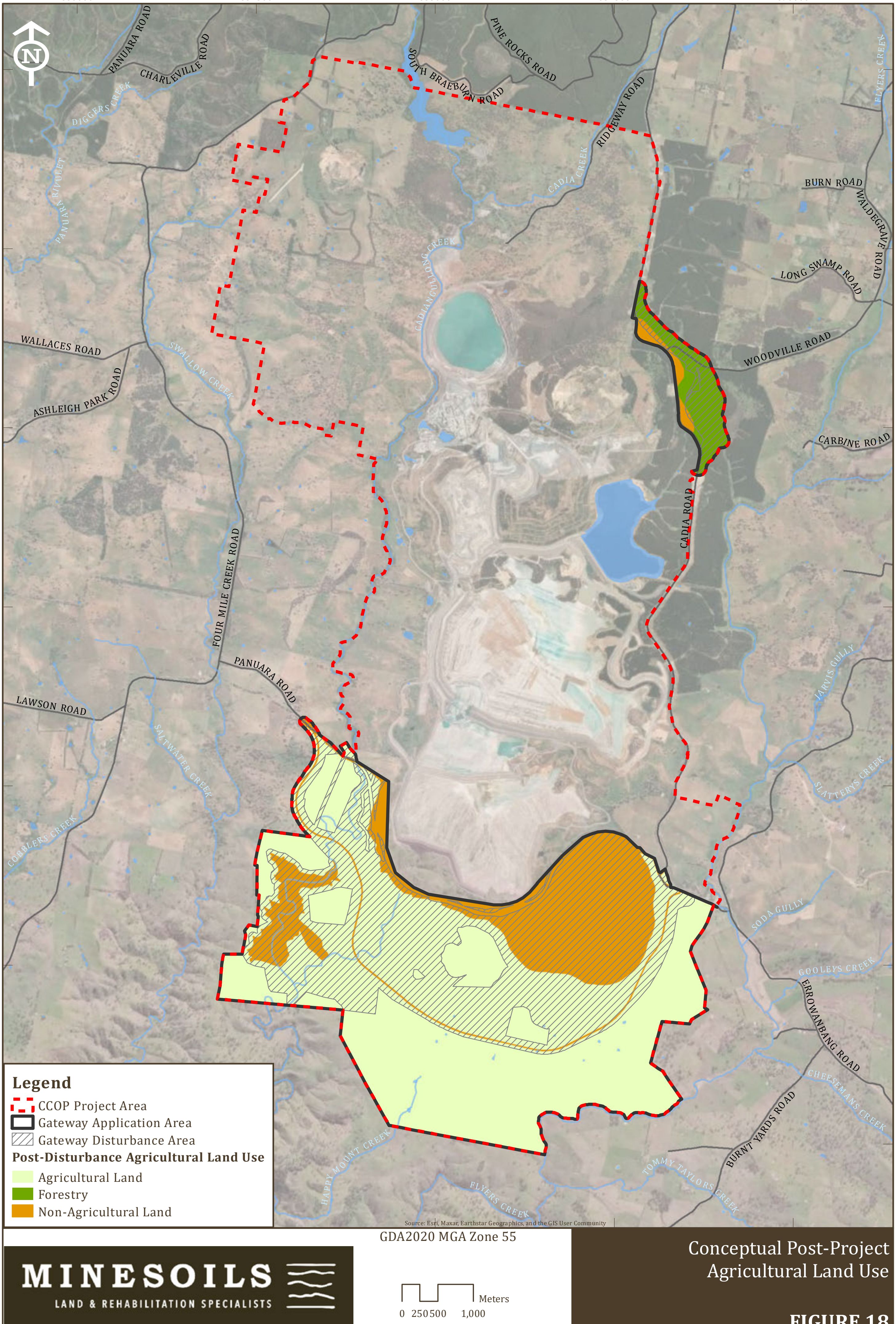
Further work is being undertaken as part of the EIS process to identify opportunities to maximise the extent of land to be returned to agriculture post mining. These outcomes will be detailed further in the Rehabilitation Strategy and Agricultural Impact Statement for the Project.

For the purpose of this assessment, it is assumed that the identified present agricultural lands within the GAA will be returned to an agricultural land use, with the exception of the infrastructure footprint areas for the South Water Storage Area, the Proposed Final Tailings area and the Proposed Tailings Embankment (all presented on **Figure 2**). These areas, that total 407 ha, will be permanently removed from agricultural land use.

The permeant removal of 407 ha from agricultural land use is a minor impact in the context of land used for agriculture within the Blayney Shire and Cabonne LGA's (0.3% and 0.1% respectively).

The conceptual post-Project agricultural land use areas for the GAA are presented in **Figure 18**.

A comparison of land used for agricultural within the GAA prior to and following the Project is presented in **Table 9**.




Conceptual Post-Project Agricultural Land Use

FIGURE 18

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### Table 9: Land Used for Agriculture within the GAA prior to and following the Project

| Agricultural Land Status | Pre-Project | | Post-Project | |
|---|---|---|---|---|
| | ha | % | ha | % |
| Agricultural Land | 2,090 | 92 | 1,683 | 74 |
| Non-Agricultural Land | 63 | 3 | 489 | 22 |
| Forestry | 112 | 5 | 93 | 4 |
| Total Area | 2,265 | 100 | 2,265 | 100 |

#### Agricultural Productivity

For the purposes of evaluating the potential likely impacts of the project on agricultural productivity, this assessment has provided an analysis of the temporary and permeant potential loss of productive land over the life of the Project.

When compared to the maximum estimated gross margin for growing-out steers as outlined in **Table 7**, the Project would result in a temporary reduction of potential agricultural productivity of up to $808,412 per year over the life of the Project.

This represents 1.3% of the gross value of agriculture within the Blayney Shire LGA, within which all grazing activities within the GAA occurs (refer Section 4.2).

Considering that a large proportion of the GAA, particularly those areas to the south and east of the Panuara Road alignment, are not proposed to be removed from agricultural productivity during the life of the Project, this assessment considers that the potential temporary impacts on agricultural productivity outlined above represent a conservative worst case scenario. It is expected that the mitigation measures and rehabilitation outcomes to be detailed in the EIS would further reduce the upper bounds of these potential impacts to agricultural productivity.

The Project will permanently remove a total of 407 ha of land used for agriculture (refer **Table 9**). By applying the productivity estimation method as detailed in section 4.3, and as presented in **Table 10** below, this will result in a permanent lost agricultural productivity of up to $157,427 per year.

### Table 10: Estimated Permanent Lost Productivity of Grazing Land within the GAA

| Enterprise | Estimated Gross Margin ($/ha/year) | Permanently Removed Agricultural land (ha) | Gross Margin ($/year) |
|---|---|---|---|
| Inland Weaners | 161.65 | 407 | 65,791 |
| Growing-out Steers 240 – 460kg | 386.8 | 407 | 157,427 |

## 5.3 SOCIO-ECONOMIC IMPACTS

### Support Services

Changes to the supply and viability of agricultural support services in Orange, Blayney and other regional centres are generally driven by social and market trends exceeding the scale of CCOP. In addition, the reduction in cattle being sold will not be a significant impact on the regional saleyards, as this reduction will represent an estimated <0.1% of all cattle sold.

Several support service businesses have been identified as having current or contemporary connections to agricultural activities undertaken in the GAA. These businesses include;

- Silmac, Orange;
- The Rural Centre, Orange; and
- Greens Mandurama Rural Service Centre, Mandurama.

These businesses may be affected by a potential reduction in trade associated with the temporary/permanent removal of agricultural production in areas of the GAA and changes in long term LSC classes and land uses.

As with established support service businesses, temporary or permanent changes in the agricultural practices within the GAA have the potential to affect short term opportunities for local contractors who attend the GAA to undertake work. These include, but are not limited to, shearers (up to four workers, 2 – 3 weeks per year) and sprayers (up to 4 weeks per year). While some of these activities (such as weed spraying and other environmental management works) would continue to occur over the Project life, other activities associated with direct agricultural production (such as shearing) would reduce.

On balance, the estimated economic impact to the above support services associated with the removal of the entire GAA from agricultural productivity is estimated by farm managers to be approximately $50,000 to 100,000 per year.

By applying the economic multiplier of 2.1788 (DPI, 2026) to the estimated lost productivity detailed is Section 5.2, the Project is anticipated to have a temporary secondary productivity impact of up to $1,761,368 per year, and a permanent secondary productivity impact of up to $343,001 per year.

Further economic impacts resulting from the temporary and permanent removal of agricultural land will be assessed during the EIS as part of an Economic Impact Assessment for the Project.

### Critical Mass Thresholds

Due to the prevalence of the cattle industry in the wider region and the minor contribution the GAA plays in terms of total cattle sold at regional saleyards (<0.1%), there will be no impact to critical mass thresholds of agricultural enterprises needed to attract and maintain investment in agricultural service industries and infrastructure.

### Employment

The agricultural enterprises of the GAA currently support approximately five full time equivalent workers. As such, and accounting for potential impacts on aforementioned support services, impacts on local and regional employment are expected to be negligible and outweighed by the employment benefits of the Project.

### Visual Amenity

Visual amenity is an important attribute of rural landscapes and may, in certain circumstances, play an important role for enterprises that attract visitors because of the rural ambience and lifestyle experience. The GAA is located directly adjacent to a highly modified landscape associated with existing mining operations and proximal to large scale energy generation infrastructure.

A specialist assessment on the visual impacts of the Project is currently being undertaken as part of the EIS process. The outcomes of this visual impact assessment will be further considered as part of a Land Use Conflict Risk Assessment that is being prepared for the Project in accordance with Secretary's Environmental Assessment Requirements.

### Tourism

The assessment has identified tourism related enterprises within the local area which may be reliant on the agricultural resources or visual amenity of the GAA. These consist of a small scale function centre and a proposed eco-cabins accommodation lodge on nearby properties. On balance, the Project is anticipated to have limited impact on agriculture-related tourism or the viability of the tourism industry in the broader region.

As outlined above, a specialist visual impact assessment and Land Use Conflict Risk Assessment are being undertaken as part of the EIS process. The outcomes of these assessments will be used to further ascertain the potential for impacts to tourism related enterprises.

## 5.4 WATER IMPACTS

### Potential Risks

In order to fully consider the potential for impacts to BSAL and associated agricultural production, it is essential to understand the nature of, and potential to impact, highly productive groundwater within the meaning of the NSW Aquifer Interference Policy.

Detailed groundwater modelling and impact assessments are currently being prepared to inform the Project EIS and ascertain the potential incremental and cumulative groundwater impacts associated with the existing Cadia operations and CCOP. Specific areas of focus in this assessment include groundwater quality, drawdown, groundwater dependent ecosystems and impacts on water availability (including to surface water base flows).

The Project includes the following components which have the potential to impact on groundwater and surface water resources:

- Extension of underground mining in Cadia East mining area and Ridgeway mining area
- Change of TSF construction methods and extension of tailing storage footprint associated with STSFx
- Water management infrastructure associated with construction and operation of the STSFx
- Diversion of a short section of Cadiangullong Creek
- Realignment of Panuara Road
- Construction and operation of the South Water Storage, a clean water storage on Cadiangullong Creek
- Extended life of operations included continued water extraction from Cadiangullong Creek, Flyers Creek and Belubula River

Conceptual impact pathways associated with these Project changes are outlined below:

*Extension of underground mining operations:*

The ongoing underground mining as part of the CCOP will continue to intercept groundwater which has the potential to extend depressurisation (and associated drawdown) impacts beyond those of the currently approved operations. The extended extraction area and associated subsidence impacts will also impact groundwater recovery timeframes following the cessation of mining.

The key areas of focus regarding potential drawdown impacts are the springs in the Upper Flyers Creek catchment associated with the Cobblers Creek Limestone Formation (noting that faulting associated with the Warrengengong Fault precludes a direct connection between the fracture zone and the Cobblers Creek Limestone associated with the Flyers Creek Springs) and reduced baseflows in Flyers Creek and Cadiangullong Creek.

Changes to surface water flows will also be impacted by subsidence related impacts and this may include increased interception of surface flows into underground workings via subsidence related fracturing and the extended crater area.

*STSFx Construction and operation:*

The Project includes the construction of the STSFx which extends the STSF tailings dam footprint to the east and south. The STSFx is proposed to be constructed using a hydrocyclone sands construction method which separates the sands from the tailings stream and uses the sand for construction of the tailings dam wall. The finer tailings material is them emplaced within the tailings dam footprint. The extended footprint of the STSFx (i.e. the area beyond the current footprint of the STSF) will be engineered to prevent groundwater infiltration associated with the extended area of tailings deposition.

A series of engineered collector/finger drains will be constructed under the STSFx wall footprint to intercept water associated with the wall construction processes, rainfall and TSF seepage through the sand wall. These drains will then report to engineered perimeter drains located downslope of the TSF wall which will transport intercepted seepage and runoff from the wall to reclaim ponds where the water will be stored and/or pumped for operational purposes (eg processing and dust suppression within the tailings dams).

The reclaim ponds will be fully engineered, with a clay core also installed within the wall of the reclaim pond dam to provide a further barrier to seepage of water. Water associated with the deposition and consolidation of fine tailings in the STSFx will drain away from the wall of the TSF towards decant point in the centre of the STSFx where it will be removed for use in processing and dust suppression activities. These design features are intended to ensure that water associated with tailings deposition and infiltration through tailings and the tailings walls do not impact on groundwater quality and downstream surface flows.

The engineered foundations below the STSFx footprint and water management infrastructure, the low hydraulic conductivity of the fine tailings material deposited in the TSFs (existing and proposed) and the presence of drains below the TSF wall means mounding below the TSF is considered unlikely. Instead, these features are considered likely to reduce recharge of groundwater systems below these areas and this is likely to result in a reduced groundwater head in these areas relative to pre-mining (and existing) conditions. This may result in a reduced groundwater gradient towards groundwater discharges zones in surrounding creek lines with consequent reductions in baseflow. As the STSFx footprint occupies only a very small area of the Flyers Creek catchment and groundwater flow directions are generally towards the south of the drainage lines associated with the catchments impacted, these changes are not anticipated to have a significant (or even observable) impact on surface water flow within Flyers Creek.

*Water management infrastructure associated with construction and operation of the STSFx:*

As noted above the collector drains and perimeter drains and reclaim ponds located downslope of the STSF walls will be engineered to limit potential interactions with underlying groundwater systems. Potential shallow groundwater seepage impacts and potential for contaminated water movement into the groundwater system are considered unlikely due to the engineered foundations.

The STSFx wall extension into Rodds Creek below the existing wall and the construction of the proposed reclaim pond and perimeter drains will also limit any potential movement of potentially contaminated groundwater associated with existing operations.

The drains and reclaim ponds, together with the STSFx footprint will alter surface flows in the Rodds Creek and Cadiangullong Creek catchments. Dam and spill way designs will include specific consideration of potential flooding impacts and clean water diversions will be implemented where practicable.

*Realignment of Cadiangullong Creek:*

The realignment of a small section of Cadiangullong Creek is required to facilitate construction and operation of a reclaim pond associated with the STSFx. The design of the realignment will have specific regard to changes in fall and include natural design elements similar to nearby sections of Cadiangullong Creek with similar fall and geomorphic characteristics. Monitoring indicates that the regional water table is below the base of the existing creek in this area and no material impacts on highly productive groundwater systems are anticipated from the diversion works or changed flow condition.

The diversion design is not anticipated to have any impacts on agricultural production or water supply.

*Realignment of Panarua Road:*

The Project necessitates the realignment of Panuara Road around the STSFx and associated drainage infrastructure. The detailed road design will include measures to mitigate impacts on surface flows.

*Construction and operation of the South Water Storage:*

The South Water Storage will flood a section of Cadiangullong Creek currently used for grazing. This area of direct impact by the dam includes steeply sloping land and does not contain any areas of BSAL.

The water detained within the dam will increase groundwater heads around the inundated area. Increased recharge and seepage through the dam wall, together with the increased groundwater levels are expected to result in increased baseflows in Cadiangullong Creek downstream of the dam wall.

Flows in Cadiangullong Creek will be maintained through release measures designed to maintain appropriate flow conditions. These discharge arrangements will operate on a similar arrangement to that currently applying to Cadiangullong Dam upstream.

The Dam and spillway design will have specific regard to the management of potential scour and erosion risks in the downstream catchment.

*Extended life of operations:*

The extended life of operations will see the continuation of existing approved impacts for the life of the Project.

Existing licences for extraction from the Belubula River, Cadiangullong Creek and Flyers Creek will be maintained, as will groundwater licences associated with direct and indirect extraction of groundwater.

### Assessment Approach

Groundwater modelling and a detailed impact assessment is being undertaken as part of the EIS. These assessments will be prepared in consideration of the *Australian Groundwater Modelling Guidelines* (Commonwealth of Australia, 2012), *NSW Aquifer Interference Policy* (DPI Water 2012), relevant NSW Water Sharing Plans, *Australian and New Zealand guidelines for fresh and marine water quality* (Australian New Zealand Guidelines 2018), *Minimum Groundwater Modelling Requirements for SSD/SSI Projects* (DPE, 2022a), and Guidelines for Groundwater Documentation for SSD/SSI Projects (DPE, 2022b). At a minimum, these assessments will include:

- Details of a field investigation program to define the extent and hydraulic properties and groundwater storage parameters across the broader Project Area (and GAA).
- A conceptual hydrogeological model, informed by baseline datasets, that describes the groundwater regime and identifies areas of potential impact resulting from the CCOP.
- A numerical groundwater model to assess:
  - Groundwater inflow to the mining area.
  - The area of influence of dewatering and the level and rate of drawdown at specific locations.
  - The potential for any impact on alluvial aquifers and surface water, including impacts associated with the operation of the South Water Storage.
  - Areas of potential risk where groundwater impact mitigation/control measures may be necessary.
  - Potential for cumulative impacts.
  - Identification and assessment of potential post-mining groundwater impacts.

Conceptual and numerical modelling will include consideration of groundwater flow as well as a potential contaminant movement. The extended period of groundwater and surface water monitoring data associated with existing operations will be used to inform the development of conceptual and numerical models and calibrate the numerical models. Groundwater model calibrations and predictions will be informed by uncertainty analysis undertaken having regard to guidance contained in the IESC *Information Guidelines Explanatory Note: Uncertainty analysis for groundwater modelling* (IESC, 2023).

The Groundwater Impact Assessment will quantify and assess the CCOP against relevant policy and guideline requirements and the requirements of the SEARs and will be independently peer reviewed. In this regard, it can be expected that in addition to meeting standard requirements for groundwater assessment, the EIS will address a range of interrelated water resource considerations stipulated in the SEARS, including requirements for:

- Comprehensive baseline data of stream flow and stream quality data;
- An assessment of the likely impacts of the development on the quantity and quality of the region's surface and groundwater resources (including physio-chemical properties of all potential water pollutants), considering the NSW ambient Water Quality and River Flow Objectives for the receiving waters and having regard to the *NSW Aquifer Interference Policy*;
- An assessment of the likely impacts of the development on geomorphic condition, erosion and drainage patterns (in particular the Cadiangullong Creek diversion and water storage) and the aquatic environment;
- An assessment of long-term leakage from the tailings dams on the downstream environment, including post-closure;
- An assessment of the hydrological characteristics of the site and downstream;
- An assessment of the likely impacts of the development on the quantity and quality of the local aquifers, watercourses (including Rodds Creek, Cadiangullong Creek, Swallow Creek, Flyers Creek, Burnt Yards Creek and the Belubula River), riparian land, water-related infrastructure, basic landholder rights and other water users, including specific human and livestock uses (e.g. drinking water);
- A detailed and consolidated site water balance, including a description of site water demands (including for dust management and suppression), water disposal methods (including the location, volume and frequency of any water discharges and management of discharge water quality), water supply and transfer infrastructure and water storage structures, including an assessment of the reliability of water supply, including consideration of a range of climatic conditions and climate change projections;
- Identification of an adequate and secure authorised water supply for the life of the development and any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*, including a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant water sharing plan or water source embargo, or any alternative mechanisms agreed following consultation with relevant NSW government agencies/ statutory authorities;
- A detailed description of the proposed water management system (including sewage), water diversions, water monitoring program and measures to mitigate surface and groundwater impacts;
- A description of construction erosion and sediment controls, how the impacts of the development on areas of erosion, salinity and/or acid-sulphate risk, steep gradient land or erodible soils types would be managed and any contingency requirements to address residual impacts, including any trigger values or criteria;
- An assessment of the potential flooding impacts and risks of the development;
- An assessment of impacts during construction and operation of the South Water Storage on river hydrology, hydraulics (lotic versus lentic), geomorphology, and water quality in the catchment; and
- A tailings risk assessment, detailing life of mine tailings management strategy and risk assessment based on the tailings composition and identification, quantification and classification of the potential waste streams likely to be generated during construction and operation, including and not limited to:
    - Details on the tailings disposal strategy for all the TSFs, including deposition schedules, heights, capacity, footprints, types and size fraction of tailings material;
    - Leaching into groundwater and discharges into nearby drainage lines (e.g. Cadiangullong, Rodds and Flyers Creeks and the Belubula River) and downstream; and
    - Non-production wastes, reagent materials and potentially acid forming (PAF) waste, acid mine drainage and embankment construction materials (e.g. hydrocycloned sand).

It is expected that this comprehensive assessment will be able to identify any measures required for the management of the groundwater resource and groundwater flow for the CCOP, and be used to inform licensing requirements. The outcomes of the assessment will also be used to inform consideration of the potential impacts to high productivity groundwater resources available to support agricultural activities on areas of BSAL in the GAA, including those areas that will be returned to agricultural productivity post-mining.

## 5.5 FURTHER RISKS

### Pest Species

Pest species could be inadvertently brought into the GAA with imported materials, machinery, or allowed to invade naturally through removal of native vegetation. The presence of weed species has the potential to be a major hindrance to rehabilitation, regeneration activities and agricultural endeavours. Cadia already implements an extensive weed management program in the Project locality and will continue to implement weed management as part of the CCOP. Management strategies will be updated to incorporate the GAA and implemented to ensure that the Project does not exacerbate the proliferation of pest species.

Weeds in general will be managed across the site through a series of control measures, including:

- Prior to re-spreading stockpiled topsoil onto the disturbance area, an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and / or “scalping” of weed species prior to topsoil spreading.
- Rehabilitation monitoring programs and routine inspections will be undertaken to identify potential weed infestations; and
- There will be an ongoing effort to identify and eliminate (spray) existing weed populations on-site over the life of the Project.

The spread of declared noxious weeds will be prevented by using the measures above. The monitoring and control of weed populations using herbicides within the site will significantly reduce weed infestations. Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Any use of herbicides will be carried out in accordance with regulatory requirements. Records will be maintained of weed infestations and control programs will be implemented according to best management practice for the weed species concerned.

Programs to control feral animals will include the determination of appropriate control practices, consultation with appropriate authorities, obtaining appropriate approvals, implementing control practices and undertaking follow-up monitoring and control as required. If a substantial increase in the numbers of known feral fauna species, or the occurrence of a previously unrecorded feral fauna species, is discovered, advice will be sought from a suitably qualified and experienced person on the management and control options for that species and appropriate measures for mitigating any impacts caused by its management on native species.

Feral animals may include goats, foxes, cats, rabbits, pigs and dogs and will be controlled in accordance with Livestock Health and Pest Authority procedures.

### Biosecurity

Biosecurity is defined in the NSW Biosecurity and Food Safety Strategy 2022 - 2030 (DPI, 2022) as ‘the protection of the economy, environment and community from pests, diseases and weeds’. It includes measures to prevent new pests, diseases and weeds from entering our country, becoming established and spreading. On a locality level, appropriate weed management will reduce biosecurity risks. Any import of equipment or machinery from overseas will follow the standard procurement safeguards and quarantine procedures as per Australian requirements. Given the processes above, it is considered that the proposed Project will not have any potential impact on the biosecurity of agricultural resources and enterprises within the region.

### Air Quality and Dust

A specialist assessment on the potential air quality and dust impacts of the Project is currently being undertaken as part of the EIS process. The outcomes of this assessment and potential implications (if any) for agricultural operations in the vicinity of the GAA will be further considered as part of a Land Use Conflict Risk Assessment that is being prepared for the Project in accordance with Secretary's Environmental Assessment Requirements.

### Subsidence

While studies are still underway to ascertain the likely subsidence impacts of the CCOP, the subsidence zone of influence for the Cadia East mine is expected to extend a small way into the northeastern area of the GAA. While no direct ground disturbance impacts are expected to occur in this area, there are potential indirect impact on water resources and some ground disturbance impacts associated with the remediation of localised subsidence impacts (e.g. compression humps and tensile cracking) in this area. At present, impacts to existing forestry practices in this area are expected to be negligible. Further studies are being prepared as part of the EIS process to assess the potential impacts of subsidence on overlying and surrounding lands.

### Blast and Noise

Generally, agriculture is only impacted by noise when constantly high noise levels or sudden loud noise leads to a decrease in animal production through increased livestock stress.

The Project's construction and operation noise emissions is expected to be below the highly affected criterion of 75 dB at all sensitive receptors. In addition, given the significant distances from any potential blasting area to private grazing land (i.e. outside the 500 m flyrock exclusion zone) there is no anticipated risk of injury to livestock from flyrock. Blasting associated with the Project will be undertaken in accordance with strict blast management protocols and maintain safe distances from private land. On this basis, noise and blasting is considered highly unlikely to impact agricultural production within the area.

A specialist assessment on the blast and noise impacts of the Project is being undertaken as part of the EIS process.

### Traffic

Agricultural enterprises can be impacted by increased traffic movements through an increase in noise and dust, and also through the cumulative impact of road transport being utilised by mining operations, leaving fewer transport options for agricultural enterprises. As outlined above, the Project is not expected to result in material increases in traffic or impact access to or use of the existing road or railway networks that connect the agricultural industry to markets, services and suppliers.

A specialist assessment on the traffic impacts of the Project will be undertaken as part of the EIS process.

# 6 MITIGATION MEASURES

## 6.1 OVERVIEW

As outlined above, Cadia has already made a number of changes to the Project to avoid impacts to agricultural land and verified BSAL and minimise the amount of land within the GAA that would be removed from agricultural productivity during the operational life of the mine. Work is continuing to identify further opportunities to reduce or mitigate impacts on agricultural resources, and increase the productivity and potential future land use outcomes available in the post-mining landform.

The EIS will include a number of measures to prevent, minimise and manage adverse impacts on agricultural resources. This incorporates procedural mitigation measures along with a land management process that ensures CCOP minimises impact on agricultural resources during and following operations. CCOP is not expected to negatively impact any existing agricultural enterprise outside of the GAA and as such mitigation measures will be focused on the areas within the Project boundary and are not proposed for enterprises outside of the GAA.

The CCOP EIS will outline how all activities associated with the Project will be conducted in consideration of Cadia's obligations and environmental management measures that will be incorporated into subsequent site specific environmental management plans.

## 6.2 ANALYSIS OF ALTERNATIVES

The existing Cadia East and Ridgeway underground areas where there is a proposed continuation of mining and expansion of the disturbance footprint are known and fixed. As such there is no practical alternative to the Cadia East Mine design to allow the economic recovery of the States' mineral resource.

The alternative of not proceeding with components of the CCOP has also been considered, however, based on the significant benefits associated with ongoing operations at Cadia, it is considered that the overall benefits of the project warrant proceeding with the CCOP.

In order to progress with an optimal design for the CCOP, Cadia completed a detailed site selection and technology assessment to inform the optimal location for tailings emplacement associated with the continued operational life of the mine. The Site and Technology Selection report summarises the alternatives that were considered for the tailings storage facility, captures the criteria used for assessing these alternatives and provides a review of the technology and design associated with the construction of the proposed extension to the tailings storage facility (see **Appendix 5**).

Details regarding the various design options and other alternatives considered during the iterative project design phase will be discussed in detail in the EIS.

## 6.3 SOIL STRIPPING AND REUSE

Soil that is proposed to be disturbed by the Project would be stripped and either directly reused for progressive rehabilitation or stored for re-use in future rehabilitation efforts, in order to mitigate the Project's long term effects on the LSC of the post-mining landform.

Laboratory soil analytical results were used in conjunction with the field assessment to determine the suitability of soil resources for recovery and re-use in rehabilitation, following the life of the mine, which will be further discussed in a Soils and Land Impact Assessment prepared for the Project.

The Project will employ the following soil handling techniques, or similar, in order to establish suitable soil profiles to return land to the target post-Project LSC classes as presented in Section 5.1.

### Stripping Strategy

In areas subject to significant landform disturbance, a soil stripping operation should be undertaken to a nominated depth of at least 0.3m. In areas with suitable soil profiles, stripping may occur as deep as 1 m or until a point at which parent material is reached to maximise the recovery of soil resources prior to disturbance. This material would be appropriately stockpiled, managed and re-spread on the final landform and/or used to bolster rehabilitation efforts, prioristing areas subject to minor impacts which will target their original LSC.

For rehabilitation efforts being undertaken in the broader site at the time of stripping, stripped soils may be directly placed onto rehabilitation lands outside the GAA. This reduces the need for double handling and stockpiling of soil material. If soil resources within the GAA are used for rehabilitation elsewhere on the site, Cadia will source supplementary soil materials from elsewhere onsite with suitable physical and chemical characteristics for use in rehabilitation within the GAA in order to meet LSC class rehabilitation targets.

The following soil handling techniques are recommended to prevent excessive soil deterioration and dispersion.

- Strip soil material to maximum excavation depths only.
- Soil should ideally be stripped in a slightly moist condition. Material should not be stripped in either an excessively dry or wet condition.
- An inventory of available soil would be maintained to ensure adequate materials are available for planned rehabilitation activities when the time comes.

### Stockpile Management

Appropriate stockpile management will be an important element for the Project, with Cadia developing a detailed plan for the management of soil resources. Where appropriate, proposed long term stockpiles in areas associated with the higher impact activities where large amounts of soil will be displaced would be stripped of topsoil. Then the excavated subsoil (if requiring disturbance) would be placed on the exposed subsoil of the stockpile area to create a low-profile landform of subsoil. A thin layer of topsoil material from the stripped areas would be placed as a 'cap' over the subsoil stockpiles to promote vegetation growth. Topsoil materials should otherwise be stockpiled separately to subsoils.

Where required, the following management measures would be implemented during the stockpiling/storage of soils for the Project in accordance with an updated Land and Biodiversity Management Plan for the site:

- As a general rule, maintain stockpile height to the minimum necessary to fit within the available local footprint. Clayey soils should be stored in lower stockpiles for shorter periods of time compared to coarser textured sandy soils.
- Stockpile topsoils and subsoils materials separately.
- The surface of soil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.
- Where necessary, a flow diversion bank or catch drain should be placed up-slope of a stockpile to direct surface water flows away. All stockpiles shall remain in a free-draining location to avoid long term soil saturation.
- Where necessary, silt fences or cleared vegetation should be installed around topsoil stockpiles or stripped areas as a form of erosion and sediment control. Mulch or wood chip from cleared vegetation can also be applied as a veneer over topsoil stockpiles to slow erosion, weed establishment and to maintain moisture content.
- Seed and fertilise stockpiles as soon as possible. An annual cover crop species that produce sterile florets or seeds may be sown. A rapid growing and healthy annual pasture sward will provide sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and

enhance the desirable micro-organism activity in the soil. Final rehabilitation target species should be established on stockpiles to build up a desirable species seed bank in the topsoil.

- Prior to re-spreading stockpiled topsoil onto the disturbance area, an assessment of weed infestation on stockpiles should be undertaken to determine if individual stockpiles require herbicide application and / or "scalping" of weed species prior to topsoil spreading.

#### Soil Respread and Seedbed Preparation

The following re-spreading and seedbank preparation techniques will be applied, where required to prevent excessive soil deterioration and dispersion.

- Topsoil spread to a depth that meets the criteria for final LSC class targets.
- Topsoil spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion. Thorough seedbed preparation may also be undertaken to ensure optimum establishment and growth of vegetation.
- All topsoiled areas lightly contour ripped (after topsoil spreading) to create a "key" between the soil and material below. Ripping would be undertaken on the contour, with the best results obtained by ripping when soil is moist and when undertaken immediately prior to sowing.
- The respread soil surface would be scarified prior to, or during seeding, to reduce run-off and increase infiltration. This can be undertaken by contour tilling with a fine-tyned plough or disc harrow.

### 6.4 MONITORING PROGRAMS

Monitoring programs are instituted to assess predicted verses actual impacts as the project progresses.

All current operations at Cadia are undertaken in accordance with approved Environmental Management Plans and Strategies. The management plans include detailed environmental monitoring programs. Cadia continually monitors environmental performance and legislative compliance of the existing operations.

Mining operations are managed through the existing Environmental Management System (EMS) to minimise impacts on the surrounding environment and community. The EMS provides for the monitoring and reporting of all key environmental aspects of the current operations.

Key management plans currently in effect that assist in managing impacts on agricultural land include:

- Rehabilitation and Mine Closure Strategy;
- Rehabilitation Management Plan;
- Air Quality and Greenhouse Gas Management Plan;
- Blast Management Plan;
- Noise Management Plan;
- Water Management Plan (including Water and Salt Balance, Erosion and Sediment Control Plan, Surface Water Management and Monitoring Plan, Groundwater Management and Monitoring Plan, Surface and Groundwater Response Plan); and
- Pollution Incident Response Management Plan.

These management plans will be reviewed and revised where necessary to incorporate the requirements associated with the Project prior to commencement. A key component of these updated plans will be the review and refinement of trigger levels and Trigger Response Action Plans to reflect the nature and location of activities proposed under CCOP. **Table 11** below provides a list of potential environmental monitoring programs and data collection outcomes that may be implemented for the CCOP. These programs build on the measures currently undertaken at site and will be expanded upon in the EIS for the project.

In addition, an Annual Review will be prepared for the Project. This document will summarise Project activities and performance in the areas of health, safety, environment and community and will be made publicly available.

Table 11: Proposed Monitoring Programs and Management Plans

| Parameter | Management Plan | Monitoring | Frequency |
|---|---|---|---|
| Meteorological Conditions | Air Quality Management Plan | - Rainfall<br>- Temperature<br>- Windspeed<br>- Wind direction<br>- Sigma Theta<br>- Solar radiation | Daily |
| Surface Water | Water Management Plan | - Run-off water quality<br>- Sediment dam water quality<br>- Surface water flows | Monthly |
| Groundwater | Water Management Plan | - Seepage/leachate<br>- Groundwater levels<br>- Water quality | Monthly |
| Air Quality | Air Quality Management Plan | - Predictive meteorological forecasting<br>- $PM_{10}$ and $PM_{2.5}$ monitoring<br>- Dust deposition<br>- Total Suspected Particulate (TSP)<br>- Regional reference site monitoring | Daily and Monthly |
| Blasting | Blast Management Plan | - Air blast overpressure (dB(Linear Peak))<br>- Vibration | As required |
| Noise | Noise Management Plan | - Predictive meteorological forecasting<br>- Real-time noise monitoring for day to day planning<br>- (Supplementary attended monitoring) | Daily<br><br>(As required) |
| Traffic | Traffic Management Plan | - Traffic volume surveys | Every 3 years |
| Waste | Waste Management Plan | - Quantities of waste<br>- Waste streams | As required |

## 6.5 REHABILITATION CAPACITY

The Newmont Corporation the parent company of CHPL is a leading global mining company with a world-class portfolio of assets and proven capability to undertake rehabilitation.

Progressive rehabilitation of disturbed lands is already underway at the existing Cadia operations, with demonstrated rehabilitation success in areas that have achieved their final landform and are no longer subject to active operational activities. As of November 2022, progressive rehabilitation has been undertaken on the following areas (Newcrest, 2022):

- North Waste Rock Dump: the waste rock dump has been completed, profiled, topsoil applied and revegetation activities undertaken.
- South Waste Rock Dump: progressive batters on the western and southern slopes of the waste rock dump have been profiled, topsoil applied and revegetation commenced.
- Cadiangullong Creek: The creek diversion has been completed and revegetation activities completed to re-instate riparian vegetation communities
- Cadia Extended / Creek: The void has been largely backfilled with waste rock mined from the Cadia Hill Pit with the area now used for various laydown and other activities. Rehabilitation has commenced over a portion of this area.

Cadia is currently reviewing several final land use options for the site. This assessment includes reviewing opportunities to improve upon existing landform, rehabilitation and land use outcomes across the Project site, and ensure that the new elements proposed as part of the CCOP are designed, managed, decommissioned and rehabilitated to the same high standards that apply to the existing operation.

Further to this, the Project SEARs include detailed requirements related to the long-term geotechnical stability of landforms on site and proposed closure, rehabilitation and final landform outcomes. Work is continuing on the detailed assessment of these matters, with the intention that the EIS will include details of how the proposed rehabilitation and final land use outcomes for the GAA will be managed to minimise long term impacts to agriculture.

## 6.6 AGRICULTURE MANAGEMENT

Cadia's Farm Manager will identify the available agriculture land within the GAA that is not subject to disturbance that can continue to be used for agriculture enterprises where practicable. The Farm Manager will also assist in developing and implementing the Farm Management Plan for rehabilitated areas. This will ensure the continued productivity of agricultural land not directly impacted by the Project.

The Farm Management Plan will include provisions for grazing, cultivation and/or cropping management, erosion and sediment controls, and pest species and weeds controls. This would be communicated and enforced over all active agricultural lands to ensure ongoing agricultural productivity.

Sustainable farming practices, such as reduced till farming and rotational grazing techniques, should be implemented in available areas outside of the direct impact area. Users of farming land will be required to commit to the implementation of sustainable practices while managing the land to its full potential.

# 7 GATEWAY CRITERIA SUMMARY

Based on the findings outlined in Sections 2 – 6, a summary assessment of the Gateway Criteria is provided below. This summary assessment has been developed based on the development of conservative scenarios that provide a reasonable worst-case consideration of potential agricultural impacts.

As outlined above, work is continuing to identify opportunities to incorporate further design refinements and measures to mitigate the impacts of the Project. These measures will be incorporated into the EIS and accompanying technical studies for the Project, including but not be limited to an Agricultural Impact Statement, Land Use Conflict Risk Assessment, Soils and Land Impact Assessment, Rehabilitation Strategy, Surface Water and Groundwater studies. It can therefore be reasonably expected that the potential impacts of the Project as proposed in the EIS would be a subset of those presented below.

*The following matters must be considered in relation to the potential of the proposed development to significantly reduce the agricultural productivity of any biophysical strategic agricultural land:*

*(i) any impacts on the land through surface area disturbance and subsidence;*

The Project is anticipated to have a direct surface impact on BSAL over an area of up to 378 ha, within the broader 1,243 ha of the GDA.

*(ii) any impacts on soil fertility, effective rooting depth or soil drainage;*

Due to the nature of the Project which will require major landform modification and soil stripping, the risk of impacts on soil resources within the GDA are certain. Permanent impacts to soil fertility, effective rooting depth and soil drainage are anticipated in areas occupied by the permeant features of the Project, including the proposed tailings and its embankments, the south water storage area and the realigned Panuara Road.

Temporary impacts are also anticipated throughout other areas within the GDA (including temporary soil stockpile areas, ancillary infrastructure areas and water management systems) however, these impacts may be mitigated by rehabilitation that includes good soil management techniques and the rehabilitation of productive agricultural land.

Long term impacts on soil fertility, effective rooting depth and soil drainage as a result of the Project will be assessed as part of the EIS process based on a soil management strategy that is tailored to the final land form and nominated final land use domains.

*(iii) increases in land surface micro relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH;*

Due to the nature of the Project which will require major landform modification, changes to the land surface micro-relief and slope are anticipated for the GDA. Post mining changes in land surface micro relief, soil salinity, rock outcrop, slope and surface rockiness and changes to soil pH will be assessed as part of the EIS process based on the final land form and rehabilitation strategy.

*(iv) any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy);*

The Project has the potential to change drawdown and groundwater take and recharge rates which may impact areas of mapped highly productive groundwater. As outlined in section 2.2, studies undertaken on site to date indicate that the area of the GAA does not align with the criteria for being a highly productive groundwater resource. Notwithstanding, specialist studies will be undertaken to identify and quantify the groundwater systems potentially impacted by the Project. These studies will be incorporated as part of the EIS process and be undertaken in accordance with the relevant considerations under the *Aquifer Interference Policy* and the comprehensive requirements for the assessment of Water Resources outlined in the Project SEARs (refer to Section 5.4).

*(v) any fragmentation of agricultural land uses; and*

Agriculture will cease over an area of up to 2,090 ha of land within the GAA currently used for agriculture for the duration of the Project. Following the life of the Project, an area of 1,688 ha would be returned to agriculture.

The reduction in land used for agriculture within the GAA would not result in the fragmentation or isolation of any existing agricultural land use, as it immediately adjoins Cadia existing operational areas. The land is entirely owned by CHPL, with the exception of a small portion to the north east which is owned by FCNSW. Regardless no additional fragmentation of agricultural use of land by a third party will occur as a result of CCOP.

*(vi) any reduction in the area of biophysical strategic agricultural land.*

The total area of verified/assumed BSAL anticipated to be directly disturbed by the Project is 378 ha. Opportunities for additional avoidance and reductions in impacts to BSAL will be further assessed as part of the EIS process.

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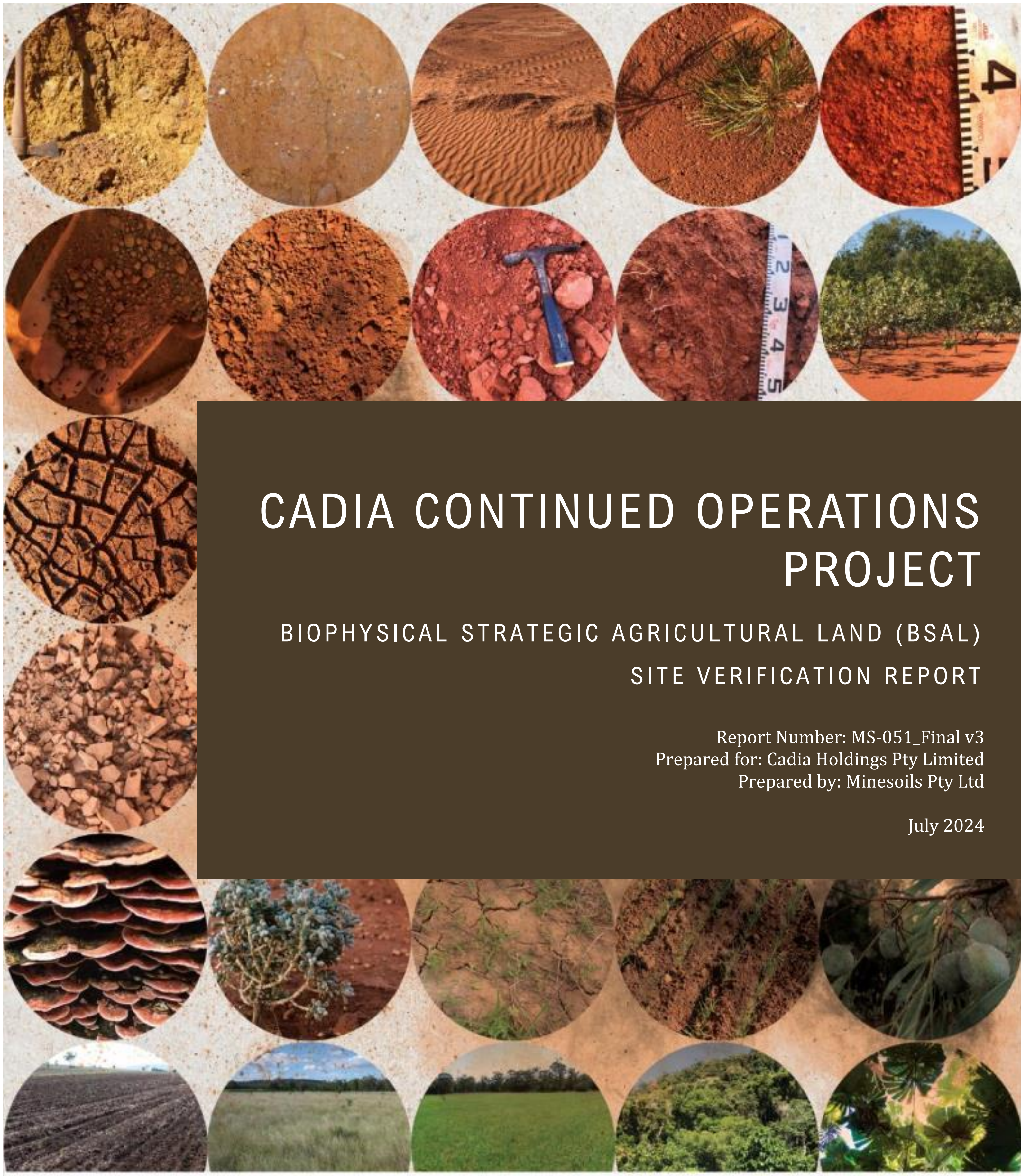
# Appendix 1
BSAL Site Verification Assessment



# CADIA CONTINUED OPERATIONS PROJECT

## BIOPHYSICAL STRATEGIC AGRICULTURAL LAND (BSAL) SITE VERIFICATION REPORT

Report Number: MS-051_Final v3
Prepared for: Cadia Holdings Pty Limited
Prepared by: Minesoils Pty Ltd

July 2024

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LAND & REHABILITATION SPECIALISTS

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# DOCUMENT CONTROL

| Reference | Date | Prepared by | Approved |
|---|---|---|---|
| **MS-051_Draft v1** | 11 October 2021 | Matt Hemingway, Clayton Richards | Clayton Richards |
| **MS-051_Draft v2** | 1 November 2021 | Matt Hemingway, Clayton Richards | Clayton Richards |
| **MS-051_Final** | 19 May 2022 | Matt Hemingway | Clayton Richards |
| **MS-051_Final v2** | 24 July 2024 | Matt Hemingway | Clayton Richards |
| **MS-051_Final v3** | 25 July 2024 | Matt Hemingway | Clayton Richards |

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# 1. INTRODUCTION

## 1.1 PROJECT BACKGROUND

Cadia Holdings Pty Limited (CHPL) owns and operates the Cadia mine, located approximately 20 kilometres (km) South-South-West of Orange in the Central Tablelands region of New South Wales (NSW) (refer **Figure 1**). The mining operation traverses two local government areas (LGAs), Blayney Shire Council and Cabonne Council.

Cadia mine is one of Australia's largest polymetallic mining operations, producing gold, copper and molybdenum products. The mine has been operating continuously since it opened in 1998. Cadia provides an important economic contribution to the region and NSW and is a major regional employer providing direct employment of approximately 1,800 full time equivalent jobs. With confirmed mineable resources extending well beyond the life of the current Project Approval (PA 06_0295) which provides for mining until 30 June 2031, Cadia has commenced planning for the continuation of mining operations.

This project is known as the Cadia Continued Operations Project (CCOP/the Project).The CCOP Project Area, Gateway Application Area and Gateway Disturbance Area is shown on **Figure 2**, and further defined in Section 1.4. The Project involves:

- Continuation of operations beyond 2031 (for a period of 25 years from the date of approval, nominally 2050) using existing and approved but not constructed infrastructure and supporting site services.
- Continuation of and extension to underground mining within the Cadia East and Ridgeway mining areas, and associated changes in subsidence surface expression.
- The continued emplacement of tailings from ore processing over the life of the continued operations within existing approved storage facilities and an extension of the existing Southern Tailings Storage Facility (SSTSF)
- Development of an additional water storage on Cadiangullong Creek (known as the Southern Water Storage) to provide improved security of water supply.
- Realignment of portions of Panuara Road and Cadia Road to maintain public safety and account for the above project features.
- Changes to site infrastructure and facilities to enable ongoing mining operations.

A new development consent will be sought for CCOP, which will replace the existing Project Approval (PA 06_0295) and provide for a new and modern consent to govern future operations at Cadia.

The *State Environmental 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 biophysical strategic agricultural land (BSAL).

CHPL is seeking a BSAL site assessment report that covers land associated with three proposed new project areas. As at the date of survey efforts these new project areas comprised the proposed additional south tailing storage facility (STSF) area at 1,443ha, the proposed south water storage dam area at 1,650ha, and the proposed extended subsidence/infrastructure area at 183ha (hereafter referred to as the proposed subsidence area). These components total an area of 3,276ha, herein referred to as the Project site (refer **Figure 2**).

## 1.2 PROJECT OBJECTIVES AND SCOPE

The objective of this report is to define and assess the Project site to verify BSAL or Non-BSAL. The assessment program was undertaken in accordance with the *Interim Protocol for Site Verification and Mapping of Biophysical*

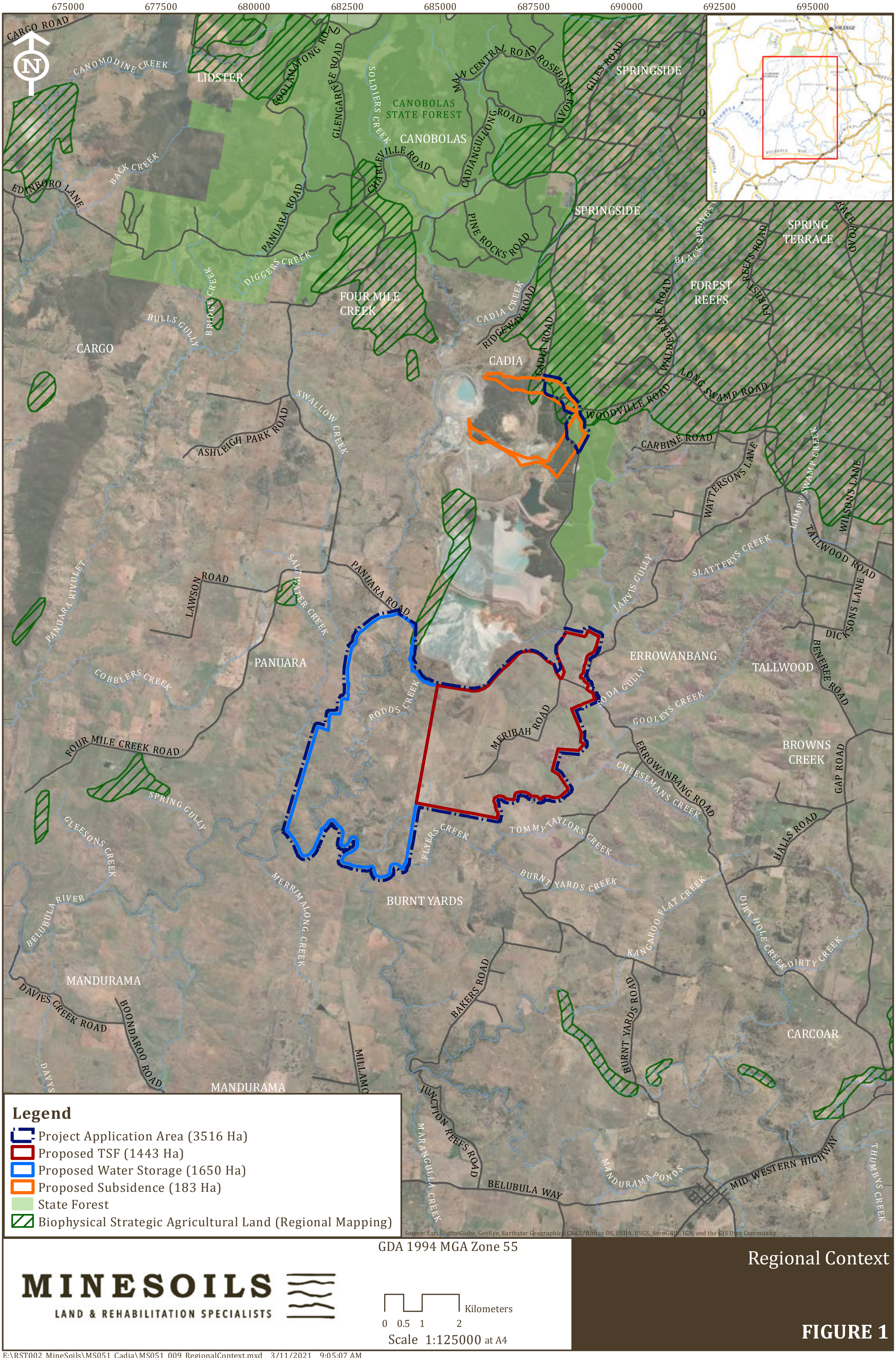
*Strategic Agricultural Land* (Office of Environment & Heritage (OEH) and Department of Primary Industries - Office of Agricultural Sustainability and Food Security (DPI-OAS&FS), 2013); hereafter referred to as the Interim Protocol.

The purpose of this report is to provide the results of the BSAL verification program conducted in accordance with the Interim Protocol.

In accordance with the Interim protocol, a 100m buffer zone was added to the Project site. Additionally, areas within existing mining leases were discounted from assessment. This results in an area of 3,516 ha and is referred to as the Project Application Area (PAA) (refer **Figure 2**).

This report provides the results of the soil survey and BSAL assessment undertaken in 2021, for the PAA as defined at the time of survey works.

This report does not include the results of subsequent soil assessment efforts as referenced in the Gateway Report, which were undertaken at a later date and targeted areas associated with the Cadia Modification 15 Project, and areas of >10% slope within the PAA.



CARGO ROAD
CANOMODINE CREEK
LIDSTER
COOLANATONG ROAD
GLENGARIFE ROAD
SOLDIERS CREEK
CANOBOLAS STATE FOREST
CANOBOLAS
MAIN CENTRAL ROAD
ROSEBANK ROAD
GILES ROAD
SPRINGSIDE
CADIANGULLONG ROAD
CHARLEVILLE ROAD
BACK CREEK
EDINBORO LANE
PANUARA ROAD
PINE ROCKS ROAD
SPRINGSIDE
SPRING TERRACE
RACE ROAD
DIGGERS CREEK
BRIDGE CREEK
BULLS GULLY
CARGO
FOUR MILE CREEK
CADIA CREEK
RIDGEWAY ROAD
CADIA ROAD
CADIA
FOREST REEFS
WALDEGRAVE ROAD
LONG SWAMP ROAD
WOODVILLE ROAD
SWALLOW CREEK
ASHLEIGH PARK ROAD
CARBINE ROAD
WATTERSONS LANE
LUMPY SWAMP CREEK
WILSONS LANE
TALLWOOD ROAD
SLATTERYS CREEK
JARVIS GULLY
PANUARA RIVULET
LAWSON ROAD
SALTWATER CREEK
PANUARA ROAD
ERROWANBANG
TALLWOOD
PANUARA
COBBLERS CREEK
RODDS CREEK
SODA GULLY
GOOLEYS CREEK
BENEREE ROAD
MERIBAH ROAD
FOUR MILE CREEK ROAD
ERROWANBANG ROAD
CHEESEMANS CREEK
BROWNS CREEK
GAP ROAD
SPRING GULLY
GLEESONS CREEK
FLYERS CREEK
TOMMY TAYLORS CREEK
HALLS ROAD
BURNT YARDS CREEK
BURNT YARDS
BELUBULA RIVER
MERRIMALONG CREEK
KANGAROO FLAT CREEK
DIRT HOLE CREEK
DIRTY CREEK
MANDURAMA
DAVIES CREEK ROAD
BOONDAROO ROAD
BAKERS ROAD
BURNT YARDS ROAD
CARCOAR
MANDURAMA
MILLAMO
JUNCTION REEFS ROAD
MARANGULLA CREEK
MANDURAMA PONDS
BELUBULA WAY
MID WESTERN HIGHWAY
THUMBYS CREEK
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6297500
6295000
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6287500
6285000
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6275000
Legend
Project Application Area (3516 Ha)
Proposed TSF (1443 Ha)
Proposed Water Storage (1650 Ha)
Proposed Subsidence (183 Ha)
State Forest
Biophysical Strategic Agricultural Land (Regional Mapping)
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
GDA 1994 MGA Zone 55
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LAND & REHABILITATION SPECIALISTS
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Scale 1:125000 at A4
Regional Context
FIGURE 1
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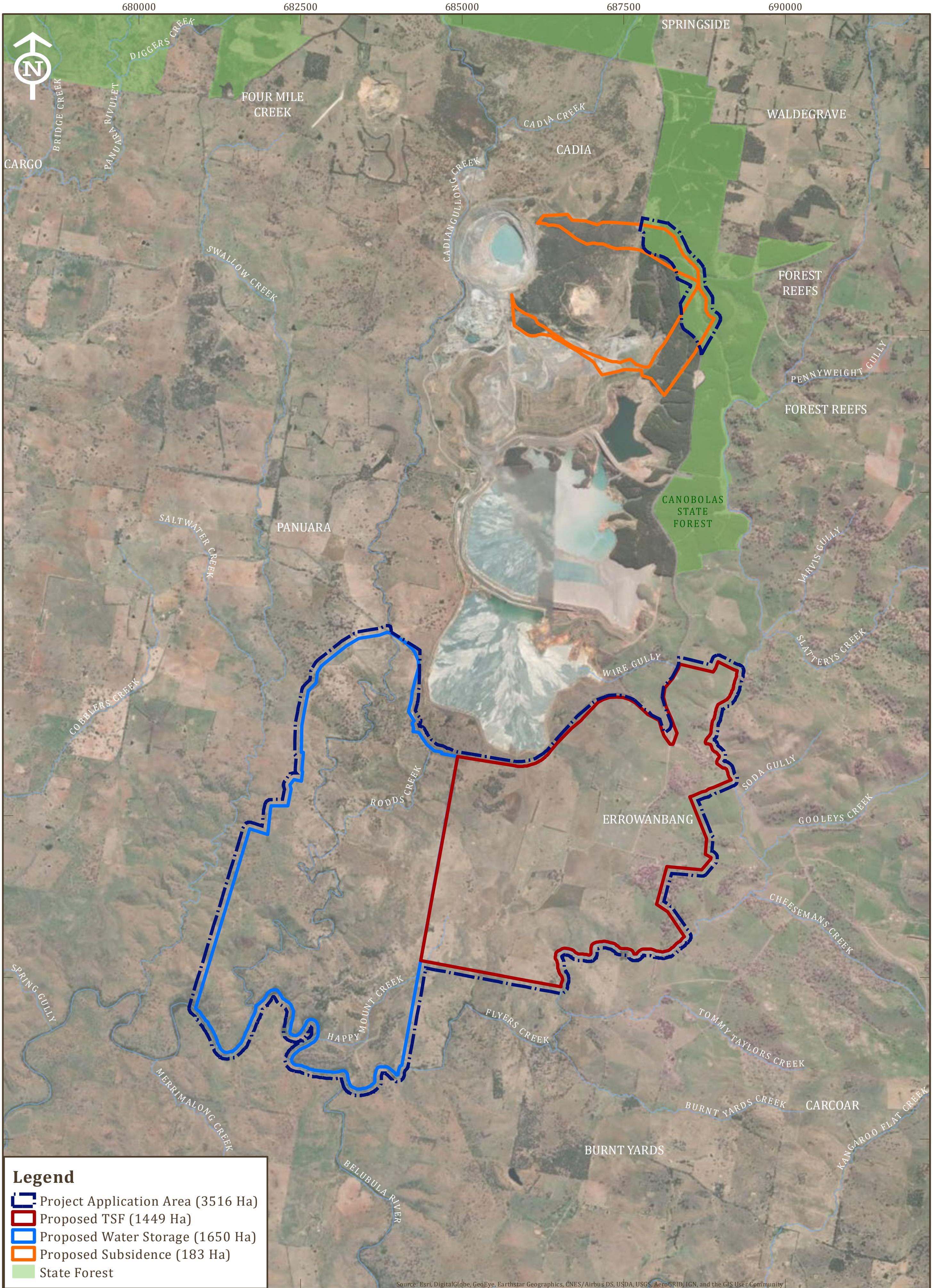


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GDA 1994 MGA Zone 55

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Project Site

FIGURE 2

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# 2 EXISTING ENVIRONMENT

## 2.1 GEOLOGY, HYDROLOGY AND TOPOGRAPHY

The PAA is located within the eastern Lachlan Fold Belt of NSW. The surficial geology of the region consists of andesite, tuff, limestone, siltstone, shale, feldspathic greywacke, chert and diorite, with coarse-grained intermediate rocks including syenite and monzonite, and in-situ and alluvial/colluvial materials derived from above parent rock (Source: DMR (2002) in Murphy & Lawrie (1989) (refer **Figure 3**).

The PAA is located in the Lachlan River Catchment. Rodds Creek and Cadiangullong Creek is located within the PAA and Flyers Creek is located immediately to the east of the PAA. These flow in a generally southerly direction into the Belubula River, which eventually flows into the Lachlan River to the west. Several un-named first and second order ephemeral streams occur within the PAA.

The landscape within the PAA ranges from gullies and creeks into low hills and smooth, undulating slopes to steep, rocky hillslopes and high plateaus, ranging from 450m AHD in the south west areas of the proposes water storage domain, up to 950m AHD in the northern areas of the proposed subsidence area domain (refer **Figure 4**). Slopes within the PAA range from 0 - 1% along the open drainage lines and flats up to steep, rocky upper slopes and crest rises. A significant portion (1,891 ha or 54%) of the PAA has a slope >10%. Increased slopes are primarily concentrated in the proposed water storage domain and proposed subsidence domain (refer **Figure 5**).

## 2.2 SOIL LANDSCAPES

Soil Landscape units for the PAA are mapped by the DPIE (2020) which compiled 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.

The PAA consists of the Panuara, Quarry, Razorback, Stoke-Burnt Yards Vittoria Blayney and Spring Hills Soil Landscapes (refer **Figure 6**), which are described below.

### Panuara Soil Landscape

Undulating low hills to rolling hills, 500 –965 m above sea level. Local relief is usually between 100–120 m, although it can be as low as 60 m for undulating slopes around Panuara. Slopes vary from 5–8% but are up to 15% in the steeper terrain. Slope lengths vary from 500–800 m. Drainage lines run west and are spaced from 500–800 m apart.

Vegetation has been extensively cleared; however, remnant native vegetation consists of dry sclerophyll forest dominated by mountain gum and manna gum.

Soil distribution consists of Red Podzolic Soils on mid to upper slopes, Yellow Solodic Soils occur in drainage lines. Yellow Podzolic Soils occur on lower slopes with Red Earths or Brown/Red Earths. Chocolate Soils or Euchrozems occur on remnants of basaltic mesas.

### Quarry Soil Landscape

Rolling low hills, 860–980 m in elevation with slope lengths ranging from 500–7 900 m, and slopes in the 12–15% range. Local relief is between 60–100 m.

Remnant native vegetation consists of Savannah woodland of yellow box with Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on slopes.

Soil distribution consists of pale Siliceous Sands on midslopes with Yellow Earths and Yellow Podzolic Soils on lower slopes. Shallow Sands and Red Podzolic Soils occur on upper slopes.

### Razorback Soil Landscape

Rolling to steep hills, from 660–1 000 m elevation with average slopes from 20–25%, with some ranging between 30–50%. Slope lengths vary from 400–700 m, with some up to 1 000 m. Local relief varies from 140–220m.

A white box-red stringybark community is found extensively on this landscape, mainly on the slopes and ridges, with yellow box and apple box in valleys and on midslopes. Tumbledown red gum grows on some stony ridges, in place of red stringybark.

Shallow Red Podzolic Soil/Krasnozem intergrades are common, with Red Earths also on slopes. Large outcrops of rocks are present. Shallow skeletal soils are dominant and are formed on most upper slopes

### Stoke-Burnt Yards Soil Landscape

Rolling low hills with elevations ranging from 640–840 m. Slopes vary from 8–15%, but near Carcoar they are up to 20%. Slope lengths range from 400–900 m, with most local relief from 40–80 m, but up to 100 m. Drainage lines are from 300–900 m apart, converging into the Belubula River.

Vegetation has been extensively cleared, however remnant native vegetation consists of yellow box occurring in valleys, while brittle gum and white box grow on midslopes in association with red box and broad-leaved peppermint. Red stringybark occurs on higher slopes.

Soil distribution consists of Krasnozems, Euchrozems and Red Clays. Yellow Soloths occur in drainage lines on lower slopes.

### Vittoria Blayney Soil Landscape

Undulating to rolling hills with 800–1050 m elevation, and local relief from 30–80 m but most to 50–60 m. Slopes are from 6–10%, with lengths averaging 600 m but ranging from 200–1500 m. Fixed drainage channels are spaced from 800–1000 m apart. The catchment boundary between the Macquarie and Lachlan River systems bisects this landscape. Upland drainage depressions have slopes from 4–5%, but in lower areas slopes are less than 2%. Broad drainage depressions (500 m wide) have plains with 1–2% slopes

Remnant native vegetation consists of savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on lower slopes

Soil distribution consists of Red Earths on well-drained crests and sideslopes, with Yellow Earths on moderately to imperfectly drained footslopes. Yellow Soloths/Yellow Podzolic Soil intergrades are found in imperfectly to poorly drained drainage depressions. Other soils include red and yellow structured earths midslope, with shallow sands and loams on crests and upper slopes.

### Spring Hills

Gently undulating to undulating rises with broad flats. Elevation is between 900–980 m. Slopes are from 2–5% and slope lengths from 500–700 m, with local relief normally to 10 m, but up to 30 m. Drainage depressions form broad flats to 1 000 m wide, with slopes <1% and often <0.5%. Drainage channels are fixed and spaced 600–800 m apart.

Remnant native vegetation includes savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint are on lower areas.

Krasnozems are the dominant soils. Yellow Podzolic Soils occur on the lower slopes with Yellow Solodic Soils in drainage lines.

### Towac Soil Landscape

Undulating hills to rolling low hills, from 980–1,080 m in elevation. Local relief varies from 40–60 m, with some to 100 m. Slopes are between 6–10% but can be up to 20%. Slopes in drainage depressions range from 8% on higher areas to 1–2% in the lower lands. Drainage lines are fixed and moderately spaced, flowing north to Molong and Heifer Station Creeks.

Remnant native vegetation consists of savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on lower areas.

Krasnozems occur on the upper to midslopes and are dominant. Red Podzolic/Krasnozem intergrades are found on upper slopes, with Yellow Podzolic/Solodic Soils in drainage depressions.

## 2.3 SOIL TYPES

Australian Soil Classification (ASC) mapping indicates the PAA is primarily dominated by Kurosols, with a sporadic occurrence of Ferrosols throughout, an area of Dermosols in the water storage domain, and an extensive Kandosol unit in the proposed SSTSF domain. A limited occurrence of Tenosols are also found within the proposed SSTSF domain (Refer to **Figure 7**).

## 2.4 INHERENT FERTILITY

Inherent fertility is based on the physical and chemical features of soils in their natural, undegraded condition and correlates to ASC mapping. Regional soil inherent fertility has been mapped for the area and indicates the Study Area contains soils with 'Low', 'Moderately Low', 'Moderate' and 'Moderately High' inherent fertility (Refer to **Figure 8**).

Soils with 'Low' fertility, due to their poor physical and/or chemical status, only support limited plant growth. Soils with 'Moderately Low' fertility can generally only support plants suited to grazing; large inputs of fertiliser are required to make the soil suitable for arable purposes. Soils with 'Moderate' fertility usually require fertilisers and/or have some physical restrictions for arable use. Soils with 'Moderately High' fertility have a high level of fertility in their virgin state which is significantly reduced after a few years of cultivation (Murphy et al 2007).

## 2.5 LAND AND SOIL CAPABILITY

Land and Soil Capability (LSC) Mapping 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. Regional Land and Soil Capability (LSC) Mapping indicates the PAA contains Class 3, Class 4 and Class 7 land (refer to **Figure 9**).

**Class 3**

This classification indicates land that 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.

Class 3 lands have been mapped in a very small area in the water storage domain and more extensively in the proposed subsidence domain, comprising 51 ha or 1% of the PAA.

**Class 4**

This classification indicates moderate capability land that 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.

Class 4 lands are the most spatially extensive of the land classes and have been mapped on 3,200 ha or 91% of the PAA.

**Class 7**

This classification indicates very low capability land that 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.

Class 7 land occurs within the proposed water storage domain and comprise 265 ha or 8% of the PAA.

## 2.6 MAPPED BSAL

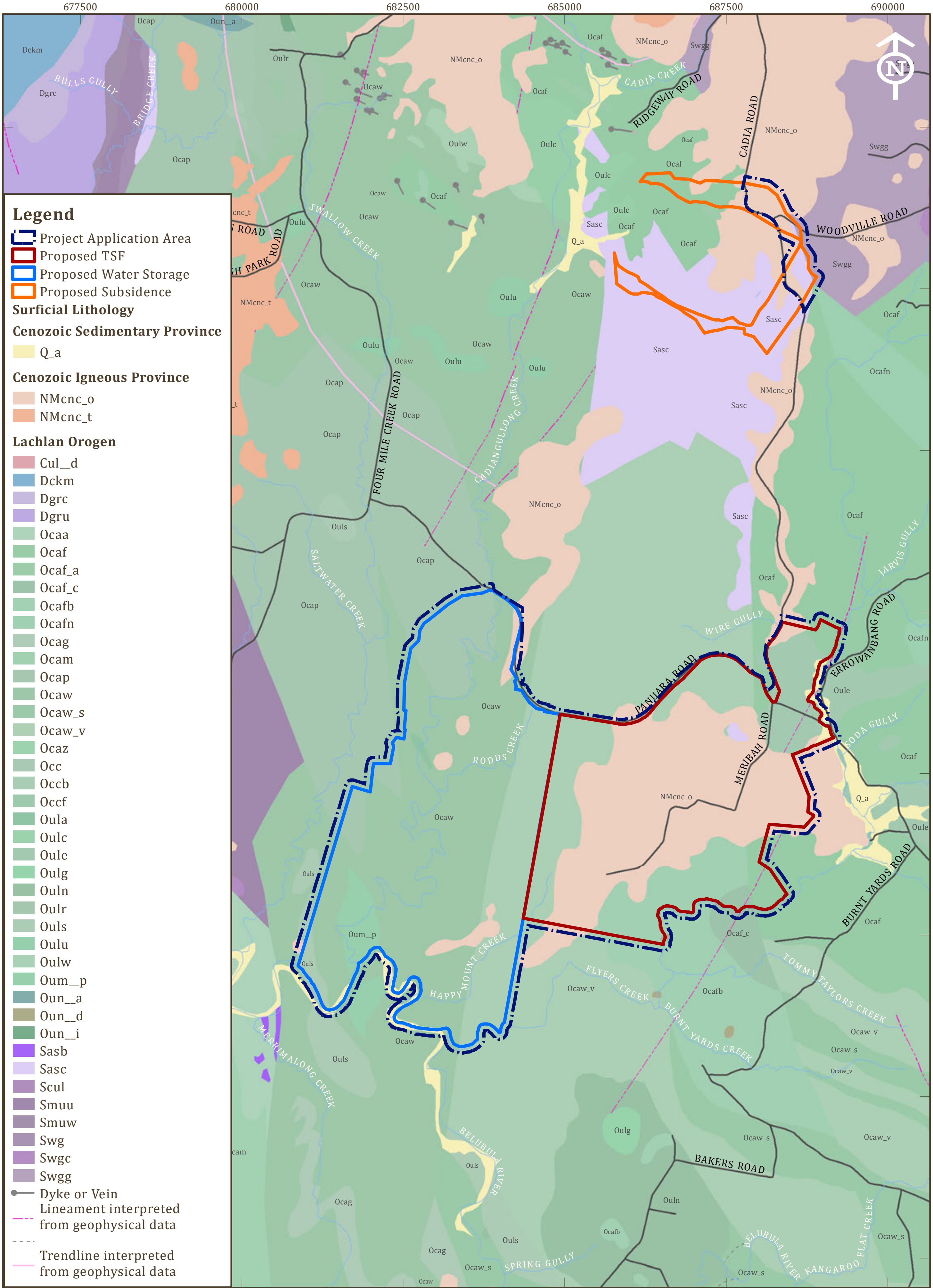
There are two separate areas of regionally mapped BSAL within the PAA (refer to **Figure 1**). Approximately 6 ha occurs in the northern most section of the proposed water storage domain, and approximately 25 ha occurs in the north east portion of the proposed subsidence area. Additionally, regionally mapped BSAL occurs sporadically throughout the Project locality, with significant extents of mapping located to the north and north east of the PAA between Orange and the Cadia.

## 2.7 LAND USE

The dominant land uses in the area include mining and agricultural activities in the form of cultivation and grazing on improved/native pastures. An extensive portion of the region to the east and north of the Cadia has designation as State Forest.

The PAA that comprises the proposed STSF and the proposed water storage areas is used for agricultural production purposes, primarily grazing and occasional cropping. As a result, the majority of the PAA is characterised by previously disturbed and largely cleared agricultural land. Some sparse patches of remnant woodland vegetation are located on low hills, with scattered paddock trees occurring across the land.

A section of the proposed subsidence domain of the PAA lies within the Canobolas State Forest which is dominated by pine plantation, with the remaining area remnant native bushland or previously disturbed by mining activity.

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Kilometers 0 0.5 1 2

Scale 1:75000 at A4

Surficial Geology

FIGURE 3

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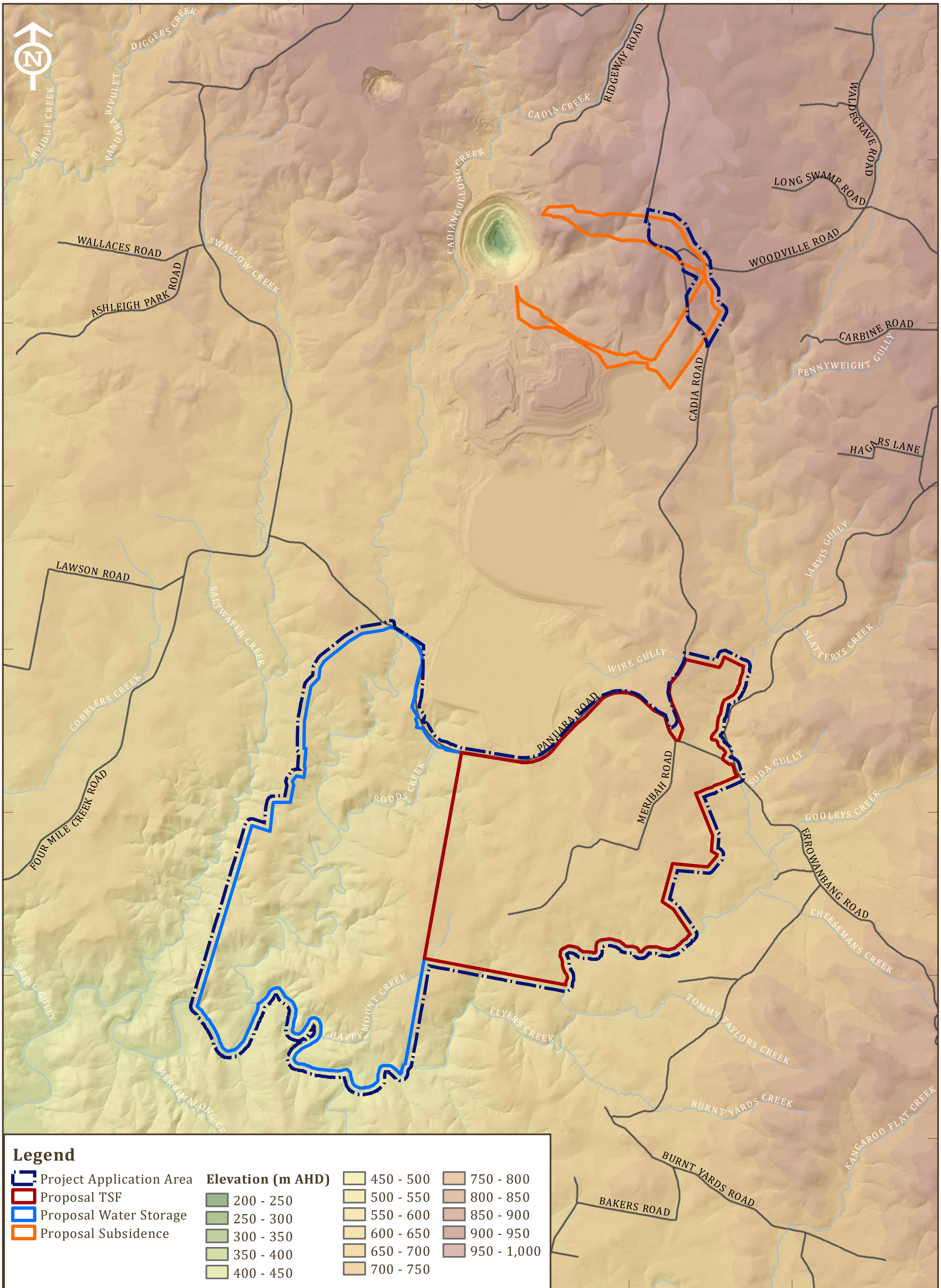


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0 0.5 1 2 Kilometers

Scale 1:75000 at A4

Topography

FIGURE 4

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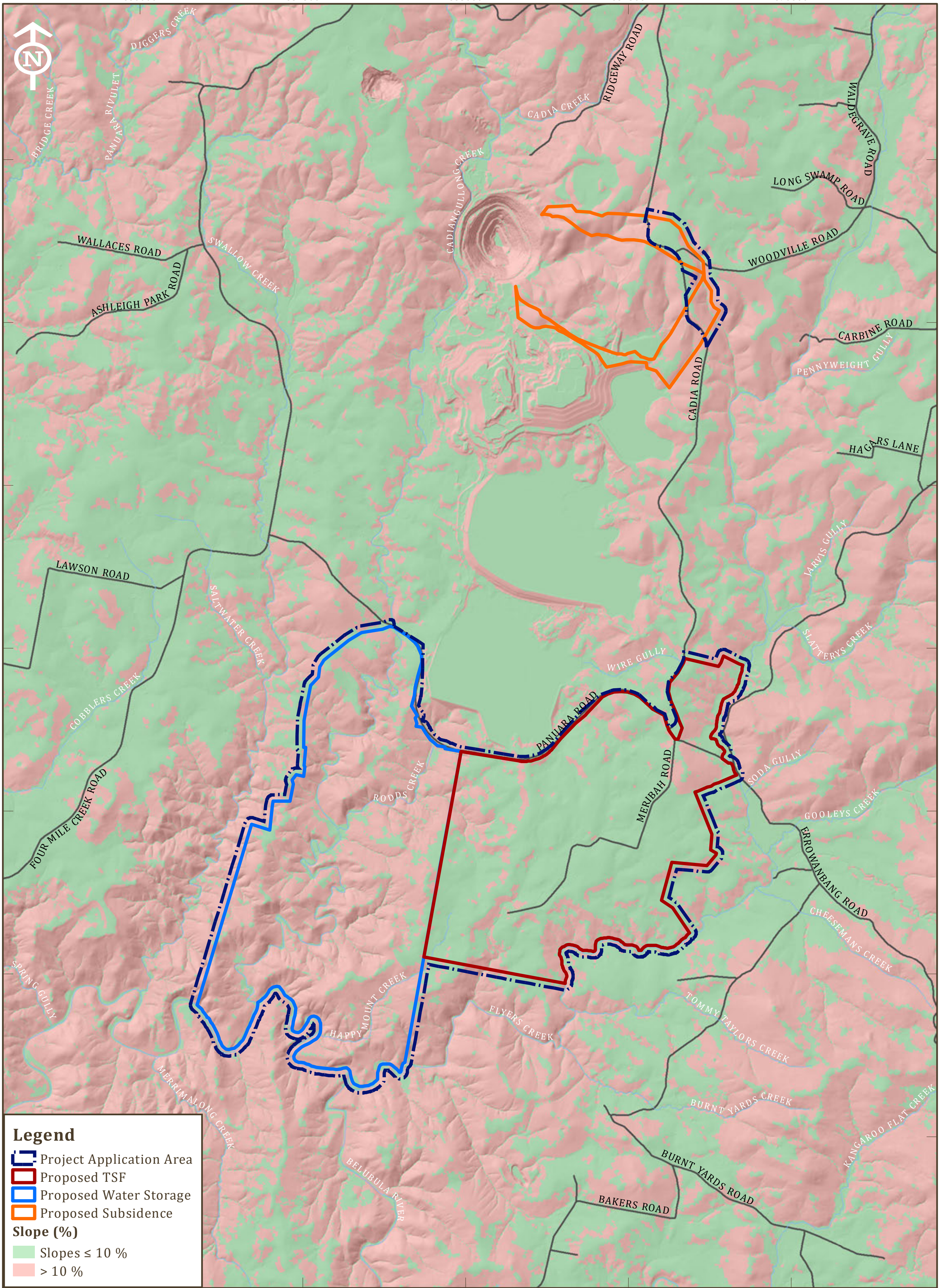


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Slope Analysis

FIGURE 5

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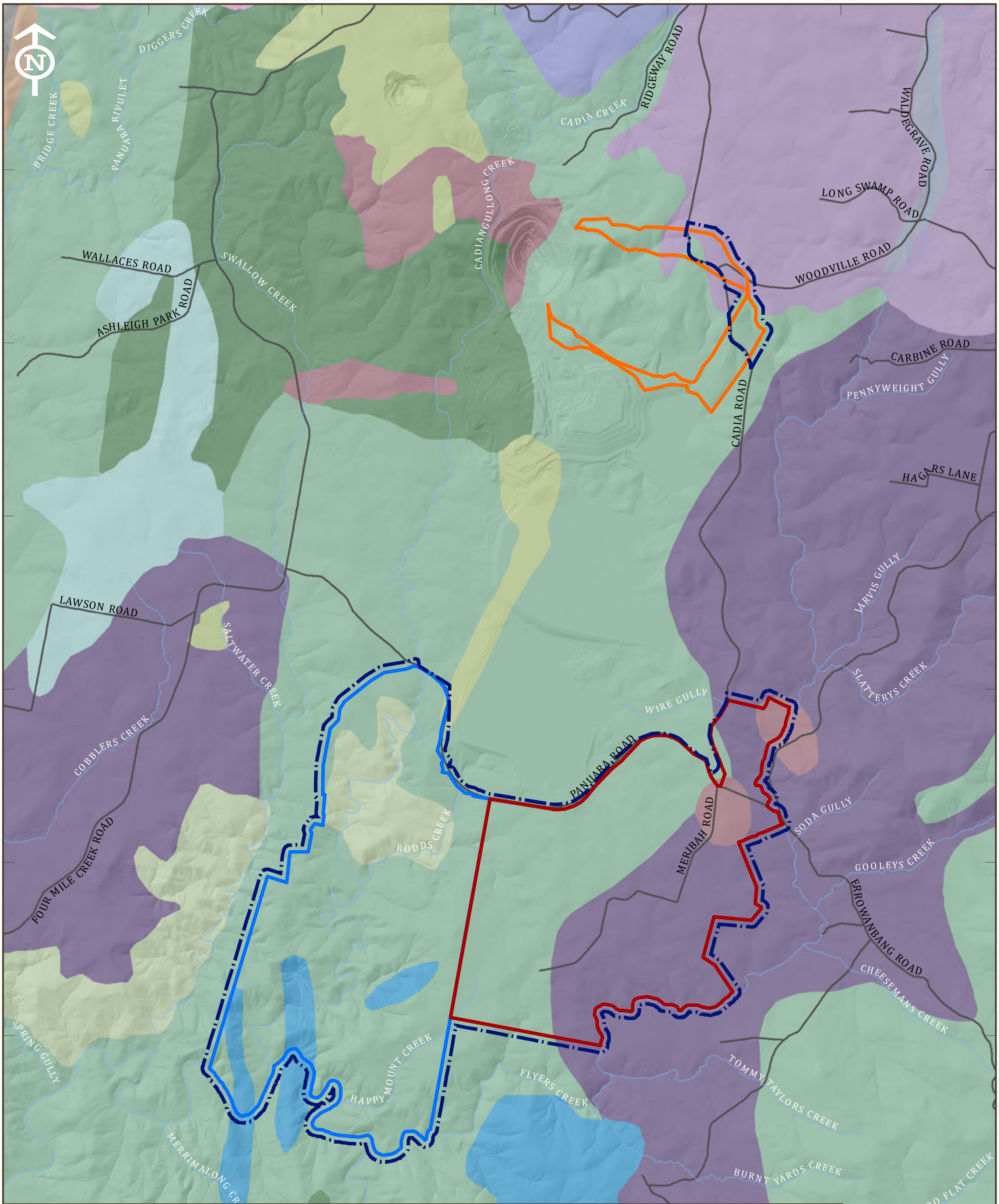


**Legend**

- Project Application Area
- Proposal TSF
- Proposal Water Storage
- Proposal Subsidence

**Soil Landscapes (Central Eastern NSW v2.1)**

- Black Rock
- Borenore-Lyndhurst
- Brinsley
- Canobolas
- Catombal
- Lees Mountain
- Macquarie
- Panuara
- Pinnacle
- Quarry
- Razorback
- Spring Hill
- Stoke-Burnt Yards
- Towac
- Turonfels
- Vittoria-Blayney

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0 0.5 1 2 Kilometers

Scale 1:75000 at A4

Soil Landscapes

FIGURE 6

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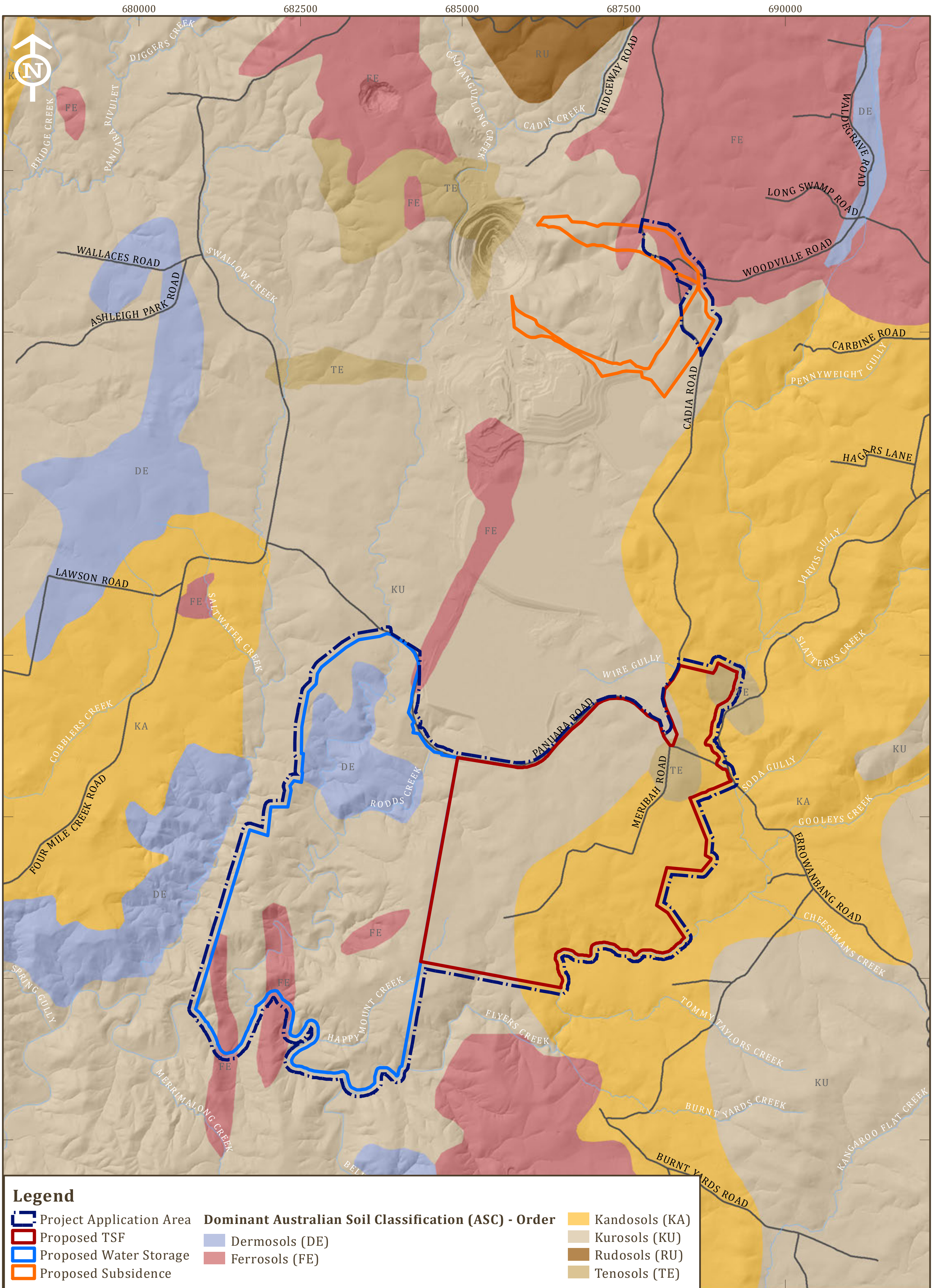


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0 0.5 1 2 Kilometers
Scale 1:75000 at A4

Australian Soil Classification

FIGURE 7

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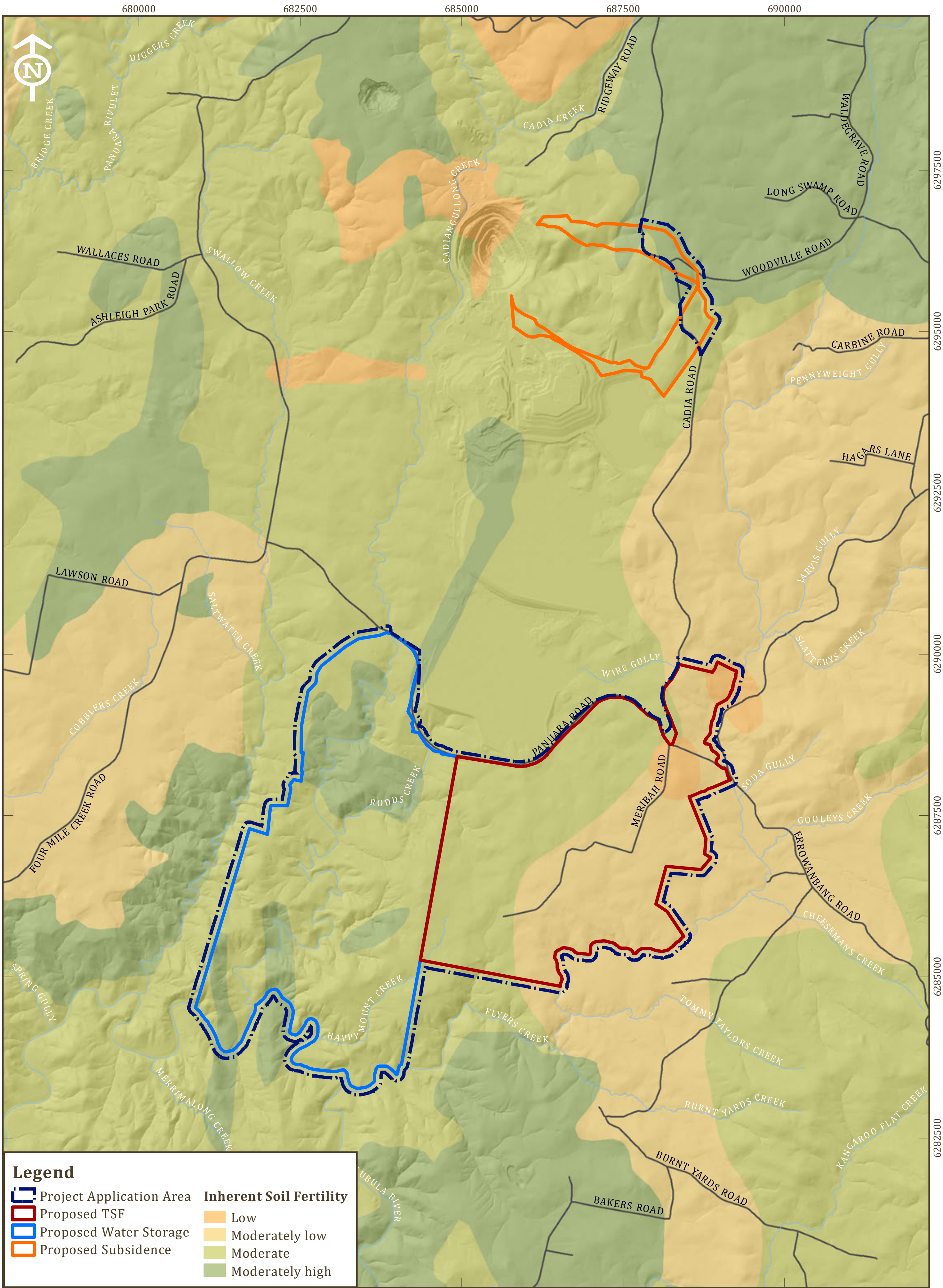


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0 0.5 1 2 Kilometers
Scale 1:75000 at A4

Inherent Soil Fertility

FIGURE 8

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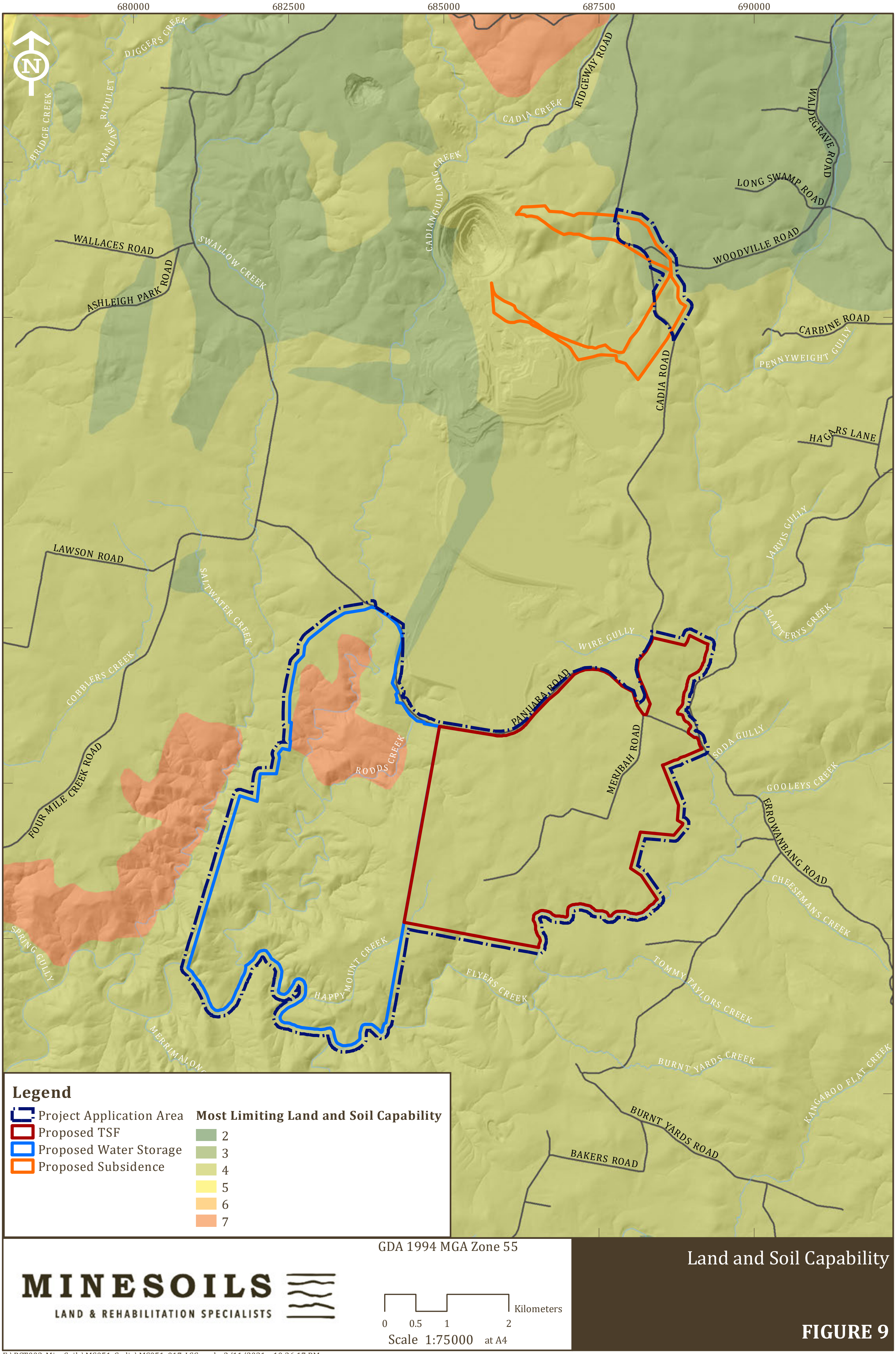


Land and Soil Capability

FIGURE 9

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# 3 THE BSAL ASSESSMENT PROCESS

BSAL is land with a rare combination of natural resources highly suitable for agriculture. These lands intrinsically have the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity and require minimal management practices to maintain this high quality.

The criteria used to measure BSAL under the original *Strategic Regional Land Use Plan* (SRLUP) (DP&I, 2012) were based on three regional scale parameters:

1. Soil Fertility – based on the regional scale *Draft Inherent General Fertility of NSW* (DP&I, 2012),
2. Land and Soil Capability – based on the regional scale *Land and Soil Capability Mapping of NSW* (OEH, 2012), and
3. Access to reliable water supply.

The application of the Strategic Agricultural Land mapping is to 'trigger' the Gateway Process for new project development applications.

The *State Environmental Planning Policy (Mining, Petroleum Production and Extraction) 2007* (Mining SEPP) requires certain types of developments (i.e. mining or petroleum developments) to verify whether the proposed development is on BSAL. The Interim Protocol assists 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.

# 4 METHODOLOGY

The methodology reported in the following section has been undertaken based on the Interim Protocol (OEH and DPI-OAS&FS, 2013).

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

*"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 PAA is 3,513 ha, inclusive of a 100m buffer surrounding the potential disturbance areas to account for minor changes in design in accordance with the Interim Protocol, as shown in **Figure 2.**

**Step 2: Confirm access to a reliable water supply**

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

Representative rainfall data for the area has been obtained from the closest Commonwealth Bureau of Meteorology (BoM) weather stations to the Activity Area; the Orange Airport Automatic Weather Station (AWS) (063303) and Orange Agricultural Institute (063254). Mean annual rainfall is approximately 881.9 millimetres (mm) at the Orange Airport AWS and approximately 906.5 mm at the Orange Agricultural Institute. This rainfall is above the criteria threshold of 350 mm per year, and therefore the site has access to a reliable water supply.

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

*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 below.*

*…*

*It is important to note that for either approach, if any criteria indicate that the site is not BSAL, then no further assessment is necessary. The flow chart in Figure 2 is designed to assess the simplest criteria first, to avoid more costly assessments if the site can be easily discounted as BSAL.*

The Proponent has access to the site for the purposes of site verification of BSAL.

**Step 4: Risk assessment**

*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.*

To identify the potential for the Project to impact on agricultural resources and the appropriate level of soil survey required, an evaluation of risk to agricultural resources and enterprises was undertaken. This risk assessment is taken from the *Guideline for Agricultural Impact Statements at the Exploration Stage* (DTIRIS, 2012) and is based on the probability of occurrence and the consequence of the impact, as described in the *Land Use Conflict Risk Assessment Guide* (NSW DPI 2011). Depending on the risk, inspection densities can range from 1 site per 25-400 ha for low risk to 1 site per 5-25 ha for high risk (Gallant *et al.*2008) (Refer **Table 1**, **Table 2** and **Table 3**).

Table 1: Agricultural Impacts Risk Ranking Matrix

| Consequence | | Probability | | | | |
|---|---|---|---|---|---|---|
| | | A Almost Certain | B Likely | C Possible | D Unlikely | E Rare |
| 1 | Severe and/or permanent damage. Irreversible impacts. | A1 | B1 | C1 | D1 | E1 |
| 2 | Significant and /or long-term damage. Long term management implications. Impacts difficult or impractical to reverse. | A2 | B2 | C2 | D2 | E2 |
| 3 | Moderate damage and/or medium-term impact to agricultural resources or industries. Some ongoing management implications which may be expensive to implement. Minor damage or impacts over the long term. | A3 | B3 | C3 | D3 | E3 |
| 4 | Minor damage and/or short-term impact to agricultural resources or industries. Can be managed as part of routine operations. | A4 | B4 | C4 | D4 | E4 |
| 5 | Very minor damage and minor impact to agricultural resources or industries. Can be effectively managed as part of normal operations. | A5 | B5 | C5 | D5 | E5 |

Low Risk

Medium Risk

High Risk

Source: Interim Protocol Appendix 3 Risk Assessment (OEH 2013)

Table 2: Agricultural Impact Risk Ranking – Probability Descriptors

| Level | Descriptor | Description |
|---|---|---|
| A | Almost certain | Common or repeating occurrence |
| B | Likely | Known to occur or it has happened |
| C | Possible | Could occur or I've heard of it happening |
| D | Unlikely | Could occur in some circumstances but not likely to occur |
| E | Rare | Practically impossible or I've never heard of it happening |

Source: Interim Protocol Appendix 3 Risk Assessment (OEH 2013)

Table 3: Agricultural Impact Risk Ranking – Consequence Descriptors

| Consequence | Description | Example of Implications |
|---|---|---|
| **Level: 1 Severe** | Severe and/or permanent damage to agricultural resources, or industries<br>Irreversible<br>Severe impact on the community | Long term (eg. 20 years) damage to soil or water resources<br>Long term impacts (eg. 20 years) on a cluster of agricultural industries or Important agricultural lands |
| **Level: 2 Major** | Significant and/or long-term impact to agricultural resources, or industries<br>Long-term management implications<br>Serious detrimental impact on the community | Water or soil impacted, possibly in the long term (eg. 20 years)<br>Long term (eg. 20 years) displacement / serious impacts on agricultural industries |
| **Level: 3 Moderate** | Moderate and/or medium-term impact to agricultural resources, or industries<br>Some ongoing management implications<br>Minor damage or impacts but over the long term. | Water or soil known to be affected, probably in the short – medium term (eg. 1-5 years)<br>Management could include significant change of management needed to agricultural enterprises to continue. |
| **Level: 4 Minor** | Minor damage and/or short-term impact to agricultural resources, or industries<br>Can be effectively managed as part of normal operations | Theoretically could affect the agricultural resource or industry in short term, but no impacts demonstrated<br>Minor erosion, compaction or water quality impacts that can be mitigated.<br>For example, dust and noise impacts in a 12-month period on extensive grazing enterprises. |
| **Level: 5 Negligible** | Very minor damage or impact to agricultural resources, or industries<br>Can be effectively managed as part of normal operations | No measurable or identifiable impact on the agricultural resource or industry |

Source: Interim Protocol Appendix 3 Risk Assessment (OEH 2013)

The proposed projects within the PAA are considered:

a. Consequence: Level 2 – Significant and/or long-term impact to agricultural resources, or industries. Long-term management implications. Serious detrimental impact on the community.

b. Probability: A – Almost Certain. Common or repeating occurrence.

The risk matrix result is A2 which is considered a high risk to agricultural activities. This area is therefore to have an inspection density of 1:25,000 which requires a minimum observation site every 25 ha within the PAA. For the purpose of this survey, the 100m buffer area is also considered to require an inspection density of 1:25,000.

Site assessment of slope gradients was undertaken using a digital elevation model, which show gradients greater than 10% (as shown in **Figure 5**). This area of 1,891 ha was discounted from BSAL field assessment and verified Non-BSAL based on a desktop review. Contiguous areas of <20 ha within broader areas of slopes >10% cover a total area of 239 ha and were additionally discounted and verified as Non-BSAL. The remainder of the PAA consisting of area of 1,386 ha was subject to further BSAL assessment. This is known as the BSAL Assessment area. Therefore, the number of inspection sites required is a minimum of 56 sites to verify BSAL or Non-BSAL based on the soil types identified.

### Step 4: Soils and landscape verification criteria

Ten site verification criteria have been identified, with the easy to measure criteria assessed first. Soil samples were collected and assessed in the field and laboratory. Analytical tests undertaken are listed in **Table 4** below. The ten site verification parameters are: slope; rock outcrop; surface rock fragments; gilgai; soil fertility (based on soil type); effective rooting depth to a physical barrier; soil drainage; soil pH; salinity; and effective rooting depth to a chemical barrier. For soil to be classified as BSAL at each representative site, it must meet all the criteria outlined in the flow chart shown in **Figure 10**. If any criteria are not met, the site is not BSAL and there is no need to continue the assessment. The specific requirements for each parameter to be assessed is outlined in the Interim Protocol.

Site field assessment of slope gradients was undertaken using a hand-held clinometer to confirm the digital elevation model results.

Other exclusion parameters were assessed in the field, including rock outcrops, surface rock and the presence of gilgai. These were considered exclusion sites and no further parameters were recorded.

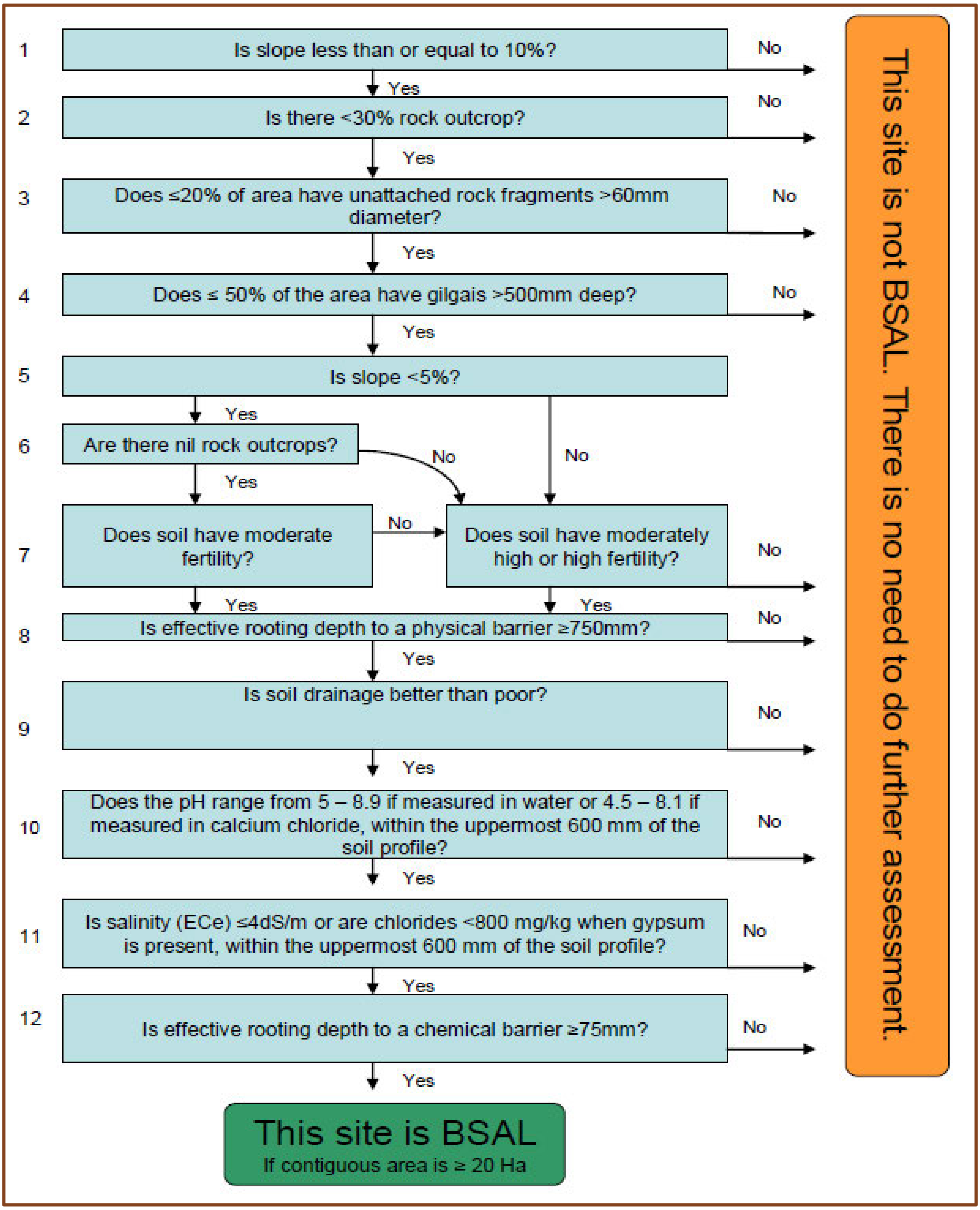
Existing regional soil and land information was considered to provide a background understanding of the area and has been mapped for the properties where access was prohibited.

The 1,386 ha area subject to field assessment is known as the BSAL assessment area and is shown on **Figure 11**. A field assessment was undertaken by Minesoils (Clayton Richards CPSS - Director & Principal Soil Scientist) between March and July 2021, with a total of 93 sites were inspected, as shown on **Figure 12**. 90 sites were subjected to detailed test pits, with samples collected at 68 sites for laboratory analysis to confirm soil type and BSAL status. The remaining three sites were included as 'check' sites. (Note: sites labelled 'C' were from the initial fieldwork assessment of the proposed STSF domain, and sites labelled 'D' were from the follow up sitework that covered the proposed subsidence domain and the proposed water storage domain).

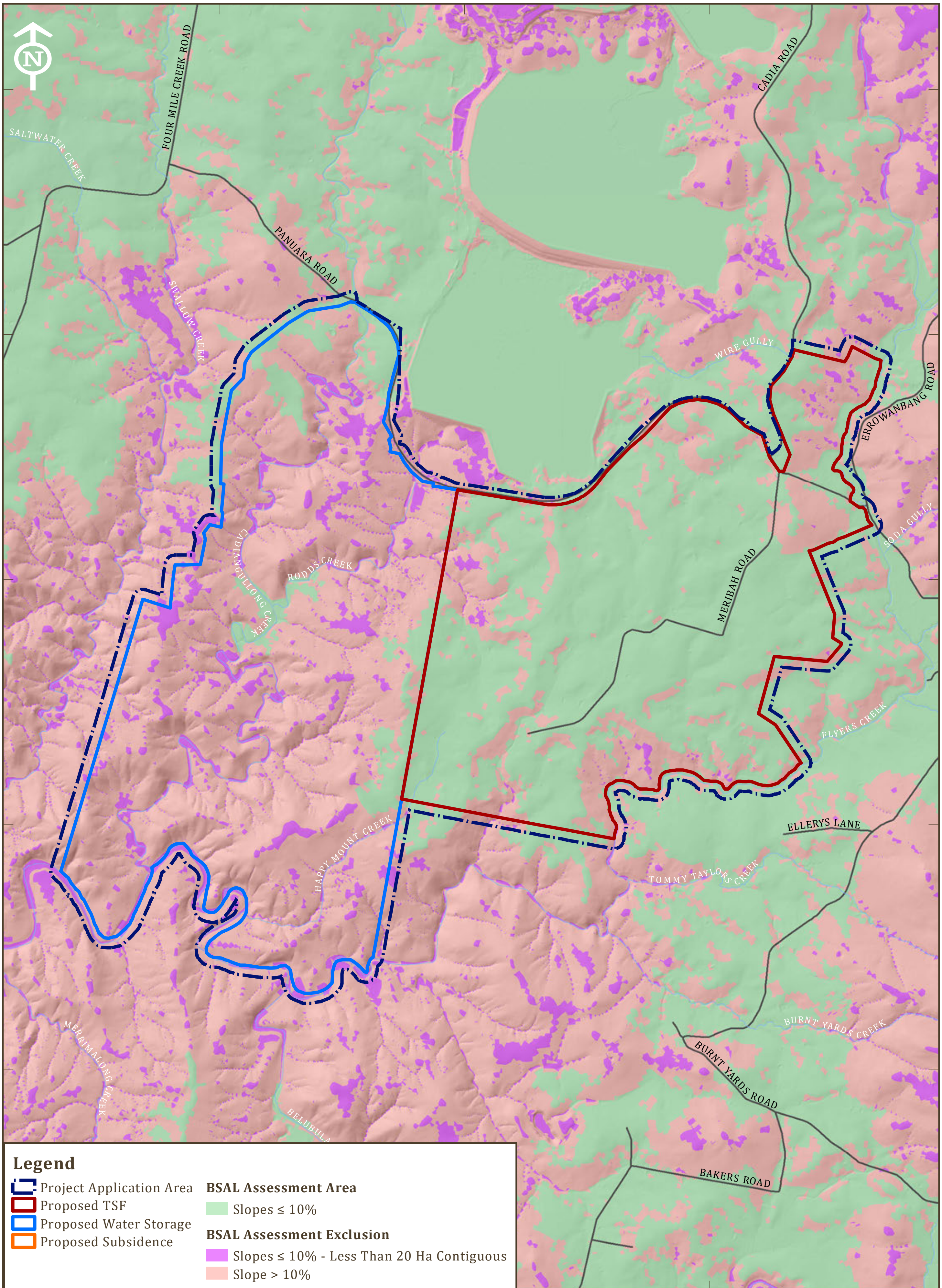
## Table 4: Soil Sample Laboratory Analysis

| Lab Analysis | |
|---|---|
| pH (1:5 water & CaCl) | Rayment & Lyons 2011-4A1 |
| Electrical Conductivity (EC) and Chloride | Rayment & Lyons 2011-3A1 |
| Cation Exchange Capacity (CEC) & ESP and Ca:Mg Ratio | Rayment & Lyons 2011-15J1 |
| Particle Size Analysis (PSA) (Selected samples only) | ISSS Hydrometer plus 0.2 and 2.0 mm Sieving (CSIRO 'Yellow Book') |

Figure 10: Schematic diagram of BSAL site verification criteria




Source: Interim Protocol (OEH 2013)

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Meters
0 250 500 1,000
Scale 1:50000 at A4

BSAL Assessment Area

FIGURE 11A

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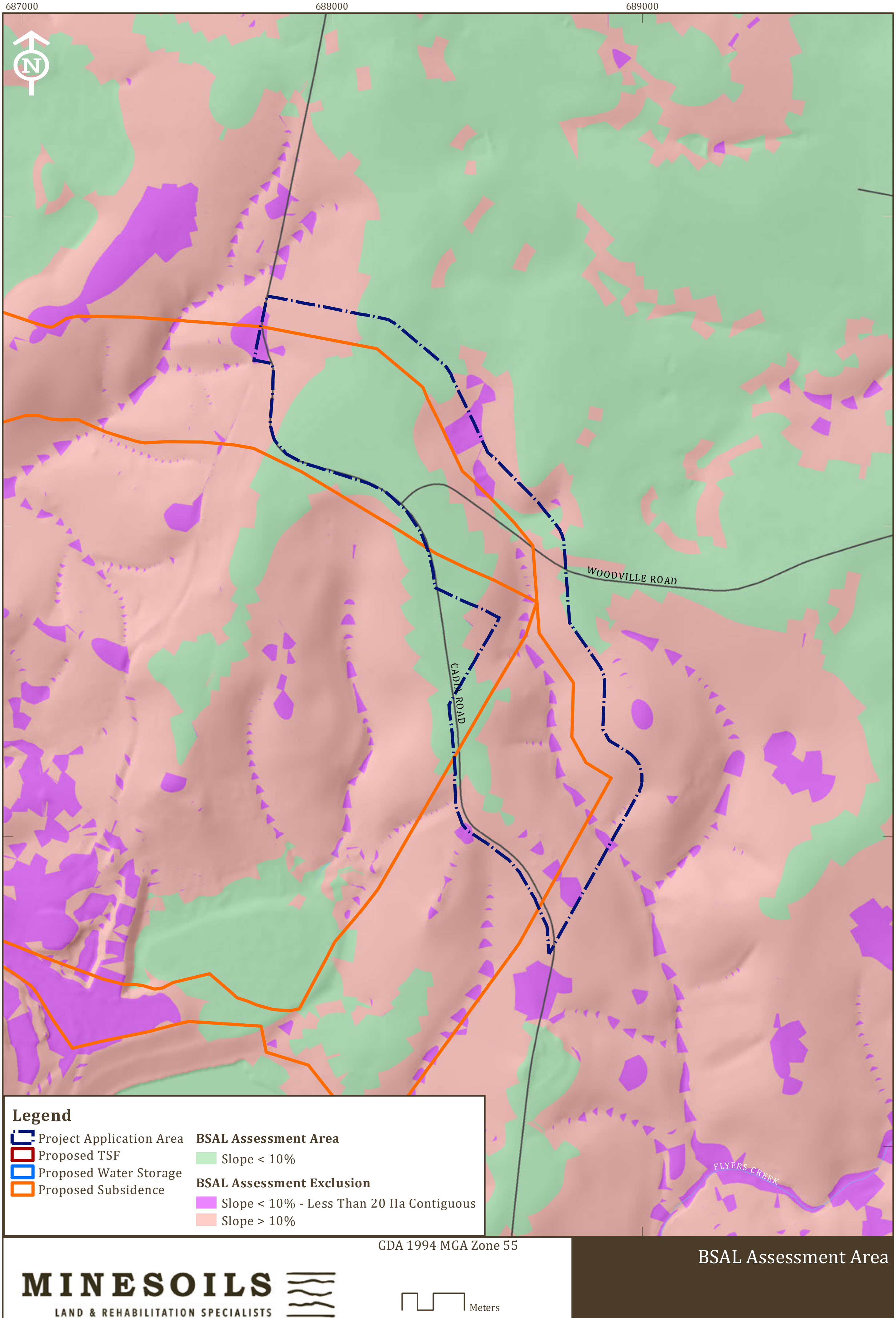


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BSAL Assessment Area

FIGURE 11B

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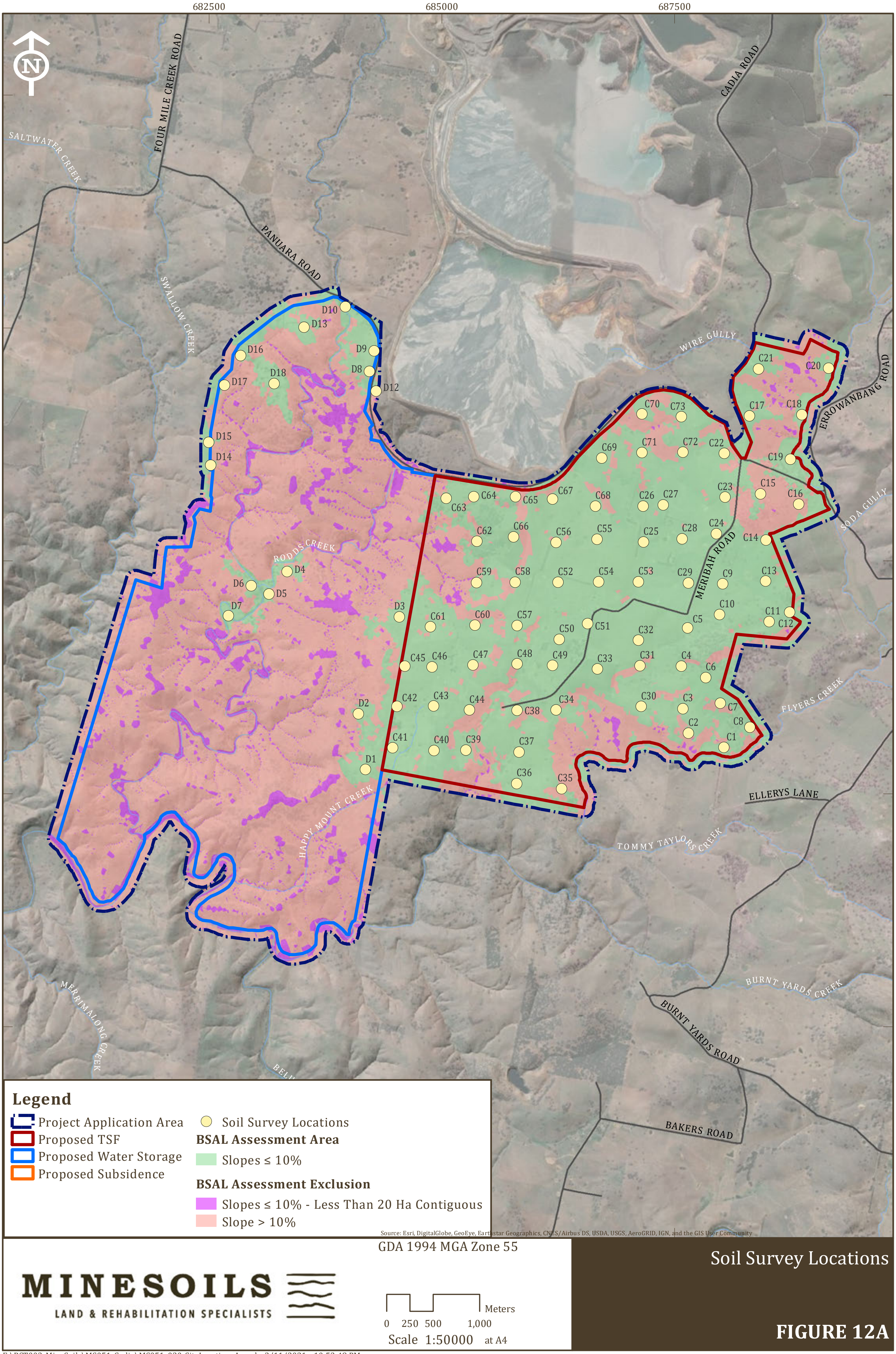


Soil Survey Locations

FIGURE 12A

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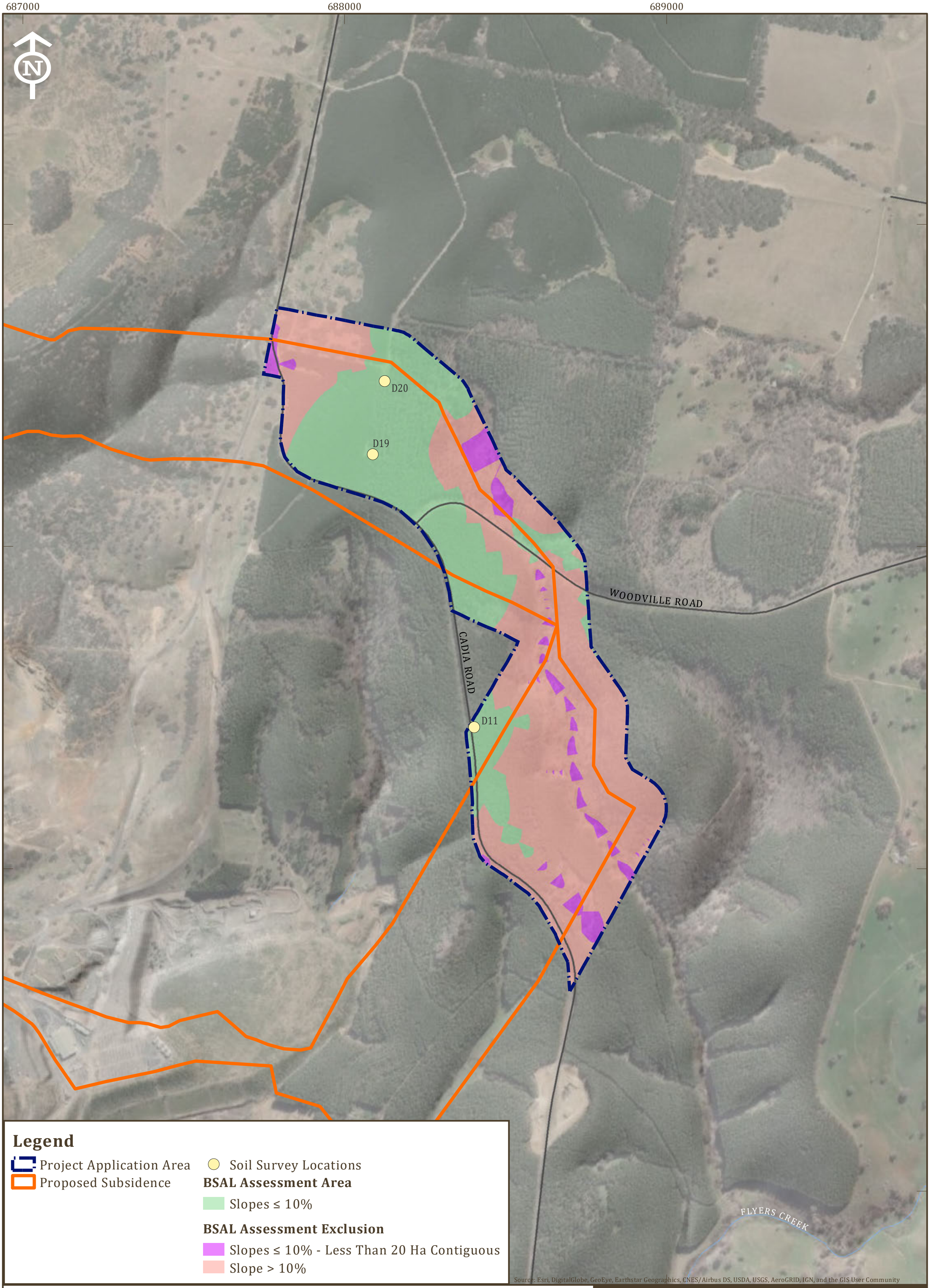


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Soil Survey Locations

FIGURE 12B

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# 5 RESULTS

## 5.1 BSAL VERIFICATION

The BSAL site verification assessment resulted in 52 sites satisfying the BSAL criteria. A further 41 sites failed to satisfy the requirements for BSAL (refer **Figure 13**). Therefore, BSAL is confirmed to be present within the PAA.

Verified BSAL occurs over an area of 825 ha within the PAA, with distribution shown of **Figure 14**. The remaining 2,691 ha of the PAA is verified Non-BSAL.

**Table 5** details the BSAL verification assessment process and summaries limiting factors for all eliminated sites.

## 5.2 SOIL MAPPING UNITS

Two soil mapping units were identified within the BSAL field assessment area of the PAA. The distribution of these soil mapping units is illustrated on **Figure 15**.

The soil mapping units consisted of the following:

- Soil Mapping Unit 1: Chromosols; and
- Soil Mapping Unit 2: Dermosols.

An overview of each of the soil mapping units is presented below.

**Soil Mapping Unit 1: Chromosols**

There is a broad association between this soil mapping unit and verified BSAL. This mapping unit is the most spatially extensive within the BSAL field assessment area of the PAA, covering an area of 736 ha.

Representative dominant soil types include a range of texture contrast soils with B horizons that are not strongly acid or sodic and often with vertic properties: These are Vertic Eutrophic Brown Chromosols (C2, C3, C4, C6, C21, C22, C29, C40, C49, C68, C73, D1), Vertic Eutrophic Red Chromosols (C7, C26, C31, C54, C59, C61, C63, C64, D17), Vertic Eutrophic Black Chromosols (C42, C62, C66, D18), and Haplic Eutrophic Red Chromosols (C24, D8, D9, D12, D19, D20)

Representative sub-dominant soil types include a range of texture contrast soils (Chromosols) with minor occurrence of sodic subsoils (Sodosols). Additionally, some sub dominant soil types lacking a texture contrast occur within this mapping unit (Dermosols): These area Bleached Eutrophic Brown Chromosols (C36, C37) Mottled Eutrophic Brown Chromosol (C11), Manganic Subnatric Black Sodosol (C19), Bleached-Mottled Eutrophic Brown Chromosol (C20) Manganic Eutrophic Brown Chromosol (C25) Mottled Eutrophic Red Chromosol (C39), Eutrophic Subnatric Brown Sodosol (C28) Bleached-Sodic Eutrophic Brown Chromosol (41), Manganic Subnatric Grey Sodosol (C43) Vertic Eutrophic Yellow Chromosol (C52), Vertic Mesotrophic Brown Chromosol (C53), Haplic Eutrophic Brown Chromosol (C60), Vertic Eutrophic Brown Dermosol (C50), Manganic Mottled-Subnatric Grey Sodosol (C51) and Haplic Eutrophic Red Dermosol (C12).

The primary limitations associated with this mapping unit where the BSAL criteria has not been met include slope, pH, drainage, and moderately low fertility.

The BSAL elimination of these sites is outlined in **Table 6** and details profile descriptions are included in **Appendix 2**.

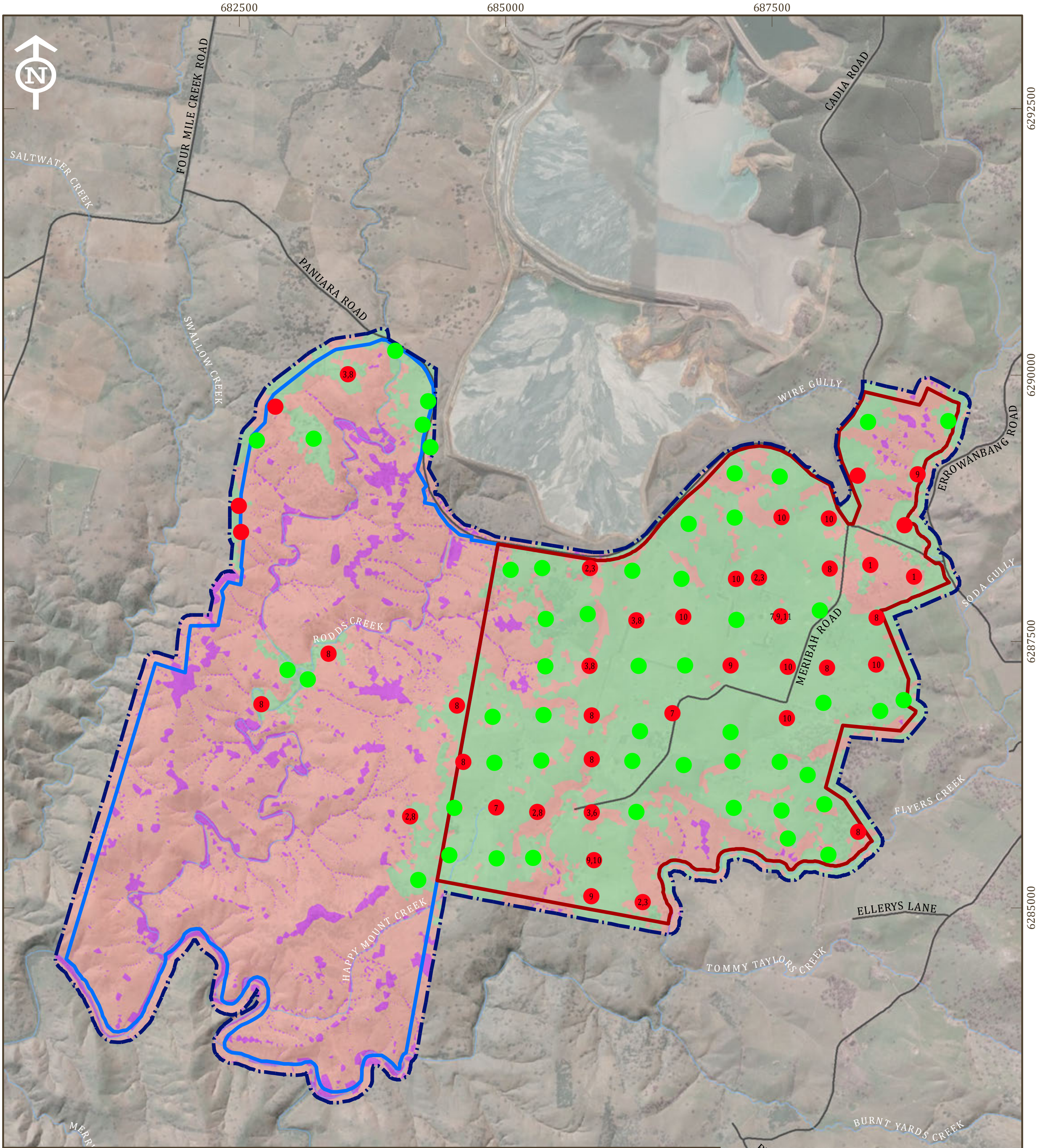
### Soil Mapping Unit 2: Dermosols

There is a broad association between this soil mapping unit and verified Non-BSAL. This mapping unit is the least spatially extensive across the BSAL field assessment area of the PAA and covers an area of 651 ha. Representative dominant soil types include a range of clay textured soils with moderate to strong pedality and lacking a texture contrast: These are Haplic Eutrophic Brown Dermosols (C1, C5, C10), Haplic Eutrophic Red Dermosols (C32, C33, C46, C47, D10, D11) and Vertic Eutrophic Red Dermosols (C70, C71, C72),

Representative sub-dominant soil types include a range of soils with weak to moderate pedality and lacking a texture contrast: These are Manganic Eutrophic Red Dermosol (C13, C34, C55), Haplic Eutrophic Black Kandosol (D5, D6), Vertic Eutrophic Black Dermosol (C18), Mottled Eutrophic Black Dermosol (C69), Haplic Epipedal Black Vertosol (C30). In addition, a series of Brown Vertosols were identified during the field assessment but were not further classified due to BSAL constraints superseding the requirement for laboratory analysis of samples (C8, C17, C48, C56, C57, C58).

The primary BSAL limitation associated with this unit are depth to a physical barrier, rockiness, and rock outcrops.

The BSAL constraints of all representative and non-representative sites is outlined in **Table 6**. Detailed profile descriptions of representative sites are included in **Appendix 2**.




## Legend

- Project Application Area
- Proposed TSF
- Proposed Water Storage
- Proposed Subsidence

**BSAL Assessment Area**

- Slopes ≤ 10%

**BSAL Assessment Exclusion**

- Slopes ≤ 10% - Less Than 20 Ha Contiguous
- Slope > 10%

**BSAL Assessment**

- BSAL
- Non-BSAL

**BSAL Limitations**

1. Slope >10%
2. >30% Rock Outcrop
3. Rock Fragments
6. Rock Outcrop
7. Moderately Low Fertility
8. Shallow Soil Depth
9. Poor Drainage
10. pH <5.0
11. Salinity <4dS/m

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,

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0 250 500 1,000 Meters

Scale 1:50000 at A4

BSAL Assessment

**FIGURE 13A**

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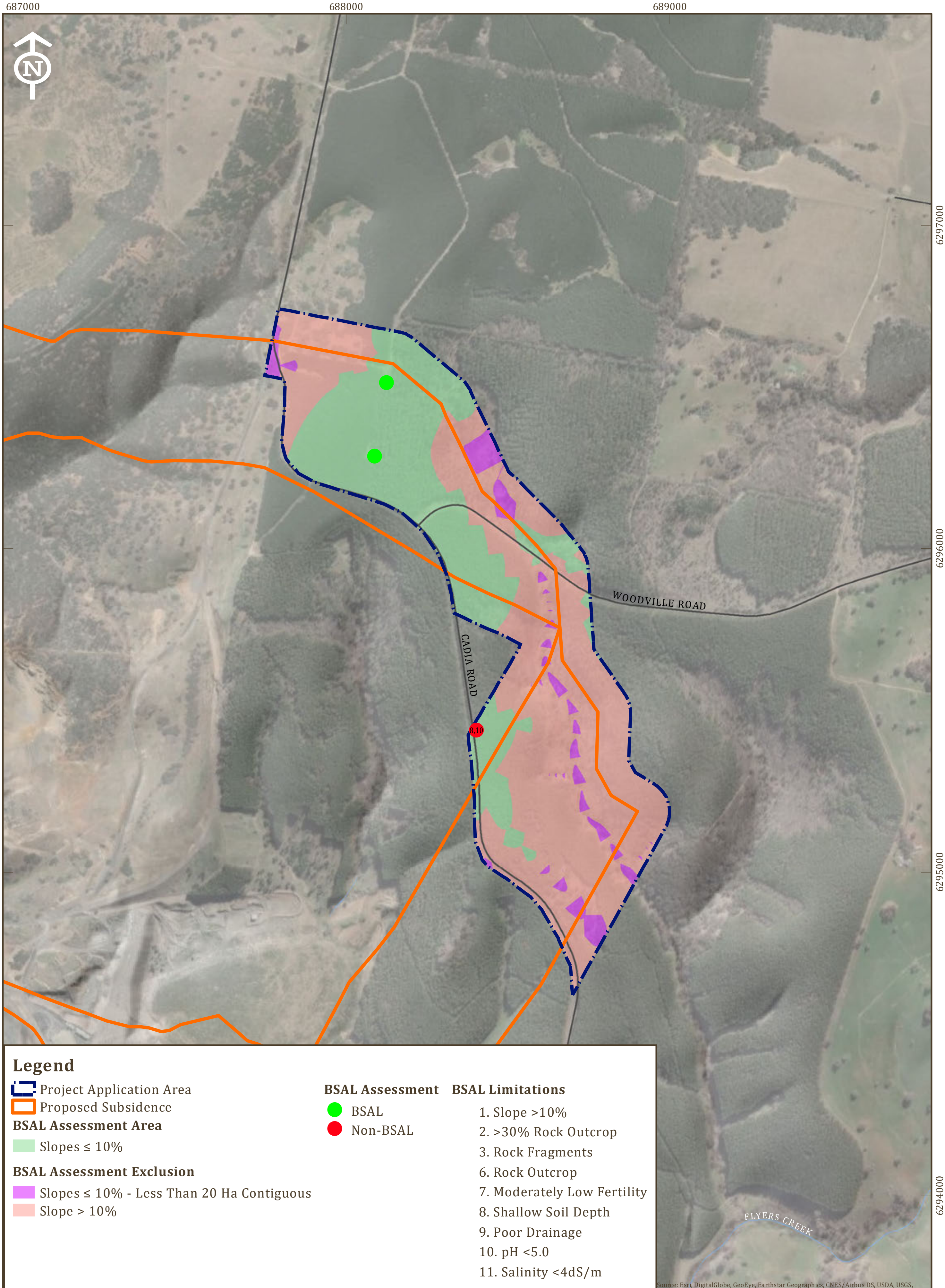


## Legend

Project Application Area
Proposed Subsidence

**BSAL Assessment Area**

Slopes ≤ 10%

**BSAL Assessment Exclusion**

Slopes ≤ 10% - Less Than 20 Ha Contiguous
Slope > 10%

**BSAL Assessment**

BSAL
Non-BSAL

**BSAL Limitations**

1. Slope >10%
2. >30% Rock Outcrop
3. Rock Fragments
6. Rock Outcrop
7. Moderately Low Fertility
8. Shallow Soil Depth
9. Poor Drainage
10. pH <5.0
11. Salinity <4dS/m

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0 50 100 200 Meters
Scale 1:15000 at A4

BSAL Assessment

**FIGURE 13B**

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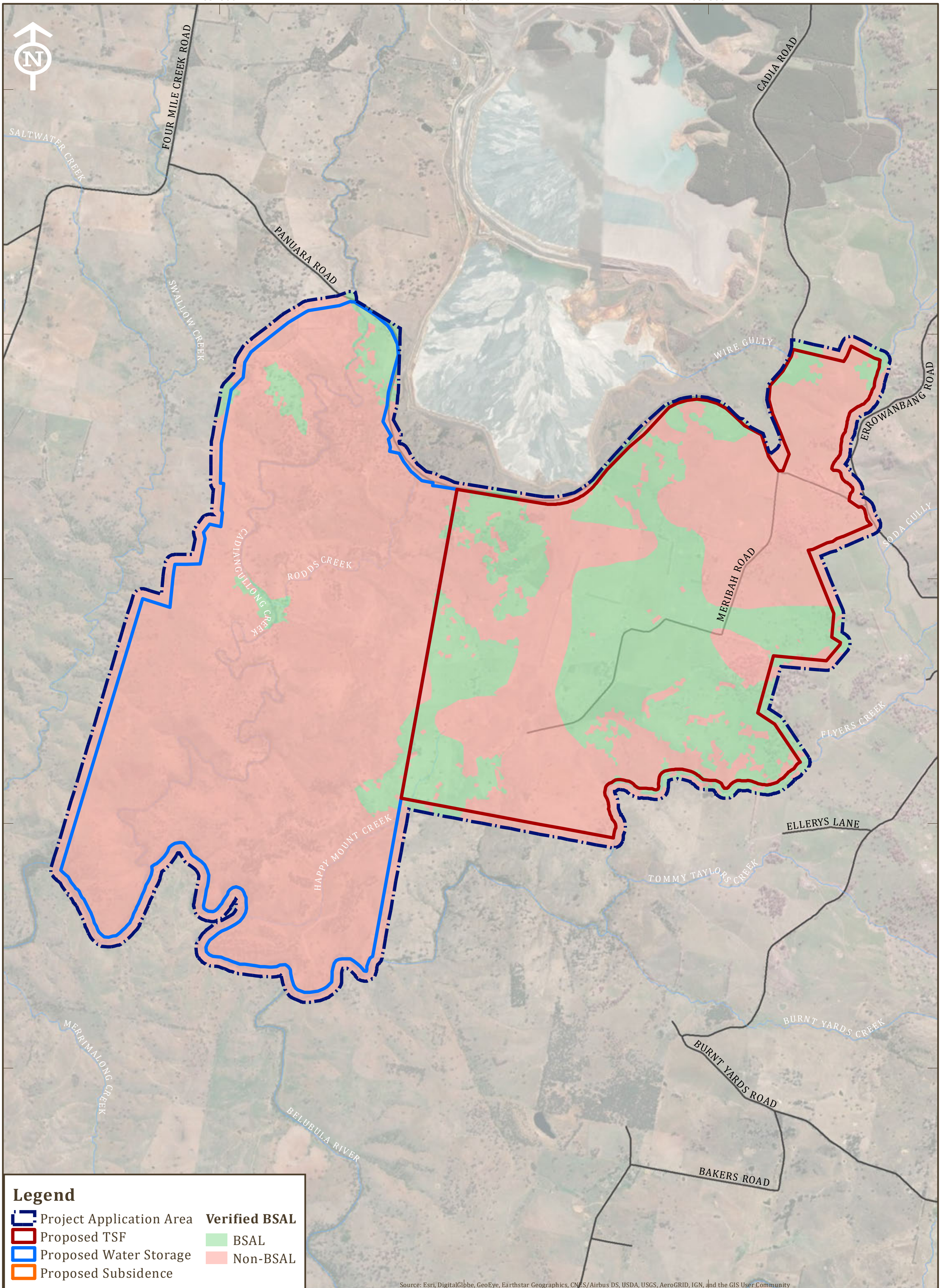


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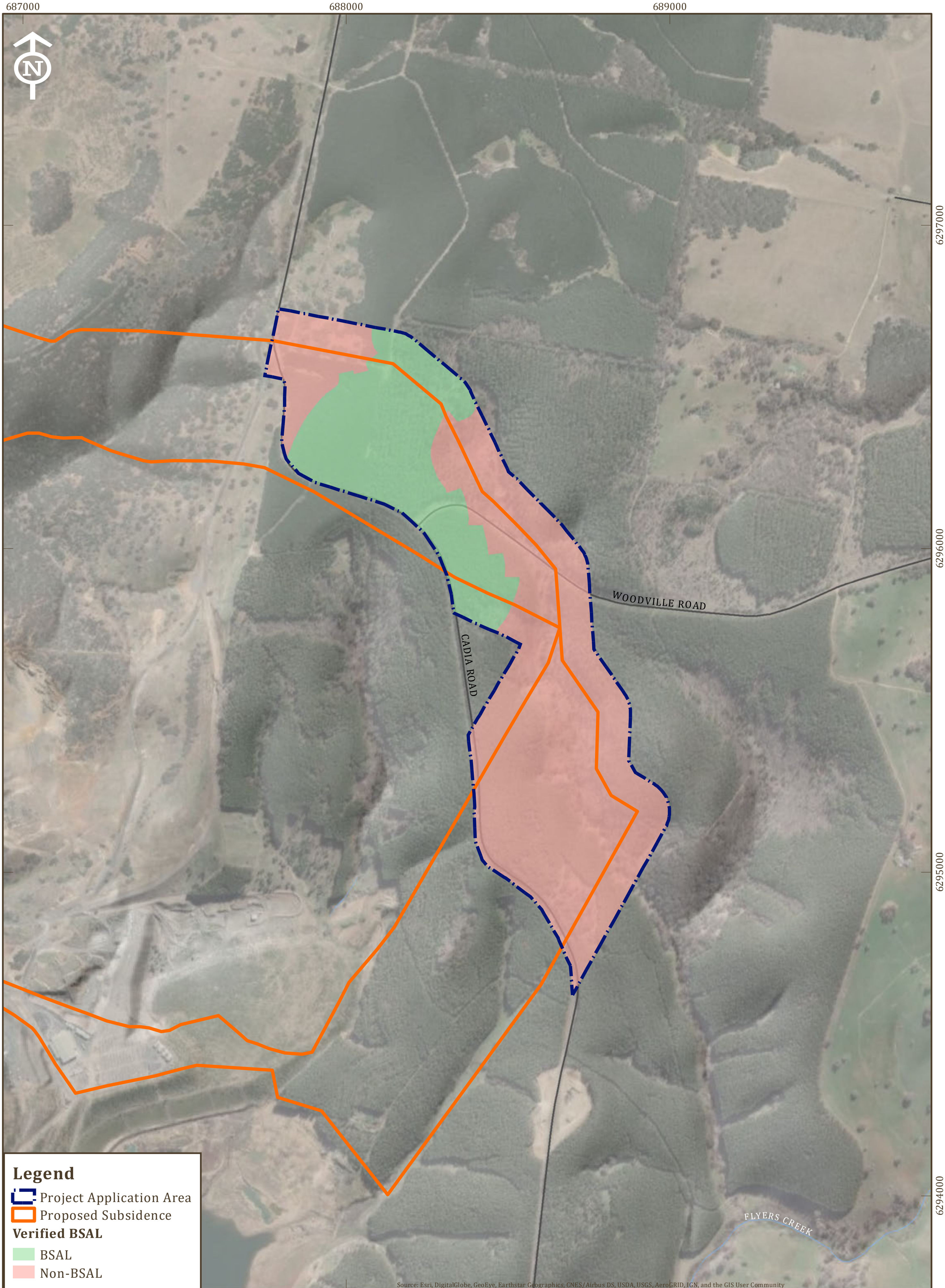
0 250 500 1,000 Meters
Scale 1:50000 at A4

Verified BSAL

FIGURE 14A

E:\RST002_MineSoils\MS051_Cadia\MS051_024_VerifiedBSAL_A.mxd 2/11/2021 11:32:42 PM




GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

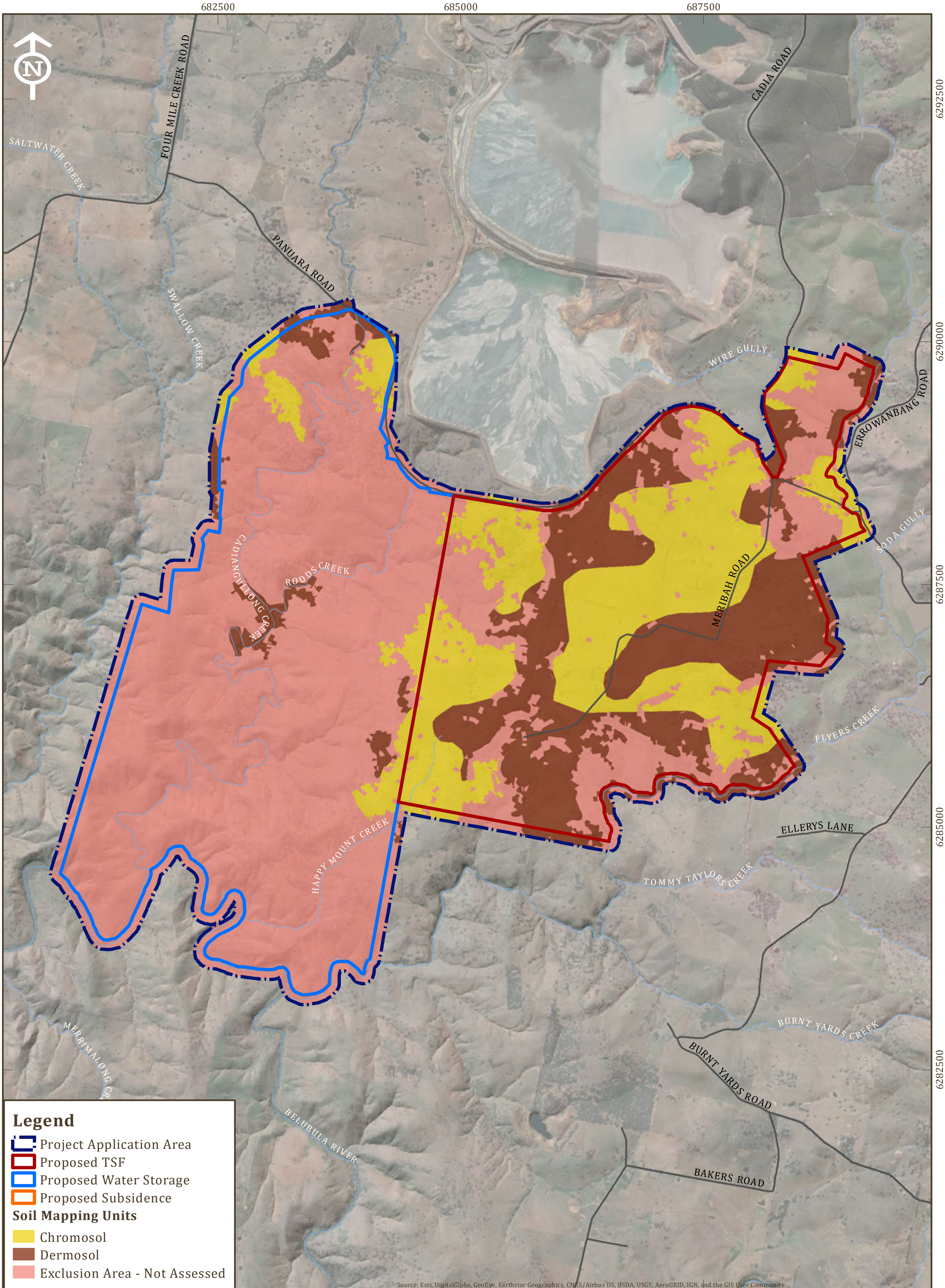
0 50 100 200 Meters

Scale 1:15000 at A4

Verified BSAL

**FIGURE 14B**

E:\RST002_MineSoils\MS051_Cadia\MS051_025_VerifiedBSAL_B.mxd 2/11/2021 11:33:48 PM




GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

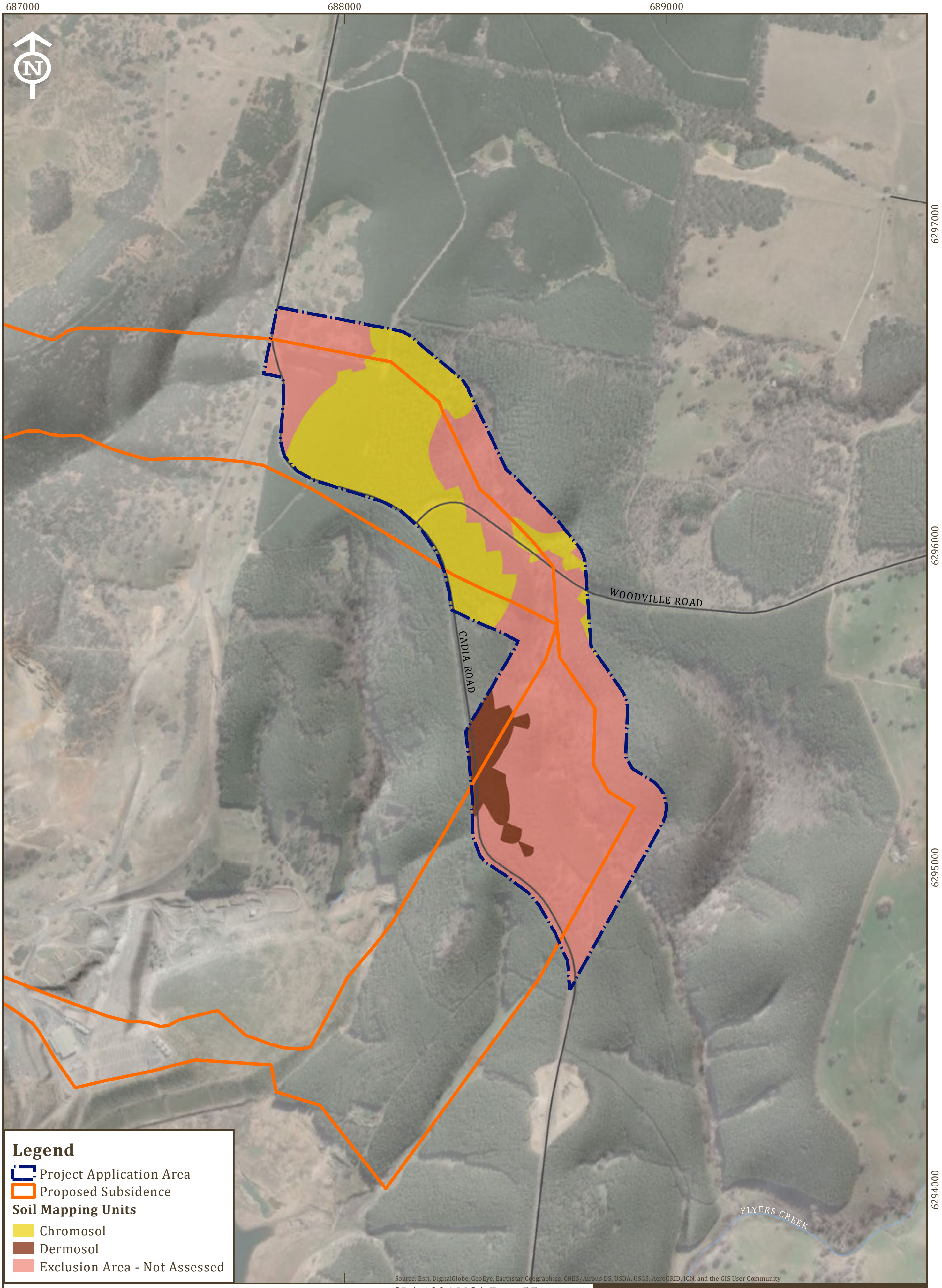
0 250 500 1,000 Meters

Scale 1:50000 at A4

Soil Mapping Units

**FIGURE 15A**

E:\RST002_MineSoils\MS051_Cadia\MS051_026_SoilUnits_A.mxd 2/11/2021 11:33:20 PM




GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

Meters
0 50 100 200
Scale 1:15000 at A4

Soil Mapping Units

**FIGURE 15B**

E:\RST002_MineSoils\MS051_Cadia\MS051_027_SoilUnits_B.mxd 2/11/2021 11:34:15 PM

Table 5: Site BSAL Verification Summary

| Site # | Inspection Site Type | Mapping Unit | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria | 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? | Soil Profile BSAL Verification | Limiting Factors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # | Name | | | | | | | | | | | | | | | | | |
| C1 | Detailed | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BFLMW | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C2 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C3 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C4 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C5 | Detailed | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | Non-BSAL | 10. pH <5.0 |
| C6 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C7 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C8 | Detailed | 2 | Dermosols | Red Vertosol | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 8. Shallow Soil Depth |
| C9 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 8. Shallow Soil Depth |
| C10 | Detailed | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BELOV | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C11 | Detailed | 1 | Chromosols | Mottled Eutrophic Brown Chromosol | BHLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C12 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Dermosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C13 | Detailed | 2 | Dermosols | Manganic Eutrophic Red Dermosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | Non-BSAL | 10. pH <5.0 |
| C14 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 8. Shallow Soil Depth |
| C15 | Check | 1 | Chromosols | - | - | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | - | - | ✓ | ✓ | - | - | - | Non-BSAL | 1. Slope >10% |
| C16 | Detailed | 1 | Chromosols | Brown Chromosol | - | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | - | - | - | - | - | - | - | Non-BSAL | 1. Slope >10% |
| C17 | Detailed | 2 | Dermosols | Brown Vertosol | - | ✓ | ✗ | ✗ | ✓ | ✓ | ✗ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 2. >30% Rock Outcrop<br>3. Rock Fragments<br>8. Shallow Soil Depth |

| Site # | Inspection Site Type | Mapping Unit | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria | 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? | Soil Profile BSAL Verification | Limiting Factors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # | Name | | | | | | | | | | | | | | | | | |
| C18 | Detailed | 2 | Dermosols | Vertic Eutrophic Black Dermosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | Non-BSAL | 9. Poor Drainage |
| C19 | Detailed | 1 | Chromosols | Manganic Subnatric Black Sodosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | Non-BSAL | 7. Moderately Low Fertility<br>9. Poor Drainage<br>11. Salinity <4dS/m |
| C20 | Detailed | 1 | Chromosols | Bleached-Mottled Eutrophic Brown Chromosol | BFKOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C21 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C22 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | Non-BSAL | 10. pH <5.0 |
| C23 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 8. Shallow Soil Depth |
| C24 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C25 | Detailed | 1 | Chromosols | Manganic Eutrophic Brown Chromosol | BFOOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C26 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFLOV | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | Non-BSAL | 10. pH <5.0 |
| C27 | Check | 1 | Chromosols | - | - | ✓ | ✗ | ✗ | ✓ | ✓ | ✗ | - | - | ✓ | ✓ | - | - | - | Non-BSAL | 2. >30% Rock Outcrop<br>3. Rock Fragments |
| C28 | Detailed | 1 | Chromosols | Eutrophic Subnatric Brown Sodosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | Non-BSAL | 7. Moderately Low Fertility<br>9. Poor Drainage |
| C29 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | Non-BSAL | 10. pH <5.0 |
| C30 | Detailed | 2 | Dermosols | Haplic Epipedal Black Vertosol | ESSW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C31 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C32 | Detailed | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C33 | Detailed | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C34 | Detailed | 2 | Dermosols | Manganic Eutrophic Brown Dermosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C35 | Detailed | 2 | Dermosols | Brown Vertosol | - | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | - | - | ✓ | ✓ | - | - | - | Non-BSAL | 2. >30% Rock Outcrop<br>3. Rock Fragments |

| Site # | Inspection Site Type | Mapping Unit | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria | 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? | Soil Profile BSAL Verification | Limiting Factors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # | Name | | | | | | | | | | | | | | | | | |
| C36 | Detailed | 1 | Chromosols | Bleached Eutrophic Brown Chromosol | BGLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | Non-BSAL | 9. Poor Drainage |
| C37 | Detailed | 1 | Chromosols | Bleached Eutrophic Brown Chromosol | BFKOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | Non-BSAL | 9. Poor Drainage<br>10. pH <5.0 |
| C38 | Detailed | 2 | Dermosols | - | - | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ | - | - | ✓ | ✓ | - | - | - | Non-BSAL | 3. Rock Fragments<br>6. Rock Outcrop |
| C39 | Detailed | 1 | Chromosols | Mottled Eutrophic Red Chromosol | CEMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C40 | Detailed | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BFOOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C41 | Detailed | 1 | Chromosols | Bleached-Sodic Eutrophic Brown Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C42 | Detailed | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C43 | Detailed | 1 | Chromosols | Manganic Subnatric Grey Sodosol | BGKOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 7. Moderately Low Fertility |
| C44 | Detailed | 2 | Dermosols | Red Dermosol | - | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 2. >30% Rock Outcrop<br>8. Shallow Soil Depth |
| C45 | Detailed | 1 | Chromosols | Epipedal Brown Vertosol | - | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 8. Shallow Soil Depth |
| C46 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Dermosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C47 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Dermosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C48 | Detailed | 2 | Dermosols | Epipedal Brown Vertosol | - | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 8. Shallow Soil Depth |
| C49 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C50 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Dermosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C51 | Detailed | 1 | Chromosols | Manganic Mottled-Subnatric Grey Sodosol | BFKOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 7. Moderately Low Fertility |
| C52 | Detailed | 1 | Chromosols | Vertic Eutrophic Yellow Chromosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C53 | Detailed | 1 | Chromosols | Vertic Mesotrophic Brown Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | Non-BSAL | 9. Poor Drainage |

| Site # | Inspection Site Type | Mapping Unit | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria | 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? | Soil Profile BSAL Verification | Limiting Factors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # | Name | | | | | | | | | | | | | | | | | |
| C54 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C55 | Detailed | 2 | Dermosols | Manganic Eutrophic Red Dermosol | BGOOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | Non-BSAL | 10. pH <5.0 |
| C56 | Detailed | 2 | Dermosols | Epipedal Brown Vertosol | - | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 3. Rock Fragments<br>8. Shallow Soil Depth |
| C57 | Detailed | 2 | Dermosols | Epipedal Brown Vertosol | - | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 8. Shallow Soil Depth |
| C58 | Detailed | 2 | Dermosols | Epipedal Brown Vertosol | - | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | - | - | ✗ | ✓ | - | - | - | Non-BSAL | 3. Rock Fragments<br>8. Shallow Soil Depth |
| C59 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C60 | Detailed | 1 | Chromosols | Haplic Eutrophic Brown Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C61 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C62 | Detailed | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C63 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C64 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C65 | Detailed | 2 | Dermosols | Epipedal Brown Vertosol | - | ✓ | ✗ | ✗ | ✓ | ✓ | ✗ | - | - | ✓ | ✓ | - | - | - | Non-BSAL | 2. >30% Rock Outcrop<br>3. Rock Fragments |
| C66 | Detailed | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C67 | Detailed | 1 | Chromosols | Manganic Eutrophic Red Dermosol | BELOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C68 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C69 | Detailed | 2 | Dermosols | Mottled Eutrophic Black Dermosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C70 | Detailed | 2 | Dermosols | Vertic Eutrophic Red Dermosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| C71 | Detailed | 2 | Dermosols | Vertic Eutrophic Red Dermosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |

| Site # | Inspection Site Type | Mapping Unit | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria | 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? | Soil Profile BSAL Verification | Limiting Factors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # | Name | | | | | | | | | | | | | | | | | |
| C72 | Detailed | 2 | Dermosols | Vertic Eutrophic Red Dermosol | BFKMW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | Non-BSAL | 10. pH <5.0 |
| C73 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D1 | Detailed | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFLOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D2 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 2. >30% Rock Outcrop<br>8. Shallow Soil Depth |
| D3 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 8. Shallow Soil Depth |
| D4 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 8. Shallow Soil Depth |
| D5 | Detailed | 2 | Dermosols | Haplic Eutrophic Black Kandosol | BFLLW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D6 | Detailed | 2 | Dermosols | Haplic Eutrophic Black Kandosol | BFLLW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D7 | Detailed | 2 | Dermosols | Leptic Rudosol | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 8. Shallow Soil Depth |
| D8 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D9 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D10 | Detailed | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELMW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D11 | Detailed | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELOV | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | ✗ | Non-BSAL | 8. Shallow Soil Depth<br>10. pH <5.0 |
| D12 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D13 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 3. Rock Fragments<br>8. Shallow Soil Depth |
| D14 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 3. Rock Fragments<br>8. Shallow Soil Depth |
| D15 | Detailed | 2 | Dermosols | Brown Dermosol | - | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 3. Rock Fragments<br>8. Shallow Soil Depth |
| D16 | Check | 1 | Chromosols | - | - | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Non-BSAL | 2. >30% Rock Outcrop<br>8. Shallow Soil Depth |

| Site # | Inspection Site Type | Mapping Unit | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria | 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? | Soil Profile BSAL Verification | Limiting Factors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # | Name | | | | | | | | | | | | | | | | | |
| D17 | Detailed | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFLOV | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D18 | Detailed | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BEMOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D19 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEKOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |
| D20 | Detailed | 1 | Chromosols | Haplic Eutrophic Red Chromosol | CELOW | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | BSAL | - |

# 6 CONCLUSION

The Cadia Continued Operations Project BSAL Site Verification Assessment was undertaken March – July 2021 by Minesoils' Clayton Richards (CPSS 2). The PAA was defined as the Project site as well as the required 100m buffer but excluding areas under a current mining lease, which totalled 3,516 ha. A total of 2,130 ha was discounted during desktop analysis by slope >10% and <20 ha contiguous area and/or areas surrounded by slopes >10%. These exclusions left 1,386 ha to be assessed.

A total of 93 sites were assessed in accordance with the Interim Protocol to obtain suitable representative soil profiles to determine soil type and characteristics. A total of 52 sites satisfied the BSAL criteria. Therefore, verified BSAL is confirmed to be present over approximately 825 ha or 23% of the PAA. The remaining 2,691 ha or 77% of the PAA is verified Non-BSAL.

The supporting documents including the e-dirt BSAL online soil data, laboratory analysis and mapping metadata have been provided to DPIE as part of the SVC Application. The soil laboratory analysis results are attached in **Appendix 3**.

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# Appendix 2
## Soil Survey Summary and Soil Profile Descriptions

Table A2.1: Soil Map Units and Soil Types Summary

| Site # | Soil Map Units | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria |
|---|---|---|---|---|
| | # | Name | | |
| C1 | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BFLMW |
| C2 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BEMOWNR |
| C3 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFMOWNR |
| C4 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BELOWNR |
| C5 | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BELOW |
| C6 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFMOWNR |
| C7 | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BEMOWNR |
| C8 | 2 | Dermosols | Red Vertosol | - |
| C9 | 2 | Dermosols | Brown Dermosol | - |
| C10 | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BELOV |
| C11 | 1 | Chromosols | Mottled Eutrophic Brown Chromosol | BHLOWNR |
| C12 | 1 | Chromosols | Haplic Eutrophic Red Dermosol | BELOW |
| C13 | 2 | Dermosols | Manganic Eutrophic Red Dermosol | BEMOW |
| C14 | 2 | Dermosols | Brown Dermosol | - |
| C15 | 1 | Chromosols | Brown Chromosol | - |
| C16 | 1 | Chromosols | Brown Chromosol | - |
| C22 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BELOWNR |
| C23 | 2 | Dermosols | Brown Dermosol | - |
| C24 | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEMOWNR |
| C25 | 1 | Chromosols | Manganic Eutrophic Brown Chromosol | BFOOWNR |
| C26 | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFLOVNR |
| C27 | 1 | Chromosols | - | - |
| C28 | 1 | Chromosols | Eutrophic Subnatric Brown Sodosol | BFLOWNR |

| Site # | Soil Map Units | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria |
|---|---|---|---|---|
| | # | Name | | |
| C29 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BEMOWNR |
| C30 | 2 | Dermosols | Haplic Epipedal Black Vertosol | ESSW |
| C31 | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFMOWNR |
| C32 | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELOW |
| C33 | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELOW |
| C34 | 2 | Dermosols | Manganic Eutrophic Brown Dermosol | BFLOW |
| C35 | 2 | Dermosols | Brown Vertosol | - |
| C36 | 1 | Chromosols | Bleached Eutrophic Brown Chromosol | BGLOWNR |
| C37 | 1 | Chromosols | Bleached Eutrophic Brown Chromosol | BFKOWNR |
| C38 | 2 | Dermosols | - | - |
| C39 | 1 | Chromosols | Mottled Eutrophic Red Chromosol | CEMOWNR |
| C40 | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BFOOWNR |
| C41 | 1 | Chromosols | Bleached-Sodic Eutrophic Brown Chromosol | BFLOWNR |
| C42 | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BFLOWNR |
| C43 | 1 | Chromosols | Manganic Subnatric Grey Sodosol | BGKOWNR |
| C44 | 2 | Dermosols | Red Dermosol | - |
| C45 | 2 | Dermosols | Epipedal Brown Vertosol | - |
| C46 | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELOW |
| C47 | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BFMOW |
| C48 | 2 | Dermosols | Epipedal Brown Vertosol | - |
| C49 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFLOWNR |
| C50 | 2 | Dermosols | Vertic Eutrophic Brown Dermosol | BFMOW |
| C51 | 1 | Chromosols | Manganic Mottled-Subnatric Grey Sodosol | BFKOWNR |
| C52 | 1 | Chromosols | Vertic Eutrophic Yellow Chromosol | BFMOWNR |

| Site # | Soil Map Units | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria |
|---|---|---|---|---|
| | # | Name | | |
| C53 | 1 | Chromosols | Vertic Mesotrophic Brown Chromosol | BFLOWNR |
| C54 | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BELOWNR |
| C55 | 2 | Dermosols | Manganic Eutrophic Red Dermosol | BGOOW |
| C56 | 2 | Dermosols | Epipedal Brown Vertosol | - |
| C57 | 2 | Dermosols | Epipedal Brown Vertosol | - |
| C58 | 2 | Dermosols | Epipedal Brown Vertosol | - |
| C59 | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFLOWNR |
| C60 | 1 | Chromosols | Haplic Eutrophic Brown Chromosol | BFLOWNR |
| C61 | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFMOWNR |
| C62 | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BFMOWNR |
| C63 | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BEMOWNR |
| C64 | 1 | Chromosols | Vertic Eutrophic Red Chromosol | BFMOWNR |
| C65 | 2 | Dermosols | Epipedal Brown Vertosol | - |
| C66 | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BFLOWNR |
| C67 | 1 | Chromosols | Manganic Eutrophic Red Dermosol | BELOW |
| C68 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFLOWNR |
| C69 | 2 | Dermosols | Mottled Eutrophic Black Dermosol | BFLOW |
| C70 | 2 | Dermosols | Vertic Eutrophic Red Dermosol | BFLOW |
| C71 | 2 | Dermosols | Vertic Eutrophic Red Dermosol | BFMOW |
| C72 | 2 | Dermosols | Vertic Eutrophic Red Dermosol | BFKMW |
| C73 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFMOWNR |
| D1 | 1 | Chromosols | Vertic Eutrophic Brown Chromosol | BFLOWNR |
| D2 | 2 | Dermosols | Brown Dermosol | - |
| D3 | 2 | Dermosols | Brown Dermosol | - |

| Site # | Soil Map Units | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria |
|---|---|---|---|---|
| | # | Name | | |
| D4 | 2 | Dermosols | Brown Dermosol | - |
| D5 | 3 | Kandosols | Haplic Eutrophic Black Kandosol | BFLLWNR |
| D6 | 3 | Kandosols | Haplic Eutrophic Black Kandosol | BFLLWNR |
| D10 | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELMW |
| D11 | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BELOV |
| D13 | 2 | Dermosols | Brown Dermosol | - |
| D14 | 2 | Dermosols | Brown Dermosol | - |
| D18 | 1 | Chromosols | Vertic Eutrophic Black Chromosol | BEMOWNR |
| D19 | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEKOWNR |
| M1 | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BEMOW |
| M2 | 2 | Dermosols | Brown Dermosol | |
| M3 | 1 | Chromosols | Eutrophic Mesonatric Brown Sodosol | BFLMWNR |
| M4 | 1 | Chromosols | Haplic Eutrophic Brown Chromosol | BFLOWNR |
| M5 | 1 | Chromosols | Haplic Hypocalcic Brown Chromosol | BEKOWNR |
| M6 | 2 | Dermosols | Brown Dermosol | |
| M7 | 1 | Chromosols | Haplic Hypocalcic Brown Chromosol | BEKMVNR |
| M8 | 1 | Chromosols | Haplic Eutrophic Brown Chromosol | BEKOWNR |
| M9 | 1 | Chromosols | Brown Chromosol | |
| M10 | 1 | Chromosols | Haplic Eutrophic Brown Chromosol | BFLOWNR |
| M11 | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEMOWNR |
| M12 | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEMOWNR |
| M13 | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BEMOWNR |
| 12 | 3 | Kandosols | Haplic Mellic Black Kandosol | BFLLWNR |
| 13 | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BGKOW |

| Site # | Soil Map Units | | Soil Profile - Australian Soil Classification (ASC) | ASC Family Criteria |
|---|---|---|---|---|
| | # | Name | | |
| 14 | 2 | Dermosols | Haplic Eutrophic Red Dermosol | BHMOV |
| 15 | 4 | Tenosols | Basic Paralithic Leptic Tenosol | BHL-UNR |
| 16 | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BGMOUNR |
| 17 | 1 | Chromosols | Mottled Eutrophic Red Chromosol | BEOOWNR |
| 18 | 1 | Chromosols | Haplic Eutrophic Red Chromosol | BGMOVNR |
| 19 | 2 | Dermosols | Haplic Eutrophic Brown Dermosol | BHOOU |
| 8 | 1 | Chromosols | Yellow Chromosol | - |

| Site Description – Site C1 | | | | |
|---|---|---|---|---|
| **Site Reference** | C1 | **ASC Name** | Haplic Eutrophic Brown Dermosol (BFLMW) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Drainage Plain | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Plain | **BSAL Site Status** | Verified BSAL | X: 688029 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285500 |

**Plate 1 –** Soil Profile (C1)

**Plate 2 –** Surface (C1)

**Plate 3 –** Landscape (C1)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Brown (Munsell 7.5YR 3/3) Silty Loam, with strong pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Gradual boundary. |
| B21 | 0.20 – 0.50 | Dark Yellowish-Brown to Strong Brown (Munsell 10YR 4/4 to 7.5YR 4/6) Silty Loam, with moderate pedality. Slightly acidic trending to neutral pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B22 | 0.50 – 0.75 | Brown (Munsell 7.5YR 4/4) Silty Clay Loam with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.6 | Non-saline | 5.4 | Strongly Acidic | 1.8 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.3 | Slightly Acidic | 0.9 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 6.7 | Neutral | 0.9 | Non-sodic |
| 0.65-0.75 | 0.1 | Non-saline | 6.9 | Neutral | 1.2 | Non-sodic |

| Site Description – Site C2 | | | | |
|---|---|---|---|---|
| **Site Reference** | C2 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BEMOWNR) | |
| **Average Slope** | 6% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper slope | **BSAL Site Status** | Verified BSAL | X: 687650 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285652 |

**Plate 1 –** Soil Profile (C2)

**Plate 2 –** Surface (C2)

**Plate 3 –** Landscape (C2)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very Dark Brown (Munsell 7.5YR 2.5/2) Clay Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B21 | 0.20 – 0.50 | Dark Yellowish-Brown to Brown (Munsell 10YR 4/4 to 10YR 4/3) Heavy Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and well drained. Gradual boundary. |
| B22 | 0.50 – 0.80 | Dark Greyish-Brown (Munsell 10YR 4/2) Heavy Clay, with strong pedality. Mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 5.6 | Moderately Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.9 | Neutral | 1.2 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.2 | Neutral | 1.3 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.4 | Mildly Alkaline | 1.5 | Non-sodic |

| Site Description – Site C3 | | | | |
|---|---|---|---|---|
| **Site Reference** | C3 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BFMOWNR) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid slope | **BSAL Site Status** | Verified BSAL | X: 687589 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285914 |

**Plate 2 –** Surface (C3)

**Plate 1 –** Soil Profile (C3)

**Plate 3 –** Landscape (C3)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Brown (Munsell 10YR 3/3) Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B21 | 0.20 – 0.50 | Dark Yellowish-Brown to Yellowish-Brown (Munsell 10YR 4/4 to 10YR 5/4) Heavy Clay, with strong pedality. Neutral to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.50 – 0.90 | Yellowish Brown (Munsell 10YR 5/4) Heavy Clay, with moderate pedality. Mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 5.9 | Moderately Acidic | 0.6 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.8 | Neutral | 0.8 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.3 | Mildly Alkaline | 1.0 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.7 | Mildly Alkaline | 1.2 | Non-sodic |

| Site Description – Site C4 | | | | |
|---|---|---|---|---|
| **Site Reference** | C4 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BELOWNR) | |
| **Average Slope** | 7% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid slope | **BSAL Site Status** | Verified BSAL | X: 687574 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286371 |

**Plate 1 –** Soil Profile (C4)

**Plate 2 –** Surface (C4)

**Plate 3 –** Landscape (C4)

| Horizon | Depth (m) | Description |
|---|---|---|
| A11 | 0.00 – 0.15 | Dark Brown (Munsell 7.5YR 3/4) Loam with strong pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| A12 | 0.15 – 0.40 | Dark Brown (Munsell 7.5YR 3/4) Clay Loam with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and well drained. Clear boundary. |
| B21 | 0.40 – 0.60 | Dark Brown (Munsell 7.5YR 3/4) Light Medium Clay with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and well drained. |
| B22 | 0.60 – 0.90 | Dark Brown (Munsell 7.5YR 3/4) Clay Loam with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.0 | Non-saline | 5.3 | Strongly Acidic | 1.3 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.5 | Neutral | 0.6 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 6.7 | Neutral | 0.6 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 6.7 | Neutral | 0.9 | Non-sodic |

| Site Description – Site C5 | | | | |
|---|---|---|---|---|
| **Site Reference** | C5 | **ASC Name** | Haplic Eutrophic Brown Dermosol (BELOW) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid slope | **BSAL Site Status** | Verified Non-BSAL | X: 687640 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6286783 |

**Plate 1 –** Soil Profile (C5)

**Plate 2 –** Surface (C5)

**Plate 3 –** Landscape (C5)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Greyish-Brown (Munsell 10YR 3/2) Loam with moderate pedality. Very strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B21 | 0.10 – 0.30 | Brown (Munsell 10YR 4/3) Loam, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B22 | 0.30+ | Yellowish-Brown (Munsell 10YR 5/4) Light Clay trending to Light Medium Clay with strong pedality. Neutral to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.3 | Non-saline | 4.7 | Very Strongly Acidic | 2.3 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.4 | Slightly Acidic | 2.1 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.1 | Neutral | 2.0 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.4 | Mildly Alkaline | 2.8 | Non-sodic |

| Site Description – Site C6 | | | | |
|---|---|---|---|---|
| **Site Reference** | C6 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BFMOWNR) | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid slope | **BSAL Site Status** | Verified BSAL | X: 687834 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286248 |

**Plate 1 –** Soil Profile (C6)

**Plate 2 –** Surface (C6)

**Plate 3 –** Landscape (C6)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Brown (Munsell 7.5YR 3/3) Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B21 | 0.20 – 0.50 | Strong Brown (Munsell 7.5YR 4/6 to 7.5YR 5/6) Heavy Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.50 – 0.90 | Yellowish-Brown (Munsell 10YR 5/6) Heavy Clay, with moderate pedality. Neutral to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 5.2 | Strongly Acidic | 0.9 | Non-sodic |
| 0.20-0.30 | 0.1 | Non-saline | 6.7 | Neutral | 0.5 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 6.9 | Neutral | 0.6 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.8 | Mildly Alkaline | 0.7 | Non-sodic |

| Site Description – Site C7 | | | | |
|---|---|---|---|---|
| **Site Reference** | C7 | **ASC Name** | Vertic Eutrophic Red Chromosol (BEMOWNR) | |
| **Average Slope** | 7% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified BSAL | X: 687993 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285972 |

**Plate 2 –** Surface (C7)

**Plate 1 –** Soil Profile (C7)

**Plate 3 –** Landscape (C7)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Reddish-Brown (Munsell 5YR 3/4) Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B21 | 0.20 – 0.40 | Dark Reddish-Brown (Munsell 2.5YR 2.5/4) Light Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40 – 0.90 | Reddish-Brown (Munsell 2.5YR 5/4) Heavy Clay trending to Medium Clay, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.1 | Non-saline | 5.8 | Moderately Acidic | 0.4 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.7 | Neutral | 0.7 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 6.6 | Neutral | 0.9 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 6.8 | Neutral | 1.3 | Non-sodic |

| Site Description – Site C8 | | | | |
|---|---|---|---|---|
| **Site Reference** | C8 | **ASC Name** | Epipedal Red Vertosol | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Broad Crest | **BSAL Site Status** | Verified BSAL | X: 688309 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6285714 |

**Plate 1 –** Soil Profile (C8)

**Plate 2 –** Surface (C8)

**Plate 3 –** Landscape (C8)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.25 | Shallow, skeletal soil with high coarse fragment content. No samples collected for laboratory analysis due to depth limitation associated with this unit. |

| Site Description – Site C9 | | | | |
|---|---|---|---|---|
| **Site Reference** | C9 | **ASC Name** | Brown Dermosol | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderate | MGA 55 |
| **Landform Element** | Broad Crest | **BSAL Site Status** | Verified Non BSAL | X: 688019 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287254 |

**Plate 1 –** Soil Profile (C9)

**Plate 2 –** Surface (C9)

**Plate 3 –** Landscape (C9)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Brown Loam (field assessment), with moderate pedality. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B2 | 0.20 – 0.50 | Yellowish Brown Clay Loam (field assessment), with moderate pedality. <5% coarse fragments. Very few fine roots and moderately drained. |
| B/C | 0.50+ | Weathered rock parent material. 90% coarse fragments. |

No laboratory sample analysis due to soil depth limitation associated with this unit.

| Site Description – Site C10 | | | | |
|---|---|---|---|---|
| Site Reference | C10 | ASC Name | Haplic Eutrophic Brown Dermosol (BELOV) | |
| Average Slope | 1% | Land Use | Grazing | Coordinates |
| Landform Pattern | Hillcrest | Soil Fertility | Moderately High | MGA 55 |
| Landform Element | Broad Crest | BSAL Site Status | Verified BSAL | X: 687984 |
| Surface Condition | Soft | Mapped as BSAL | Yes | Y: 6286924 |


**Plate 1 –** Soil Profile (C10)

**Plate 2 –** Surface (C10)

**Plate 3 –** Landscape (C10)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Yellowish-Brown (Munsell 10YR 4/4) Loam, with weak pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B2 | 0.20 – 0.70 | Brown to Reddish-Brown (Munsell 7.5YR 4/4 to 5YR 4/4) Clay Loam to Light Clay, with moderate pedality. Strongly acidic trending to neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and well drained. Gradual boundary. |
| B/C | 0.70 + | Yellowish-Brown (Munsell 10YR 5/4) Clay Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 5.0 | Strongly Acidic | 1.0 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 5.2 | Strongly Acidic | 0.8 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 6.6 | Neutral | 0.8 | Non-sodic |
| 0.65-0.75 | 0.1 | Non-saline | 6.9 | Neutral | 1.5 | Non-sodic |

| Site Description – Site C11 | | | | |
|---|---|---|---|---|
| **Site Reference** | C11 | **ASC Name** | Mottled Eutrophic Brown Chromosol (BHLOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 688517 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286848 |

**Plate 1 –** Soil Profile (C11)

**Plate 2 –** Surface (C11)

**Plate 3 –** Landscape (C11)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Brown (Munsell 7.5YR 3/4) Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. <5% coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.20 – 0.35 | Strong Brown (Munsell 7.5YR 4/6) Light Medium Clay, with moderate pedality. Neutral pH, non-saline. Non-sodic. 80% coarse fragments 5 – 10mm. No roots and moderately drained. Clear boundary. |
| B22 | 0.35 – 0.60 | Yellowish Red (Munsell 5YR 4/6) Heavy Clay, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. Gradual boundary. |
| B23 | 0.60 – 0.90 | Greyish-Brown (Munsell 10YR 5/2) Heavy Clay, with moderate pedality. Mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. Clear boundary. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 5.2 | Strongly Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 0.1 | Non-saline | 6.7 | Neutral | 0.9 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 6.9 | Neutral | 3.7 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.8 | Mildly Alkaline | 4.0 | Non-sodic |

| Site Description – Site C12 | | | | |
|---|---|---|---|---|
| **Site Reference** | C12 | **ASC Name** | Haplic Eutrophic Red Dermosol (BELOW) | |
| **Average Slope** | 9% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 688737 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286949 |


**Plate 1 –** Soil Profile (C12)

**Plate 2 –** Surface (C12)

**Plate 3 –** Landscape (C12)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Dark Brown (Munsell 7.5YR 3/4) Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B2 | 0.10 – 0.90 | Yellowish Red (Munsell 5YR 4/6) Clay Loam to Light Medium Clay, with moderate pedality. Moderately acidic trending to neutral pH, non-saline. Non-sodic. No coarse fragments. Few large roots and well drained. Gradual boundary. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.9 | Non-saline | 5.1 | Strongly Acidic | 0.4 | Non-sodic |
| 0.20-0.30 | 0.5 | Non-saline | 5.8 | Moderately Acidic | 0.6 | Non-sodic |
| 0.40-0.50 | 0.8 | Non-saline | 6.3 | Slightly Acidic | 0.9 | Non-sodic |
| 0.65-0.75 | 0.7 | Non-saline | 6.7 | Neutral | 1.7 | Non-sodic |

| Site Description – Site C13 | | | | |
|---|---|---|---|---|
| **Site Reference** | C13 | **ASC Name** | Manganic Eutrophic Red Dermosol (BEMOW) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 688479 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287284 |


**Plate 1 –** Soil Profile (C13)

**Plate 2 –** Surface (C13)

**Plate 3 –** Landscape (C13)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Brown (Munsell 7.5YR 3/4) Clay Loam, with moderate pedality. Very strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B21 | 0.15 – 0.50 | Reddish-Brown (Munsell 5YR 4/4) Clay loam trending to Light Medium Clay, with strong pedality. Moderately acidic trending to neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and well drained. Gradual boundary. |
| B22 | 0.50 – 0.80 | Reddish-Brown (Munsell 5YR 4/4) Light Clay trending to Medium Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.6 | Non-saline | 4.8 | Very Strongly Acidic | 0.6 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 5.7 | Moderately Acidic | 1.0 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 6.7 | Neutral | 1.0 | Non-sodic |
| 0.65-0.75 | 0.1 | Non-saline | 6.9 | Neutral | 1.7 | Non-sodic |

| Site Description – Site C14 | | | | |
|---|---|---|---|---|
| **Site Reference** | C14 | **ASC Name** | Brown Dermosol | |
| **Average Slope** | 12% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderate | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 688483 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287726 |

**Plate 1 –** Soil Profile (C15)

**Plate 2 –** Surface (C14)

**Plate 3 –** Landscape (C14)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Brown Loam (field assessment), with moderate pedality. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B2 | 0.10 – 0.40 | Reddish-Brown Clay Loam (field assessment), with moderate pedality. No coarse fragments. Few fine roots and poorly drained. Gradual boundary. |
| B/C | 0.40 – 0.60 | Weathered rock parent material. |

No laboratory sample analysis due to soil depth limitation associated with this unit.

| Site Description – Site C16 | | | | |
|---|---|---|---|---|
| **Site Reference** | C16 | **ASC Name** | Brown Dermosol | |
| **Average Slope** | 12% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderate | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 688835 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288110 |

**Plate 1 –** Soil Profile (C16)

**Plate 2 –** Surface (C16)

**Plate 3 –** Landscape (C16)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Brown Sandy Loam (field assessment) with moderate pedality. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| A2 | 0.15 – 0.55 | Light Brown Loamy Sand (field assessment) with weak pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B2 | 0.55+ | Brown Medium Clay (field assessment) with strong pedality. No coarse fragments. No roots and moderately drained. |

No laboratory sample analysis due to slope limitations (>10% slope) associated with this soil unit.

| Site Description – Site C22 | | | | |
|---|---|---|---|---|
| **Site Reference** | C22 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BELOWNR) | |
| **Average Slope** | 6% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 688035 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288655 |

**Plate 2 –** Surface (C22)

**Plate 1 –** Soil Profile (C22)

**Plate 3 –** Landscape (C22)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Brown (Munsell 7.5YR 3/4) Loam, with weak pedality. Very strongly acidic pH, slightly saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.15 – 0.35 | Strong Brown (Munsell 7.5YR 4/6) Heavy Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.35+ | Yellowish-Brown to Reddish-Yellow (Munsell 10YR 5/8 to 7.5YR 6/8) Heavy Clay with strong pedality. Neutral trending to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 3.5 | Slightly saline | 4.8 | Very Strongly Acidic | 1.9 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.9 | Neutral | 1.7 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 7.2 | Neutral | 3.0 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.6 | Mildly Alkaline | 4.8 | Non-sodic |

| Site Description – Site C23 | | | | |
|---|---|---|---|---|
| **Site Reference** | C23 | **ASC Name** | Brown Dermosol | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderate | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 688044 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288185 |

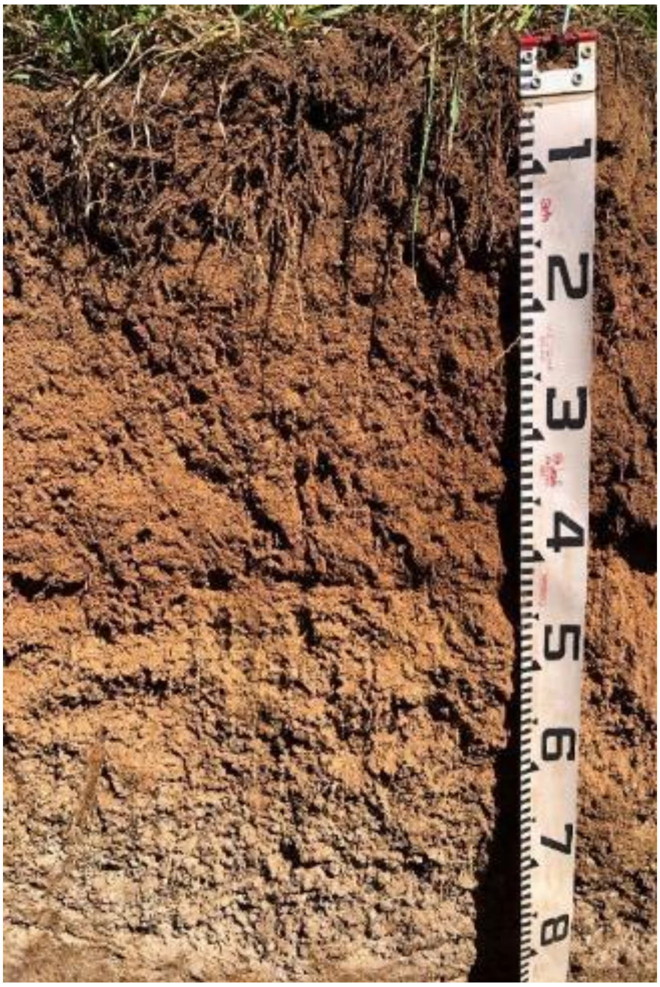

**Plate 1 –** Soil Profile (C23)

**Plate 2 –** Surface (C23)

**Plate 3 –** Landscape (C23)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Loam (field assessment), with moderate pedality. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B2 | 0.15 – 0.60 | Brown Clay Loam (field assessment), with moderate pedality. No coarse fragments. Few fine roots and moderately drained. Clear boundary. |
| BC | 0.60+ | 100% coarse fragments in the form of gravel. |

No laboratory sample analysis due to soil depth limitations associated with this unit.

| Site Description – Site C24 | | | | |
|---|---|---|---|---|
| **Site Reference** | C24 | **ASC Name** | Haplic Eutrophic Red Chromosol (BEMOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified BSAL | X: 687950 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6287795 |

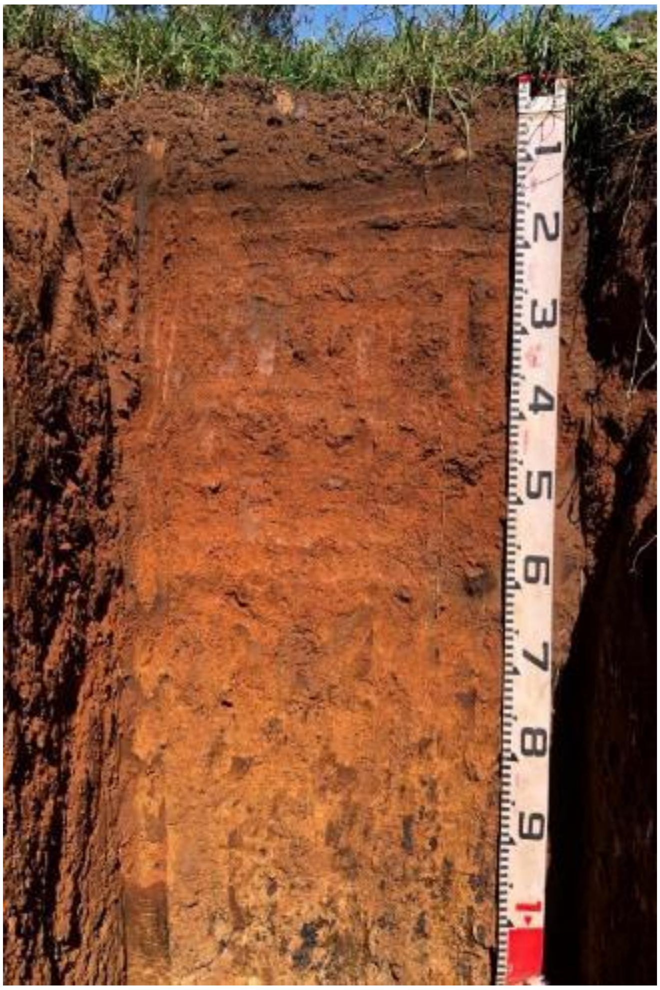

**Plate 2 –** Surface (C24)

**Plate 1 –** Soil Profile (C24)

**Plate 3 –** Landscape (C24)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Brown (Munsell 10YR 2/2) Clay Loam, with moderate pedality. Mildly alkaline pH, slightly saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B21 | 0.10 – 0.60 | Yellowish-Red (Munsell 5YR 5/8 to 2.5YR 2.5/4) Light Medium Clay, with strong pedality. Slightly acidic to neutral pH, slightly saline. Non-sodic. No coarse fragments. Very few fine roots and well drained. Gradual boundary. |
| B22 | 0.60+ | Dark Reddish-Brown to Yellowish-Red (Munsell 5YR 4/6) Medium Clay to Light Clay with strong pedality. Mildly alkaline trending to moderately alkaline pH, slightly saline to non-saline. Non-sodic. No coarse fragments. No roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 2.3 | Slightly saline | 7.7 | Mildly Alkaline | 0.2 | Non-sodic |
| 0.20-0.30 | 2.5 | Slightly saline | 6.4 | Slightly Acidic | 0.8 | Non-sodic |
| 0.40-0.50 | 2.6 | Slightly saline | 6.8 | Neutral | 1.1 | Non-sodic |
| 0.65-0.75 | 1.6 | Non-saline | 7.1 | Neutral | 2.0 | Non-sodic |

| Site Description – Site C25 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C25 | **ASC Name** | Manganic Eutrophic Brown Chromosol (BFMOWNR) | | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Drainage Line | **Soil Fertility** | Moderately High | MGA 55 | |
| **Landform Element** | Drainage Line | **BSAL Site Status** | Verified BSAL | X: 687167 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6287704 | |

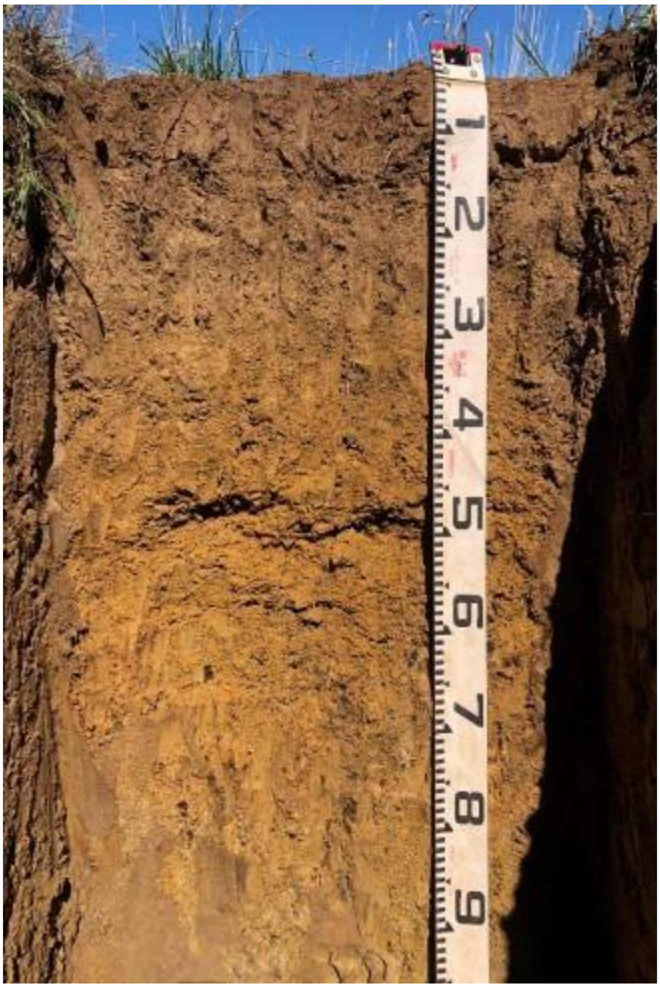


**Plate 1 –** Soil Profile (C25)

**Plate 2 –** Surface (C25)

**Plate 3 –** Landscape (C25)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Dark Grey (Munsell 5Y 4/1) Clay Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| A2 | 0.10 – 0.30 | Dark Greyish-Brown (Munsell 2.5Y 4/2) Clay Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Clear boundary. |
| B2 | 0.30+ | Yellowish-Brown to Light-Olive Brown (Munsell 10YR 5/4 to 2.5Y 5/3) Medium Clay to Heavy Clay with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 2.0 | Non-saline | 5.1 | Strongly Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.7 | Neutral | 2.3 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 6.9 | Neutral | 1.5 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.2 | Neutral | 4.2 | Non-sodic |

| Site Description – Site C26 | | | | |
|---|---|---|---|---|
| **Site Reference** | C26 | **ASC Name** | Vertic Eutrophic Red Chromosol (BFLOVNR) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 687163 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288090 |

**Plate 1 –** Soil Profile (C26)

**Plate 2 –** Surface (C26)

**Plate 3 –** Landscape (C26)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very Dark Greyish-Brown (Munsell 10YR 3/2) Loam, with moderate pedality. Very strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B21 | 0.20 – 0.60 | Dusky Red to Red (Munsell 2.5YR 3/2 to 10R 4/8) Heavy Clay, with strong pedality. Moderately acidic to slightly acidic pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. Gradual boundary. |
| B22 | 0.60 – 0.75 | Dark Greyish-Brown (Munsell 2.5Y 4/2) Heavy Clay to Light Medium Clay with strong pedality. Neutral pH, non-saline. Non-sodic. 10% coarse fragments. No roots and poorly drained. Clear boundary. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.0 | Non-saline | 4.9 | Very Strongly Acidic | 0.7 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 5.8 | Moderately Acidic | 0.8 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 6.4 | Slightly Acidic | 2.8 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.1 | Neutral | 3.1 | Non-sodic |

| Site Description – Site C28 | | | | |
|---|---|---|---|---|
| **Site Reference** | C28 | **ASC Name** | Eutrophic Subnatric Brown Sodosol (BFLOWNR) | |
| **Average Slope** | 0% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Drainage Line | **Soil Fertility** | Moderately Low | MGA 55 |
| **Landform Element** | Drainage Line | **BSAL Site Status** | Verified Non-BSAL | X: 687584 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287740 |


**Plate 1 –** Soil Profile (C28)

**Plate 2 –** Surface (C28)

**Plate 3 –** Landscape (C28)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Dark Greyish Brown (Munsell 2.5Y 4/2) Silty Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| A2 | 0.10 – 0.40 | Light Grey (Munsell 5Y 7/1) Silty Loam. Apedal structure. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and poorly drained. Clear boundary. |
| B2 | 0.40 – 1.00 | Dark Greyish Brown (Munsell 2.5Y 4/2 to 10YR 4/2) Medium Clay to Heavy Clay with strong pedality. Neutral pH, non-saline. Sodic. No coarse fragments. No roots and poorly drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.0 | Non-saline | 5.3 | Strongly Acidic | 3.7 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 5.7 | Moderately Acidic | 5.9 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 6.7 | Neutral | 7.3 | Sodic |
| 0.65-0.75 | 0.4 | Non-saline | 7.0 | Neutral | 9.4 | Sodic |

| Site Description – Site C29 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C29 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BEMOWNR) | | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 | |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 687652 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287263 | |

**Plate 1 –** Soil Profile (C29)

**Plate 2 –** Surface (C29)

**Plate 3 –** Landscape (C29)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Yellowish-Brown (Munsell 10YR 3/4) Loam, with moderate pedality. Very strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.20 – 0.60 | Brown to Dark Yellowish-Brown (Munsell 10YR 4/3 to 10YR 3/4) Light Medium Clay, with strong pedality Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Very few roots and moderately drained. Gradual boundary. |
| B22 | 0.60+ | Olive Yellow (Munsell 2.5Y 6/6) Heavy Clay with strong pedality. Strongly acidic trending to neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.6 | Non-saline | 4.6 | Very Strongly Acidic | 2.1 | Non-sodic |
| 0.20-0.30 | 1.2 | Non-saline | 5.3 | Strongly Acidic | 1.9 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 6.7 | Neutral | 1.5 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.1 | Neutral | 2.3 | Non-sodic |

| Site Description – Site C30 | | | | |
|---|---|---|---|---|
| **Site Reference** | C30 | **ASC Name** | Haplic Epipedal Black Vertosol (ESSW) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 687144 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285938 |

**Plate 1 –** Soil Profile (C30)

**Plate 2 –** Surface (C30)

**Plate 3 –** Landscape (C30)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very Dark Brown (Munsell 10YR 2/2) Heavy Clay, with strong pedality. Very strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many roots and moderately drained. Gradual boundary. |
| B21 | 0.15 – 0.40 | Very Dark Greyish-Brown (Munsell 10YR 3/2) Heavy Clay, with strong pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. Gradual boundary. |
| B22 | 0.40 – 0.80 | Dark Olive-Brown to Very Dark Grey (Munsell 2.5Y 3/3 to 5Y 3/1) Heavy Clay, with moderate pedality. Neutral to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.6 | Non-saline | 4.6 | Very Strongly Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 1.2 | Non-saline | 5.3 | Strongly Acidic | 1.4 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 6.7 | Neutral | 2.1 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.1 | Neutral | 4.3 | Non-sodic |

| Site Description – Site C31 | | | | |
|---|---|---|---|---|
| **Site Reference** | C31 | **ASC Name** | Vertic Eutrophic Red Chromosol (BFMOWNR) | |
| **Average Slope** | 8% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 687131 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286377 |

**Plate 1 –** Soil Profile (C31)

**Plate 2 –** Surface (C31)

**Plate 3 –** Landscape (C31)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dusky Red (Munsell 10R 3/4) Clay Loam, with strong pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B2 | 0.20+ | Dark Red (Munsell 10R 3/6) Heavy Clay trending to Medium Clay, with strong pedality. Neutral trending to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. Very few fine roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.5 | Non-saline | 5.4 | Strongly Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.7 | Neutral | 0.8 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 6.8 | Neutral | 0.8 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.3 | Mildly Alkaline | 0.7 | Non-sodic |

| Site Description – Site C32 | | | | |
|---|---|---|---|---|
| **Site Reference** | C32 | **ASC Name** | Haplic Eutrophic Red Dermosol (BELOW) | |
| **Average Slope** | 1% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Crest | **BSAL Site Status** | Verified BSAL | X: 687114 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286649 |

**Plate 2 –** Surface (C32)

**Plate 1 –** Soil Profile (C32)

**Plate 3 –** Landscape (C32)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Reddish-Brown (Munsell 5YR 3/3) Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B21 | 0.15 – 0.30 | Dark Red (Munsell 10R 3/6) Clay Loam, with strong pedality. Slightly acidic to neutral pH, non-saline. Non-sodic. No coarse fragments. Very few fine roots and well drained. Gradual boundary. |
| B22 | 0.30+ | Dark Red to Red (Munsell 10R 3/6 to 10R 4/6) Light Clay trending to Light Medium Clay, with strong pedality. Slightly acidic to neutral pH, non-saline. Non-sodic. No coarse fragments. Very few fine roots and well drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 5.6 | Moderately Acidic | 0.5 | Non-sodic |
| 0.20-0.30 | 0.6 | Non-saline | 6.4 | Slightly Acidic | 0.5 | Non-sodic |
| 0.40-0.50 | 0.8 | Non-saline | 6.7 | Neutral | 1.5 | Non-sodic |
| 0.65-0.75 | 0.4 | Non-saline | 7.2 | Neutral | 1.0 | Non-sodic |

| Site Description – Site C33 | | | | |
|---|---|---|---|---|
| **Site Reference** | C33 | **ASC Name** | Haplic Eutrophic Red Dermosol (BELOW) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 686671 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286339 |

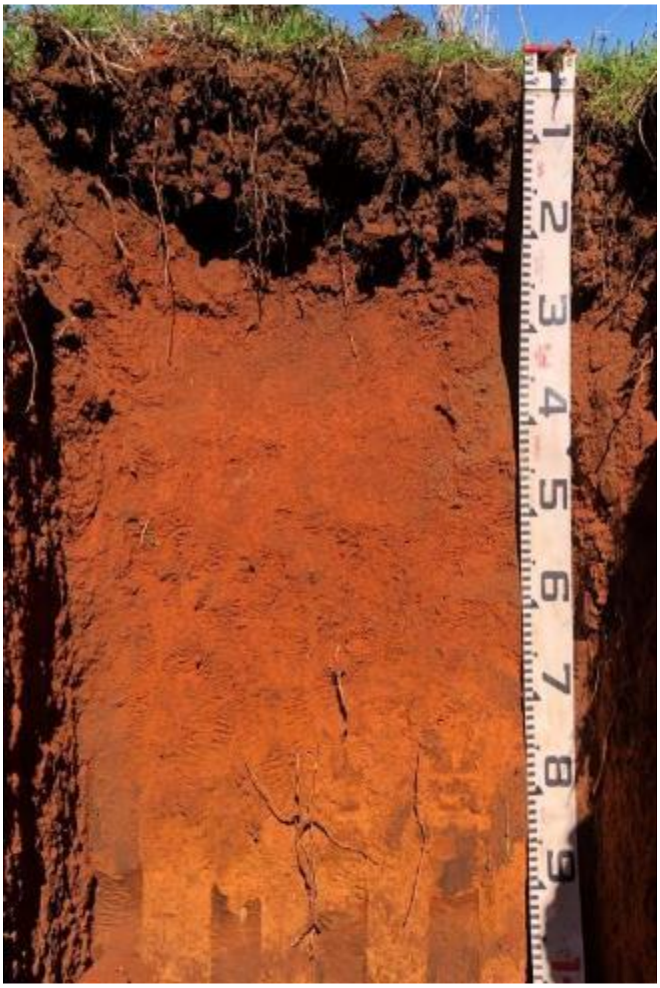


**Plate 1 –** Soil Profile (C33)

**Plate 2 –** Surface (C33)

**Plate 3 –** Landscape (C33)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Brown (Munsell 7.5YR 3/3) Silty Loam, with strong pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B2 | 0.15+ | Red to Light Red (Munsell 10R 4/8 to 2.5YR 6/8) Clay Loam trending to Medium Clay, with strong pedality. Slightly acidic to neutral pH, non-saline. Non-sodic. No coarse fragments. Very few roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 5.3 | Strongly Acidic | 0.4 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.5 | Slightly Acidic | 0.5 | Non-sodic |
| 0.40-0.50 | 0.5 | Non-saline | 6.7 | Neutral | 0.7 | Non-sodic |
| 0.65-0.75 | 0.4 | Non-saline | 7.0 | Neutral | 1.1 | Non-sodic |

| Site Description – Site C34 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C34 | **ASC Name** | Manganic Eutrophic Brown Dermosol (BFLOW) | | |
| **Average Slope** | 5% | **Land Use** | Grazing | | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | | MGA 55 |
| **Landform Element** | Upper Slope/Crest | **BSAL Site Status** | Verified BSAL | | X: 686228 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | | Y: 6285903 |

**Plate 2 –** Surface (C34)

**Plate 1 –** Soil Profile (C34)

**Plate 3 –** Landscape (C34)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Dark Brown (Munsell 7.5YR 3/4) Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B21 | 0.10 – 0.50 | Dark Brown (Munsell 7.5YR 3/4 to 10YR 3/3) Loam to Clay Loam, with strong pedality. Neutral to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.50 – 0.90 | Dark Brown to Brown (Munsell 10YR 4/3) Light Clay with strong pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.6 | Non-saline | 6.0 | Moderately Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.8 | Neutral | 0.9 | Non-sodic |
| 0.40-0.50 | 0.5 | Non-saline | 7.3 | Mildly Alkaline | 1.3 | Non-sodic |
| 0.65-0.75 | 0.4 | Non-saline | 7.8 | Moderately Alkaline | 4.0 | Non-sodic |

| Site Description – Site C35 | | | | |
|---|---|---|---|---|
| **Site Reference** | C35 | **ASC Name** | Brown Vertosol | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 686286 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6285054 |

**Plate 1 –** Soil Profile (C5)

**Plate 2 –** Surface (C35)

**Plate 3 –** Landscape (C35)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Brown Clay Loam (field assessment), with moderate pedality. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B2 | 0.10 – 0.60 | Brown Clay (field assessment), with strong pedality. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| C | 0.60+ | Weathered parent material. |

No laboratory sample analysis due to limited soil depth and presence of extensive surface rock outcrop associated with this soil unit.

| Site Description – Site C36 | | | | |
|---|---|---|---|---|
| **Site Reference** | C36 | **ASC Name** | Bleached Eutrophic Brown Chromosol (BGLOWNR) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 685806 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6285109 |

**Plate 1 –** Soil Profile (C36)

**Plate 2 –** Surface (C36)

**Plate 3 –** Landscape (C36)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Greyish Brown (Munsell 2.5Y 3/2) Silty Loam, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| A2 | 0.10 – 0.35 | Olive Brown (Munsell 2.5Y 4/3) Loam, with weak pedality. Slightly acidic pH, non-saline. Non-sodic. 20% coarse fragments <5mm. Few fine roots and poorly drained. Clear boundary. |
| B2 | 0.35+ | Dark Grey to Olive (Munsell 10YR 4/1 to 5Y 4/3) Heavy Clay with strong pedality. Neutral trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and poorly drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 7.1 | Neutral | 1.9 | Non-sodic |
| 0.20-0.30 | 0.5 | Non-saline | 6.5 | Slightly Acidic | 1.1 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.2 | Neutral | 1.7 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.2 | Moderately Alkaline | 3.2 | Non-sodic |

## Site Description – Site C37

| Site Reference | C37 | ASC Name | Bleached Eutrophic Brown Chromosol (BFKOWNR) | |
|---|---|---|---|---|
| Average Slope | 4% | Land Use | Grazing | Coordinates |
| Landform Pattern | Hillslope | Soil Fertility | Moderately High | MGA 55 |
| Landform Element | Lower Slope | BSAL Site Status | Verified Non-BSAL | X: 685830 |
| Surface Condition | Soft | Mapped as BSAL | No | Y: 6285450 |

**Plate 1 –** Soil Profile (C37)

**Plate 2 –** Surface (C37)

**Plate 3 –** Landscape (C37)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very Dark Greyish Brown (Munsell 10YR 3/2) Loamy Sand, with moderate pedality. Very strongly acidic pH, slightly-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| A2 | 0.20 – 0.40 | Grey (Munsell 5Y 6/1) Silty Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. 20% coarse fragments <5mm. No roots and poorly drained. Clear boundary. |
| B2 | 0.40+ | Light Olive Brown to Very Dark Greyish Brown Olive (Munsell 2.5Y 5/3 to 2.5Y 3/2) Heavy Clay with strong pedality. Mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and poorly drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 2.2 | Slightly saline | 4.9 | Very Strongly Acidic | 2.5 | Non-sodic |
| 0.20-0.30 | 0.1 | Non-saline | 6.7 | Neutral | 1.8 | Non-sodic |
| 0.40-0.50 | 0.5 | Non-saline | 7.3 | Mildly Alkaline | 3.2 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.5 | Mildly Alkaline | 3.2 | Non-sodic |

| Site Description – Site C38 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C38 | **ASC Name** | - | | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | - | MGA 55 | |
| **Landform Element** | Crest | **BSAL Site Status** | Verified Non-BSAL | X: 685810 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6285896 | |

**Plate 1 –** Soil Profile (C38)

**Plate 2 –** Surface (C38)

**Plate 3 –** Landscape (C38)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Brown Clay Loam (field assessment) with strong pedality. Presence of large surface rock. Many fine roots and moderately drained. Gradual boundary. |
| B/C | 0.10+ | 80% weathered parent material. |

No laboratory sample analysis due to soil depth and surface rock limitations associated with this soil unit.

| Site Description – Site C39 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C39 | **ASC Name** | Mottled Eutrophic Red Chromosol (CEMOWNR) | | |
| **Average Slope** | 6% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 | |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 685260 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285470 | |

**Plate 1 –** Soil Profile (C39)

**Plate 2 –** Surface (C39)

**Plate 3 –** Landscape (C39)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.30 | Dark Reddish Brown (Munsell 5YR 3/3) Loam, with moderate pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.30 – 0.60 | Dark Brown to Dark Reddish Brown (Munsell 7.5YR 3/4 to 2.5YR 3/4) Clay Loam, with moderate pedality. Neutral to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.60+ | Dark Yellowish Brown (Munsell to 10YR 3/6) Heavy Clay with moderate pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 8.0 | Moderately Alkaline | 4.5 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.9 | Neutral | 0.8 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.7 | Mildly Alkaline | 1.4 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.2 | Moderately Alkaline | 2.1 | Non-sodic |

| Site Description – Site C40 | | | | |
|---|---|---|---|---|
| **Site Reference** | C40 | **ASC Name** | Vertic Eutrophic Black Chromosol (BFMOWNR) | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 684917 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285467 |


**Plate 1 –** Soil Profile (C40)

**Plate 2 –** Surface (C40)

**Plate 3 –** Landscape (C40)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Brown (Munsell 7.5YR 2.5/3) Clay Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.10 – 0.50 | Black to Very Dark Brown (Munsell 7.5YR 2.5/1 to 10YR 2/2) Heavy Clay, with strong pedality. Neutral trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B22 | 0.50+ | Black (Munsell 5Y 2.5/2) Heavy Clay with strong pedality. Neutral trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Very few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 5.9 | Moderately Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 7.1 | Neutral | 1.4 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.9 | Moderately Alkaline | 2.4 | Non-sodic |
| 0.65-0.75 | 0.6 | Non-saline | 8.3 | Moderately Alkaline | 3.4 | Non-sodic |

| Site Description – Site C41 | | | | |
|---|---|---|---|---|
| **Site Reference** | C41 | **ASC Name** | Bleached-Sodic Eutrophic Brown Chromosol (BFLOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified BSAL | X: 684472 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285493 |

**Plate 1 –** Soil Profile (C41)

**Plate 2 –** Surface (C41)

**Plate 3 –** Landscape (C41)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Brown (Munsell 7.5YR 2.5/3) Silty Loam, with moderate pedality. Very strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many roots and moderately drained. Clear boundary. |
| A2 | 0.10 – 0.20 | Light Grey (Munsell 5Y 7/1) Silty Loam. Apedal structure. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. Abrupt boundary. |
| B2 | 0.20 – 1.00 | Olive Brown to Light Olive-Brown (Munsell 2.5Y 4/3 to 2.5Y 5/3) Heavy Clay with strong pedality. Neutral trending to strongly alkaline pH, non-saline. Sodic. No coarse fragments. Few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 5.0 | Very Strongly Acidic | 3.2 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 5.6 | Moderately Acidic | 2.6 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.3 | Neutral | 3.8 | Non-sodic |
| 0.65-0.75 | 0.5 | Non-saline | 8.8 | Strongly Alkaline | 6.5 | Sodic |

| Site Description – Site C42 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C42 | **ASC Name** | Vertic Eutrophic Black Chromosol (BFLOWNR) | | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | High | MGA 55 | |
| **Landform Element** | Crest | **BSAL Site Status** | Verified BSAL | X: 684517 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285940 | |

**Plate 2 –** Surface (C42)

**Plate 1 –** Soil Profile (C42)

**Plate 3 –** Landscape (C42)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Grey (Munsell 10YR 3/1) Clay Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.10 – 0.40 | Dark Brown (Munsell 7.5YR 3/2) Heavy Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. Clear boundary. |
| B22 | 0.40+ | Olive Grey to Dark Greyish Brown (Munsell 5Y 4/2 to 2.5Y 4/2) Heavy Clay with strong pedality. Mildly alkaline trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 6.0 | Moderately Acidic | 2.1 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.6 | Neutral | 1.3 | Non-sodic |
| 0.40-0.50 | 0.4 | Non-saline | 7.4 | Mildly Alkaline | 2.5 | Non-sodic |
| 0.65-0.75 | 0.5 | Non-saline | 8.2 | Moderately Alkaline | 4.3 | Non-sodic |

| Site Description – Site C43 | | | | |
|---|---|---|---|---|
| **Site Reference** | C43 | **ASC Name** | Manganic Subnatric Grey Sodosol (BGKOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately Low | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 684913 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6285942 |

**Plate 1 –** Soil Profile (C43)

**Plate 2 –** Surface (C43)

**Plate 3 –** Landscape (C43)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Dark Greyish Brown (Munsell 2.5Y 4/2) Loamy Sand, with moderate pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| A2 | 0.10 – 0.35 | Grey (Munsell 5Y 5/1) Silty Loam, apedal structure. Slightly acidic pH, non-saline. Non-sodic. 30% coarse fragments <10mm. Very few fine roots and poorly drained. Clear boundary. |
| B21 | 0.35 – 0.60 | Brown (Munsell 7.5YR 4/2) Heavy Clay with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Very few roots and poorly drained. Gradual boundary. |
| B22 | 0.60 – 1.20 | Light Olive Brown (Munsell 2.5Y 5/3) Heavy Clay with strong pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and poorly drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 2.5 | Slightly saline | 6.2 | Slightly Acidic | 1.9 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.3 | Slightly Acidic | 2.3 | Non-sodic |
| 0.40-0.50 | 0.7 | Non-saline | 7.0 | Neutral | 6.6 | Sodic |
| 0.65-0.75 | 0.8 | Non-saline | 8.1 | Moderately Alkaline | 10.9 | Sodic |

| Site Description – Site C44 | | | | |
|---|---|---|---|---|
| **Site Reference** | C44 | **ASC Name** | Red Dermosol | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 685295 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6285899 |

**Plate 1 –** Soil Profile (C44)

**Plate 2 –** Surface (C44)

**Plate 3 –** Landscape (C44)

**Description**

No laboratory sample analysis due to limited soil depth and surface rockiness.

| Site Description – Site C45 | | | | |
|---|---|---|---|---|
| **Site Reference** | C45 | **ASC Name** | Brown Vertosol | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 684604 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6286370 |

**Plate 1 –** Soil Profile (C45)

**Plate 2 –** Surface (C45)

**Plate 3 –** Landscape (C45)

**Description**

Shallow soil (0.0 – 0.60). No laboratory sample analysis due to limited soil depth.

| Site Description – Site C46 | | | | |
|---|---|---|---|---|
| **Site Reference** | C46 | **ASC Name** | Haplic Eutrophic Red Dermosol (BELOW) | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 684892 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286364 |

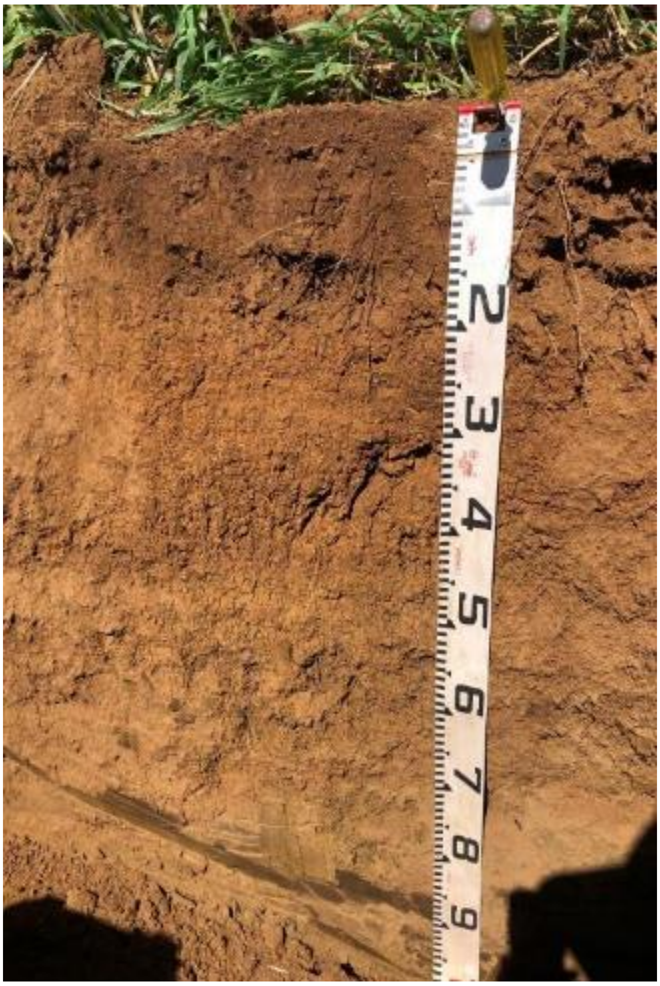

**Plate 2 –** Surface (C46)

**Plate 1 –** Soil Profile (C46)

**Plate 3 –** Landscape (C46)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Reddish-Grey (Munsell 5YR 4/2) Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B21 | 0.20 – 0.50 | Reddish-Brown (Munsell 2.5YR 4/4 to 2.5YR 4/4) Loam to Clay Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.50 – 1.00 | Olive-Brown (Munsell 2.5Y 4/3) Heavy Clay with strong pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.0 | Non-saline | 5.6 | Moderately Acidic | 1.2 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.7 | Neutral | 1.1 | Non-sodic |
| 0.40-0.50 | 0.7 | Non-saline | 7.1 | Neutral | 2.0 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.1 | Moderately Alkaline | 2.6 | Non-sodic |

| Site Description – Site C47 | | | | |
|---|---|---|---|---|
| **Site Reference** | C47 | **ASC Name** | Haplic Eutrophic Red Dermosol (BFMOW) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified BSAL | X: 685334 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286382 |


**Plate 1 –** Soil Profile (C47)

**Plate 2 –** Surface (C47)

**Plate 3 –** Landscape (C47)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dusky-Red (Munsell 2.5YR 2.5/2) Silty Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B21 | 0.10 – 0.40 | Dark Reddish-Brown (Munsell 2.5YR 2.5/3) Silty Clay Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40 – 0.60 | Dark Reddish-Brown (Munsell 5YR 3/4) Light Medium Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B23 | 0.60 – 0.90 | Dusky-Red (Munsell 10R 3/2) Heavy Clay, with strong pedality. Mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 5.4 | Strongly Acidic | 1.0 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.6 | Neutral | 1.2 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.2 | Neutral | 1.1 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.5 | Mildly Alkaline | 1.9 | Non-sodic |

| Site Description – Site C48 | | | | |
|---|---|---|---|---|
| **Site Reference** | C48 | **ASC Name** | Brown Vertosol | |
| **Average Slope** | 8% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderate | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 685810 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6286395 |

**Plate 2 –** Surface (C48)

**Plate 1 –** Soil Profile (C48)

**Plate 3 –** Landscape (C48)

**Description**

Shallow soil (0.0 – 0.50). No laboratory sample analysis due to limited soil depth.

| Site Description – Site C49 | | | | |
|---|---|---|---|---|
| **Site Reference** | C49 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BFLOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Drainage Line | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified BSAL | X: 686190 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286378 |


**Plate 1 –** Soil Profile (C49)

**Plate 2 –** Surface (C49)

**Plate 3 –** Landscape (C49)

| Horizon | Depth (m) | Description |
|---|---|---|
| A11 | 0.00 – 0.10 | Dark Reddish-Grey (Munsell 2.5YR 3/1) Silty Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| A12 | 0.10 – 0.30 | Reddish-Brown (Munsell 2.5YR 4/3) Silty Clay Loam, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. Clear boundary. |
| B2 | 0.30 – 1.00 | Brown to Light Olive-Brown (Munsell 7.5YR 5/3 to 2.5Y 5/3) Heavy Clay with strong pedality. Neutral trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Very few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 5.2 | Strongly Acidic | 1.0 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.4 | Slightly Acidic | 1.3 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.2 | Neutral | 1.7 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.0 | Moderately Alkaline | 2.7 | Non-sodic |

| Site Description – Site C50 | | | | |
|---|---|---|---|---|
| **Site Reference** | C50 | **ASC Name** | Vertic Eutrophic Brown Dermosol (BFMOW) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 686263 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286660 |


**Plate 1 –** Soil Profile (C50)

**Plate 2 –** Surface (C50)

**Plate 3 –** Landscape (C50)

| Horizon | Depth (m) | Description |
|---|---|---|
| A11 | 0.00 – 0.15 | Very Dark Greyish-Brown (Munsell 2.5Y 3/2) Clay Loam, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| A12 | 0.15 – 0.30 | Very Dark Greyish-Brown (Munsell 10YR 3/2) Clay Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. Gradual boundary. |
| B2 | 0.30+ | Dark Yellowish-Brown to Yellowish-Brown (Munsell 10YR 4/6 to 10YR 5/4) Heavy Clay with strong pedality. Mildly alkaline trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Very few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 6.2 | Slightly Acidic | 0.4 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 7.1 | Neutral | 0.9 | Non-sodic |
| 0.40-0.50 | 0.4 | Non-saline | 7.8 | Mildly Alkaline | 1.5 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.4 | Moderately Alkaline | 3.1 | Non-sodic |

| Site Description – Site C51 | | | | |
|---|---|---|---|---|
| **Site Reference** | C51 | **ASC Name** | Manganic Mottled-Subnatric Grey Sodosol (BFKOWNR) | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 686567 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6286828 |

**Plate 2 –** Surface (C51)

**Plate 1 –** Soil Profile (C51)

**Plate 3 –** Landscape (C51)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Grey (Munsell 5Y 4/1) Silty Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| A2 | 0.15 – 0.45 | Gray (Munsell 5Y 6/1) Silty Loam, apedal structure. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and poorly drained. Clear boundary. |
| B2 | 0.45 – 1.00 | Light Greyish-Brown (Munsell 2.5Y 6/2) Heavy Clay, with moderate pedality. Neutral trending to moderately alkaline pH, non-saline. Sodic. No coarse fragments. No roots and poorly drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.2 | Non-saline | 5.4 | Strongly Acidic | 2.4 | Non-sodic |
| 0.20-0.30 | 0.1 | Non-saline | 6.4 | Slightly Acidic | 2.4 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.7 | Mildly Alkaline | 8.4 | Sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.3 | Moderately Alkaline | 10.7 | Sodic |

| Site Description – Site C52 | | | | |
|---|---|---|---|---|
| **Site Reference** | C52 | **ASC Name** | Vertic Eutrophic Yellow Chromosol (BFMOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified BSAL | X: 686249 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6287270 |

**Plate 1 –** Soil Profile (C52)

**Plate 2 –** Surface (C52)

**Plate 3 –** Landscape (C52)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very Dark Brown (Munsell 7.5YR 2.5/3) Silty Clay Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B2 | 0.20 – 0.90 | Olive-Yellow to Yellowish-Brown (Munsell 2.5Y 6/6 to 10YR 5/4) Heavy Clay, with strong pedality. Slightly acidic trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 5.5 | Moderately Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 0.5 | Non-saline | 6.5 | Slightly Acidic | 0.8 | Non-sodic |
| 0.40-0.50 | 0.4 | Non-saline | 7.2 | Neutral | 1.4 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.0 | Moderately Alkaline | 2.0 | Non-sodic |

| Site Description – Site C53 | | | | |
|---|---|---|---|---|
| **Site Reference** | C53 | **ASC Name** | Vertic Mesotrophic Brown Chromosol (BFLOWNR) | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 687113 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287278 |

**Plate 1 –** Soil Profile (C53)

**Plate 2 –** Surface (C53)

**Plate 3 –** Landscape (C53)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Olive Brown (Munsell 2.5Y 4/3) Loamy Sand, with moderate pedality. Moderately acidic pH, slightly saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| A2 | 0.10 – 0.30 | Dark Brown (Munsell 10YR 3/3) Silty Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. 40% coarse fragments 10mm. Few fine roots and poorly drained. Clear boundary. |
| B2 | 0.30+ | Light Olive Brown (Munsell 2.5Y 5/6 to 2.5Y 5/4) Heavy Clay, with strong pedality. Neutral trending to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and poorly drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 3.0 | Slightly saline | 5.5 | Moderately Acidic | 1.6 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.8 | Neutral | 2.0 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 6.8 | Neutral | 2.1 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.4 | Mildly Alkaline | 1.9 | Non-sodic |

| Site Description – Site C54 | | | | |
|---|---|---|---|---|
| **Site Reference** | C54 | **ASC Name** | Vertic Eutrophic Red Chromosol (BELOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid/Upper Slope | **BSAL Site Status** | Verified BSAL | X: 686683 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6287275 |

**Plate 2 –** Surface (C54)

**Plate 1 –** Soil Profile (C54)

**Plate 3 –** Landscape (C54)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very Dark Grey (Munsell 7.5YR 3/1) Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B2 | 0.15 – 1.00 | Reddish-Brown to Yellowish-Red (Munsell 2.5YR 4/4 to 5YR 5/6) Light Clay to Heavy Clay, with strong pedality. Slightly acidic trending to neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 5.2 | Strongly Acidic | 2.3 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.2 | Slightly Acidic | 1.0 | Non-sodic |
| 0.40-0.50 | 0.4 | Non-saline | 6.8 | Neutral | 2.5 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.3 | Neutral | 4.0 | Non-sodic |

| Site Description – Site C55 | | | | |
|---|---|---|---|---|
| **Site Reference** | C55 | **ASC Name** | Manganic Eutrophic Red Dermosol (BGOOW) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified Non-BSAL | X: 686666 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287735 |

**Plate 2 –** Surface (C55)

**Plate 1 –** Soil Profile (C55)

**Plate 3 –** Landscape (C55)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Brown (Munsell 7.5YR 4/3) Silty Clay Loam, with moderate pedality. Very strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| A2 | 0.10 – 0.30 | Yellowish-Red (Munsell 5YR 5/6) Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B21 | 0.30 – 0.60 | Reddish-Brown (Munsell 5YR 4/4) Clay Loam, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. Gradual boundary. |
| B22 | 0.60+ | Olive Yellow (Munsell 2.5Y 6/6) Heavy Clay with moderate pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.0 | Non-saline | 5.0 | Very Strongly Acidic | 1.4 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 5.9 | Moderately Acidic | 1.2 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.1 | Neutral | 1.4 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.8 | Moderately Alkaline | 2.2 | Non-sodic |

| Site Description – Site C56 | | | | |
|---|---|---|---|---|
| **Site Reference** | C56 | **ASC Name** | Epipedal Brown Vertosol | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified Non-BSAL | X: 686227 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287701 |

**Plate 1 –** Soil Profile (C56)

**Plate 2 –** Surface (C56)

**Plate 3 –** Landscape (C56)

**Description**

No laboratory sample analysis due to soil depth and surface rock limitations associated with this soil unit.

| Site Description – Site C57 | | | | |
|---|---|---|---|---|
| **Site Reference** | C57 | **ASC Name** | Epipedal Brown Vertosol | |
| **Average Slope** | 7% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Crest | **BSAL Site Status** | Verified Non-BSAL | X: 685807 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6286809 |

**Plate 1 –** Soil Profile (C57)

**Plate 2 –** Surface (C57)

**Plate 3 –** Landscape (C57)

**Description**

Shallow soil (0.0 – 0.5m). No laboratory sample analysis due to soil depth limitations associated with this unit.

| Site Description – Site C58 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C58 | **ASC Name** | Epipedal Brown Vertosol | | |
| **Average Slope** | 6% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 | |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified Non-BSAL | X: 685789 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287272 | |

**Plate 2 –** Surface (C58)

**Plate 1 –** Soil Profile (C58)

**Plate 3 –** Landscape (C58)

## Description

Shallow soil (0.0 – 0.4m). No laboratory sample analysis due to soil depth and surface rock outcrop limitations associated with this unit.

| Site Description – Site C59 | | | | |
|---|---|---|---|---|
| **Site Reference** | C59 | **ASC Name** | Vertic Eutrophic Red Chromosol (BFLOWNR) | |
| **Average Slope** | 8% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified BSAL | X: 685374 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6287269 |


**Plate 1 –** Soil Profile (C59)

**Plate 2 –** Surface (C59)

**Plate 3 –** Landscape (C59)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Brown (Munsell 7.5YR 3/3) Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. 10% coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.15 – 0.60 | Dark Reddish Brown to Dark Yellowish Brown (Munsell 2.5YR 3/4 to 10YR 4/6) Heavy Clay to Medium Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. 10% coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.60+ | Yellowish-Brown (Munsell 10YR 5/6) Loam, with moderate pedality. Mildly alkaline pH, non-saline. Non-sodic. 10% coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.6 | Non-saline | 6.0 | Moderately Acidic | 0.6 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.7 | Neutral | 0.8 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.2 | Neutral | 1.1 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.4 | Mildly Alkaline | 1.6 | Non-sodic |

| Site Description – Site C60 | | | | |
|---|---|---|---|---|
| **Site Reference** | C60 | **ASC Name** | Haplic Eutrophic Brown Chromosol (BFLOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Drainage Line | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified BSAL | X: 685356 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6286813 |

**Plate 2 –** Surface (C60)

**Plate 1 –** Soil Profile (C60)

**Plate 3 –** Landscape (C60)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very Dark Brown (Munsell 7.5YR 2.5/3) Silty Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| A2 | 0.20 – 0.40 | Dark Reddish-Brown (Munsell 5YR 2.5/2) Clay Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. Clear boundary. |
| B2 | 0.40 – 1.00 | Very Dark Reddish-Brown to Olive Brown (Munsell 10 YR 3/2 to 2.5Y 4/3) Heavy Clay with strong pedality. Mildly alkaline trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 5.9 | Moderately Acidic | 0.5 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.9 | Neutral | 0.7 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.7 | Mildly Alkaline | 1.6 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.2 | Moderately Alkaline | 2.8 | Non-sodic |

| Site Description – Site C61 | | | | |
|---|---|---|---|---|
| **Site Reference** | C61 | **ASC Name** | Vertic Eutrophic Red Chromosol (BFMOWNR) | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 684879 |
| **Surface Condition** | Hard Set | **Mapped as BSAL** | Yes | Y: 6286793 |

**Plate 1 –** Soil Profile (C61)

**Plate 2 –** Surface (C61)

**Plate 3 –** Landscape (C61)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Brown (Munsell 7.5YR 3/2) Silty Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B21 | 0.15 – 0.40 | Reddish-Brown (Munsell 2.5YR 4/3) Heavy Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40+ | Pale Olive to Olive (Munsell 5Y 6/4 to 5Y 4/4) Heavy Clay to Medium Clay, with strong pedality. Neutral trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.0 | Non-saline | 5.7 | Moderately Acidic | 0.6 | Non-sodic |
| 0.20-0.30 | 0.1 | Non-saline | 6.8 | Neutral | 0.7 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 7.3 | Neutral | 0.8 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.7 | Mildly Alkaline | 1.2 | Non-sodic |

| Site Description – Site C62 | | | | |
|---|---|---|---|---|
| **Site Reference** | C62 | **ASC Name** | Vertic Eutrophic Black Chromosol (BFMOWNR) | |
| **Average Slope** | 6% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified BSAL | X: 685377 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6287712 |

**Plate 1 –** Soil Profile (C62)

**Plate 2 –** Surface (C62)

**Plate 3 –** Landscape (C62)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Reddish-Brown (Munsell 5YR 3/2) Silty Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B21 | 0.15 – 0.40 | Dark Brown (Munsell 7.5YR 3/2) Heavy Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40+ | Very dark Greyish Brown to Olive (Munsell 10YR 3/2 to 5Y 4/4) Heavy Clay, with strong pedality. Mildly alkaline trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 5.6 | Moderately Acidic | 0.4 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.8 | Neutral | 0.6 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.7 | Mildly Alkaline | 1.4 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.2 | Moderately Alkaline | 2.4 | Non-sodic |

| Site Description – Site C63 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C63 | **ASC Name** | Vertic Eutrophic Red Chromosol (BEMOWNR) | | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 | |
| **Landform Element** | Crest | **BSAL Site Status** | Verified BSAL | X: 685047 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288174 | |

**Plate 1 –** Soil Profile (C63)

**Plate 2 –** Surface (C63)

**Plate 3 –** Landscape (C63)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very Dark Brown (Munsell 5YR 3/1) Silty Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.15 – 0.50 | Dark Reddish-Brown to Reddish-Brown (Munsell 2.5YR 3/4 to 2.5Y 4/3) Heavy Clay, with strong pedality. Neutral pH trending to mildly alkaline, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B22 | 050+ | Dark Reddish Grey (Munsell 5YR 4/2) Heavy Clay, with moderate pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.9 | Non-saline | 5.6 | Moderately Acidic | 0.4 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.9 | Neutral | 0.8 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.3 | Mildly Alkaline | 1.3 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.6 | Mildly Alkaline | 1.8 | Non-sodic |

| Site Description – Site C64 | | | | |
|---|---|---|---|---|
| **Site Reference** | C64 | **ASC Name** | Vertic Eutrophic Red Chromosol (BFMOWNR) | |
| **Average Slope** | 6% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified BSAL | X: 685344 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288189 |

**Plate 1 –** Soil Profile (C64)

**Plate 2 –** Surface (C64)

**Plate 3 –** Landscape (C64)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Reddish-Grey (Munsell 2.5YR 3/1) Silty Loam, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.15 – 0.50 | Dark Reddish-Brown to Dark Brown (Munsell 2.5YR 3/3 to 7.5YR 3/2) Heavy Clay, with strong pedality. Neutral pH trending to mildly alkaline, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B22 | 0.50+ | Dark Yellowish-Brown (Munsell 10YR 4/6) Heavy Clay, with moderate pedality. Mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.4 | Non-saline | 6.5 | Neutral | 0.4 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.6 | Neutral | 0.6 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.1 | Neutral | 0.6 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.6 | Mildly Alkaline | 0.7 | Non-sodic |

| Site Description – Site C65 | | | | |
|---|---|---|---|---|
| **Site Reference** | C65 | **ASC Name** | Epipedal Brown Vertosol | |
| **Average Slope** | 8% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 685792 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288190 |

**Plate 2 –** Surface (C65)

**Plate 1 –** Soil Profile (C65)

**Plate 3 –** Landscape (C65)

## Description

No laboratory sample analysis due to surface rock limitations (>30%) associated with this soil unit.

| Site Description – Site C66 | | | | |
|---|---|---|---|---|
| **Site Reference** | C66 | **ASC Name** | Vertic Eutrophic Black Chromosol (BFLOWNR) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 685769 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6287761 |

**Plate 1 –** Soil Profile (C66)

**Plate 2 –** Surface (C66)

**Plate 3 –** Landscape (C66)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Grey (Munsell 10YR 3/1) Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B2 | 0.10 – 0.80 | Very Dark Greyish Brown to Dark Olive Grey (Munsell 10YR 2/2 to 5Y 3/2) Light Medium Clay to Heavy Clay, with strong pedality. Neutral trending to strongly alkaline pH, non-saline. Non-sodic. No coarse fragments. Few fine roots decreasing with depth and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 5.9 | Moderately Acidic | 1.2 | Non-sodic |
| 0.20-0.30 | 0.7 | Non-saline | 6.7 | Neutral | 1.0 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.8 | Moderately Alkaline | 1.9 | Non-sodic |
| 0.65-0.75 | 0.4 | Non-saline | 8.4 | Strongly Alkaline | 3.7 | Non-sodic |

| Site Description – Site C67 | | | | |
|---|---|---|---|---|
| **Site Reference** | C67 | **ASC Name** | Manganic Eutrophic Red Dermosol (BELOW) | |
| **Average Slope** | 0% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Drainage Plain | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Drainage Line | **BSAL Site Status** | Verified BSAL | X: 686191 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288164 |

**Plate 1 –** Soil Profile (C67)

**Plate 2 –** Surface (C67)

**Plate 3 –** Landscape (C67)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dusky Brown (Munsell 2.5YR 2.5/2) Silty Loam, with moderate pedality. Strongly acid pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B21 | 0.10 – 0.40 | Dark Reddish-Brown (Munsell 2.5YR 3/3) Silty Loam, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40 – 0.65 | Dark Reddish-Brown (Munsell 5YR 3/4) Loam, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and poorly drained. Gradual boundary. |
| B23 | 0.65+ | Very Dark Greyish-Brown (Munsell 10YR 3/2) Clay Loam, with moderate pedality. Neutral pH, non-saline. Sodic. No coarse fragments. No roots and poorly drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.6 | Non-saline | 5.4 | Strongly Acidic | 0.8 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.3 | Slightly Acidic | 1.1 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 6.8 | Neutral | 2.0 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.2 | Neutral | 6.9 | Sodic |

| Site Description – Site C68 | | | | |
|---|---|---|---|---|
| **Site Reference** | C68 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BFLOWNR) | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Drainage Plain | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Drainage Line | **BSAL Site Status** | Verified BSAL | X: 686650 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288089 |

**Plate 1 –** Soil Profile (C68)

**Plate 2 –** Surface (C68)

**Plate 3 –** Landscape (C68)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very Dark Grey (Munsell 10YR 3/1) Silty Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Clear boundary. |
| B21 | 0.20 – 0.50 | Very Dark Greyish-Brown to Very Dark Grey (Munsell 2.5Y 3/2 to 2.5Y 3/1) Light Clay to Heavy Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.50+ | Olive (Munsell 5Y 4/3) Heavy Clay with strong pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.4 | Non-saline | 5.5 | Moderately Acidic | 1.2 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.7 | Neutral | 1.4 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.2 | Neutral | 2.4 | Non-sodic |
| 0.65-0.75 | 0.4 | Non-saline | 8.4 | Moderately Alkaline | 5.2 | Non-sodic |

| Site Description – Site C69 | | | | |
|---|---|---|---|---|
| **Site Reference** | C69 | **ASC Name** | Mottled Eutrophic Black Dermosol (BFLOW) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 686719 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288607 |

**Plate 1 –** Soil Profile (C69)

**Plate 2 –** Surface (C69)

**Plate 3 –** Landscape (C69)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark Brown (Munsell 7.5YR 3/2) Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. Minor coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B21 | 0.20 – 0.40 | Very Dark Greyish-Brown to Dark Reddish-Brown (Munsell 10YR 3/2) Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40+ | Dark Reddish-Brown to Olive Grey (Munsell 5YR 3/2 to 5Y 4/2) Heavy Clay, with strong pedality. Neutral to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Very few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.6 | Non-saline | 5.8 | Moderately Acidic | 0.7 | Non-sodic |
| 0.20-0.30 | 0.5 | Non-saline | 6.6 | Neutral | 1.3 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.1 | Neutral | 1.6 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.6 | Mildly Alkaline | 2.7 | Non-sodic |

| Site Description – Site C70 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | C70 | **ASC Name** | Vertic Eutrophic Red Dermosol (BFLOW) | | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 | |
| **Landform Element** | Crest | **BSAL Site Status** | Verified BSAL | X: 687149 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6289080 | |

**Plate 1 –** Soil Profile (C70)

**Plate 2 –** Surface (C70)

**Plate 3 –** Landscape (C70)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Dark Brown (Munsell 7.5YR 3/3) Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B21 | 0.10 – 0.40 | Dark Red (Munsell 2.5YR 3/6) Clay Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and well drained. Gradual boundary. |
| B22 | 0.40+ | Red to Dark Reddish Brown (Munsell 2.5YR 4/8 to 2.5YR 3/4) Medium Clay to Heavy Clay with strong pedality. Mildly alkaline trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Very few roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.0 | Non-saline | 5.8 | Moderately Acidic | 1.1 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.7 | Neutral | 1.8 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.6 | Mildly Alkaline | 2.7 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 8.0 | Moderately Alkaline | 4.9 | Non-sodic |

| Site Description – Site C71 | | | | |
|---|---|---|---|---|
| **Site Reference** | C71 | **ASC Name** | Vertic Eutrophic Red Dermosol (BFMOW) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified BSAL | X: 687151 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288663 |

**Plate 2 –** Surface (C71)

**Plate 1 –** Soil Profile (C71)

**Plate 3 –** Landscape (C71)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very Dark Brown (Munsell 10YR 2/2) Silty Clay Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B21 | 0.20 – 0.40 | Dark Reddish-Brown (Munsell 5YR 2.5/2) Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40+ | Dark Reddish-Brown to Olive Brown (Munsell 2.5YR 3/4 to 2.5Y 4/4) Heavy Clay with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.6 | Non-saline | 5.9 | Moderately Acidic | 0.4 | Non-sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.8 | Neutral | 0.6 | Non-sodic |
| 0.40-0.50 | 0.3 | Non-saline | 6.9 | Neutral | 0.9 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.2 | Neutral | 1.3 | Non-sodic |

| Site Description – Site C72 | | | | |
|---|---|---|---|---|
| **Site Reference** | C72 | **ASC Name** | Vertic Eutrophic Red Dermosol (BFKMW) | |
| **Average Slope** | 9 - 12% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified Non-BSAL | X: 687589 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288667 |

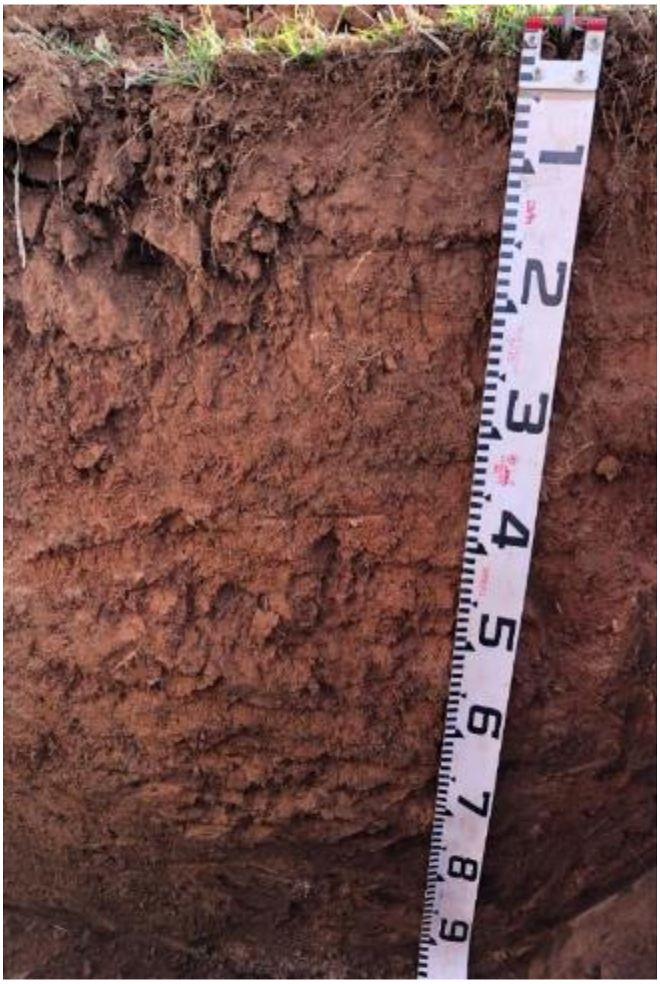

**Plate 1 –** Soil Profile (C72)

**Plate 2 –** Surface (C72)

**Plate 3 –** Landscape (C72)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.40 | Dusky Brown to Dusky Red (Munsell 7.5YR 3/3 to 10R 3/4) Loamy Sand to Loam, with moderate pedality. Very strongly acidic trending to slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B2 | 0.40 – 1.00 | Red (Munsell 2.5YR 4/8) Clay Loam with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common roots and well drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.3 | Non-saline | 5.0 | Very Strongly Acidic | 1.4 | Non-sodic |
| 0.20-0.30 | 0.1 | Non-saline | 6.3 | Slightly Acidic | 1.4 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 6.8 | Neutral | 0.7 | Non-sodic |
| 0.65-0.75 | 0.1 | Non-saline | 7.0 | Neutral | 0.8 | Non-sodic |

| Site Description – Site C73 | | | | |
|---|---|---|---|---|
| **Site Reference** | C73 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BFMOWNR) | |
| **Average Slope** | 7% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 687574 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6289049 |

**Plate 1 –** Soil Profile (C73)

**Plate 2 –** Surface (C73)

**Plate 3 –** Landscape (C73)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very Dark Brown (Munsell 7.5YR 2.5/2) Clay Loam, with moderate pedality. Moderately acidic trending to slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B2 | 0.15 – 1.00 | Dark Brown to Olive (Munsell 7.5YR 3/2 to 5Y 5/4) Heavy Clay trending to Clay Loam, with moderate pedality. Neutral trending to mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. Common roots throughout and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.4 | Non-saline | 6.0 | Moderately Acidic | 0.6 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 7.0 | Neutral | 0.7 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.4 | Mildly Alkaline | 0.7 | Non-sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.8 | Mildly Alkaline | 1.1 | Non-sodic |

| Site Description – Site D1 | | | | |
|---|---|---|---|---|
| **Site Reference** | D1 | **ASC Name** | Vertic Eutrophic Brown Chromosol (BFLOWNR) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Crest | **BSAL Site Status** | Verified BSAL | X: 684178 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6285261 |

**Plate 1 –** Soil Profile (D1)

**Plate 2 –** Surface (D1)

**Plate 3 –** Landscape (D1)

| Horizon | Depth (m) | Description |
|---|---|---|
| A11 | 0.00 – 0.10 | Dark Reddish-Brown (Munsell 2.5YR 3/3) Loam, with strong pedality. Strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Gradual boundary. |
| A12 | 0.10 – 0.30 | Dark Reddish-Brown (Munsell 2.5YR 3/4) Clay Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Clear boundary. |
| B2 | 0.30+ | Light Olive Brown to Olive (Munsell 2.5Y 5/6 to 5Y 4/3) Heavy Clay with strong pedality. Moderately alkaline to strongly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 5.4 | Strongly Acidic | 0.9 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.7 | Neutral | 1.0 | Non-sodic |
| 0.40-0.50 | 0.4 | Non-saline | 8.0 | Moderately Alkaline | 2.6 | Non-sodic |
| 0.65-0.75 | 1.2 | Non-saline | 8.5 | Strongly Alkaline | 2.7 | Non-sodic |

| Site Description – Site D2 | | | | |
|---|---|---|---|---|
| **Site Reference** | D2 | **ASC Name** | Brown Vertosol | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Crest | **BSAL Site Status** | Verified Non-BSAL | X: 684101 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6285860 |

**Plate 1 –** Soil Profile (D2)

**Plate 2 –** Surface (D2)

**Plate 3 –** Landscape (D2)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Brown Clay Loam (field assessment), with strong pedality. No coarse fragments. Many roots and moderately drained. Gradual boundary. |
| B2 | 0.15 – 0.60 | Brown Clay (field assessment), with strong pedality. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| C | 0.60+ | Parent material. |

No laboratory sample analysis due to soil depth limitations associated with this soil unit.

| Site Description – Site D3 | | | | |
|---|---|---|---|---|
| **Site Reference** | D3 | **ASC Name** | Brown Vertosol | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified Non-BSAL | X: 684545 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6286901 |

**Plate 1 –** Soil Profile (D3)

**Plate 2 –** Surface (D3)

**Plate 3 –** Landscape (D3)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Brown Clay (field assessment), with strong pedality. No coarse fragments. Many roots and moderately drained. Gradual boundary. |
| B2 | 0.15 – 0.50 | Brown Clay (field assessment), with strong pedality. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| C | 0.50+ | Parent material. |

No laboratory sample analysis due to soil depth limitations associated with this soil unit.

| Site Description – Site D4 | | | | |
|---|---|---|---|---|
| **Site Reference** | D4 | **ASC Name** | Brown Vertosol | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 683338 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6287388 |

**Plate 2 –** Surface (D4)

**Plate 1 –** Soil Profile (D4)

**Plate 3 –** Landscape (D4)

**Description**

No laboratory sample analysis due to soil depth limitations associated with this soil profile.

| Site Description – Site D5 | | | | |
|---|---|---|---|---|
| **Site Reference** | D5 | **ASC Name** | Haplic Eutrophic Black Kandosol (BFLLWNR) | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Drainage slope | **Soil Fertility** | Moderate | MGA 55 |
| **Landform Element** | Lower slope | **BSAL Site Status** | Verified BSAL | X: 683140 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6287144 |


**Plate 1 –** Soil Profile (D5)

**Plate 2 –** Surface (D5)

**Plate 3 –** Landscape (D5)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Brown (Munsell 7.5YR 2.5/3) Loamy Sand, with moderate pedality. Slightly acidic pH, slightly saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B21 | 0.10 – 0.50 | Dark Reddish-Brown (Munsell 5YR 3/2) Silty Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common roots and well drained. Gradual boundary. |
| B22 | 0.50+ | Red (Munsell 5YR 3/4 to 2.5YR 4/8) Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. Minor gravel presence. Few roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 2.9 | Slightly saline | 6.5 | Slightly Acidic | 0.6 | Non-sodic |
| 0.20-0.30 | 0.5 | Non-saline | 7.0 | Neutral | 1.7 | Non-sodic |
| 0.40-0.50 | 0.6 | Non-saline | 6.9 | Neutral | 1.8 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.0 | Neutral | 3.0 | Non-sodic |

| Site Description – Site D6 | | | | |
|---|---|---|---|---|
| Site Reference | D6 | ASC Name | Haplic Eutrophic Black Kandosol (BFLLWNR) | |
| Average Slope | 0% | Land Use | Grazing | Coordinates |
| Landform Pattern | Alluvial Bank | Soil Fertility | Moderate | MGA 55 |
| Landform Element | Drainage Line | BSAL Site Status | Verified BSAL | X: 682707 |
| Surface Condition | Soft | Mapped as BSAL | Yes | Y: 6286912 |

**Plate 1 –** Soil Profile (D6)

**Plate 2 –** Surface (D6)

**Plate 3 –** Landscape (D6)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Brown (Munsell 7.5YR 2.5/3) Silty Loam, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| B21 | 0.10 – 0.35 | Very Dark Brown (Munsell 10YR 2/2) Silty Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common roots and well drained. Gradual boundary. |
| B22 | 0.35+ | Dark Reddish-Brown to Dark-Yellowish Brown (Munsell 5YR 3/4 to 10YR 3/6) Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 6.1 | Slightly Acidic | 2.4 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.9 | Neutral | 1.3 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 7.2 | Neutral | 1.7 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.2 | Neutral | 1.7 | Non-sodic |

| Site Description – Site D10 | | | | |
|---|---|---|---|---|
| **Site Reference** | D10 | **ASC Name** | Haplic Eutrophic Red Dermosol (BELMW) | |
| **Average Slope** | 0% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Alluvial Flat | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Drainage Line | **BSAL Site Status** | Verified BSAL | X: 683962 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6290230 |

**Plate 2 –** Surface (C10)

**Plate 1 –** Soil Profile (D10)

**Plate 3 –** Landscape (D10)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very Dark Brown (Munsell 10YR 2/2) Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B21 | 0.15 – 0.60 | Dark Reddish-Brown (Munsell 5YR 4/4) Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. Gradual boundary. |
| B22 | 0.60 – 0.80 | Very Dark Brown (Munsell 10YR 2/2) Clay Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.4 | Non-saline | 6.0 | Moderately Acidic | 1.2 | Non-sodic |
| 0.20-0.30 | 0.5 | Non-saline | 6.6 | Neutral | 1.3 | Non-sodic |
| 0.40-0.50 | 0.4 | Non-saline | 6.9 | Neutral | 1.0 | Non-sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.1 | Neutral | 1.0 | Non-sodic |

| Site Description – Site D11 | | | | |
|---|---|---|---|---|
| **Site Reference** | D11 | **ASC Name** | Haplic Eutrophic Red Dermosol (BELOV) | |
| **Average Slope** | 3% | **Land Use** | Pine Forest | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Crest | **BSAL Site Status** | Verified Non-BSAL | X: 688402 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6295439 |


**Plate 1 –** Soil Profile (D11)

**Plate 2 –** Surface (D11)

**Plate 3 –** Landscape (D11)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very Dark Brown (Munsell 7.5YR 2.5/2) Loamy Sand, with moderate pedality. Very strongly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Gradual boundary. |
| A2 | 0.20 – 0.40 | Reddish-Brown (Munsell 5YR 4/4) Loamy Sand, with moderate pedality. Strongly acidic pH, non-saline. Non-sodic. 10% coarse fragments 100mm. Common roots and well drained. Clear boundary. |
| BC | 0.40+ | Red (Munsell 10R 4/8) Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. 50% coarse fragments 10 – 50mm. Few large roots and well drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 4.8 | Very Strongly Acidic | 0.3 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 5.2 | Strongly Acidic | 0.7 | Non-sodic |
| 0.40-0.50 | 0.2 | Non-saline | 5.7 | Moderately Acidic | 1.6 | Non-sodic |
| 0.65-0.75 | 0.1 | Non-saline | 5.7 | Moderately Acidic | 2.2 | Non-sodic |

| Site Description – Site D13 | | | | |
|---|---|---|---|---|
| **Site Reference** | D13 | **ASC Name** | Brown Vertosol | |
| **Average Slope** | 7% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | - | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified Non-BSAL | X: 684545 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6286901 |

**Plate 1 –** Soil Profile (D13)

**Plate 2 –** Surface (D13)

**Plate 3 –** Landscape (D13)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Brown Clay (field assessment), with strong pedality. No coarse fragments. Many roots and moderately drained. Gradual boundary. |
| B2 | 0.10 – 0.55 | Brown Clay (field assessment), with strong pedality. 20% coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| C | 0.55+ | Parent material. |
| No laboratory sample analysis due to soil depth limitations associated with this soil unit. | | |

| Site Description – Site D14 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | D14 | **ASC Name** | Brown Dermosol | | |
| **Average Slope** | 7% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillslope | **Soil Fertility** | - | MGA 55 | |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified Non-BSAL | X: 684545 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6286901 | |


**Plate 1 –** Soil Profile (D14)

**Plate 2 –** Surface (D14)

**Plate 3 –** Landscape (D14)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Brown Clay Loam (field assessment), with strong pedality. 10% coarse fragments. Many roots and moderately drained. Gradual boundary. |
| B2 | 0.10 – 0.20 | Brown Clay (field assessment), with strong pedality. 10% coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| C | 0.20+ | Parent material. |

No laboratory sample analysis due to soil depth limitations associated with this soil unit.

| Site Description – Site D18 | | | | |
|---|---|---|---|---|
| **Site Reference** | D18 | **ASC Name** | Vertic Eutrophic Black Chromosol (BEMOWNR) | |
| **Average Slope** | 3% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Ridgeline | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Crest | **BSAL Site Status** | Verified BSAL | X: 683198 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6289407 |

**Plate 1 –** Soil Profile (D18)

**Plate 2 –** Surface (D18)

**Plate 3 –** Landscape (D18)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.30 | Very Dark Brown (Munsell 10YR 2/2) Clay Loam, with strong pedality. Slightly acidic trending to neutral pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and moderately drained. Gradual boundary. |
| B2 | 0.30 – 0.90 | Very Dark Greyish-Brown to Dark Olive Grey (Munsell 10YR 3/2 to 5Y 3/2) Heavy Clay, with strong pedality. Moderately alkaline to strongly alkaline pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 6.1 | Slightly Acidic | 1.5 | Non-sodic |
| 0.20-0.30 | 0.2 | Non-saline | 7.2 | Neutral | 0.7 | Non-sodic |
| 0.40-0.50 | 0.4 | Non-saline | 8.4 | Moderately Alkaline | 1.2 | Non-sodic |
| 0.65-0.75 | 0.5 | Non-saline | 8.5 | Strongly Alkaline | 2.0 | Non-sodic |

| Site Description – Site D19 | | | | |
|---|---|---|---|---|
| **Site Reference** | D19 | **ASC Name** | Haplic Eutrophic Red Chromosol (BEKOWNR) | |
| **Average Slope** | 0% | **Land Use** | Pine Forest | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Crest | **BSAL Site Status** | Verified BSAL | X: 688087 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6296286 |

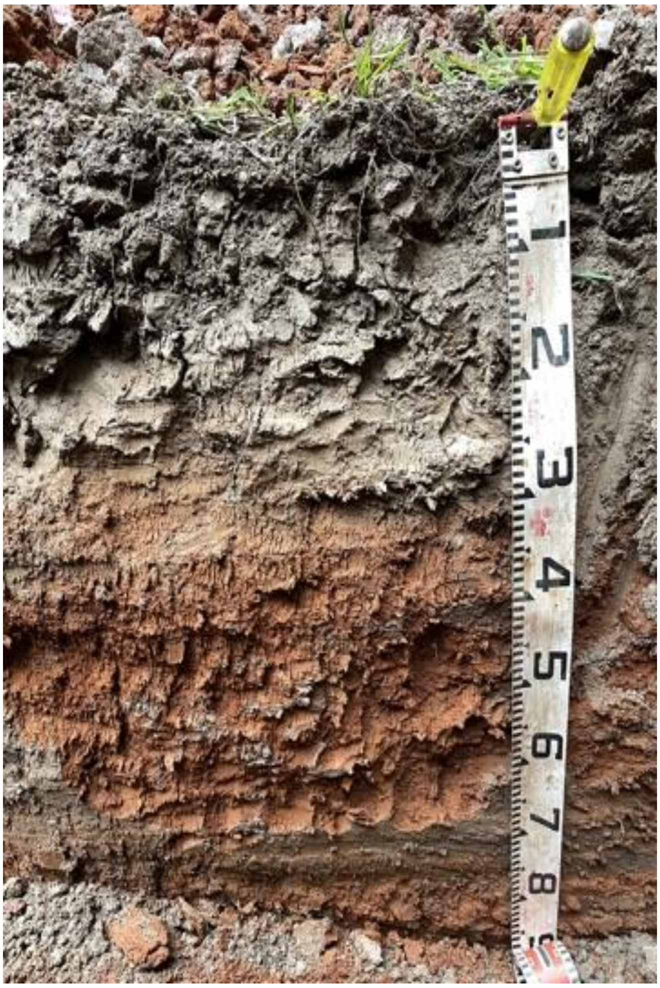

**Plate 1 –** Soil Profile (D19)

**Plate 2 –** Surface (D19)

**Plate 3 –** Landscape (D19)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Dark Grey (Munsell 7.5YR 4/1) Silty Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| A2 | 0.10 – 0.30 | Olive Brown (Munsell 2.5Y 4/4) Loamy Sand, with weak pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Many fine roots and well drained. Clear boundary. |
| B2 | 0.30 – 0.90 | Red to Dark Red (Munsell 10R 4/8 to 10R 3/6) Heavy Clay, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.3 | Non-saline | 6.0 | Moderately Acidic | 1.0 | Non-sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.0 | Slightly Acidic | 1.3 | Non-sodic |
| 0.40-0.50 | 0.1 | Non-saline | 5.8 | Moderately Acidic | 0.8 | Non-sodic |
| 0.65-0.75 | 0.1 | Non-saline | 5.9 | Moderately Acidic | 0.8 | Non-sodic |

| Site Description – Site M1 | | | | |
|---|---|---|---|---|
| **Site Reference** | M1 | **ASC Name** | Haplic Eutrophic Brown Dermosol (BEMOW) | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 685489 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288313 |

**Plate 1 –** Soil Profile (M1)

**Plate 2 –** Surface (M1)

**Plate 3 –** Landscape (M1)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very dark brown (Munsell 7.5YR 2.5/2) Clay Loam, with moderate pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Gradual boundary. |
| A2 | 0.15 – 0.35 | Dark brown (Munsell 7.5YR 3/3) Light Medium Clay, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Gradual boundary. |
| B21 | 0.35 – 0.60 | Dark yellowish-brown (Munsell 10YR 4/4) Medium Clay, with strong pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. Gradual boundary. |
| B22 | 0.60+ | Dark yellowish-brown (Munsell 10YR 4/4) Heavy Clay, with strong pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 6.2 | Slightly Acidic | 0.5 | Non sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.8 | Neutral | 1.1 | Non sodic |
| 0.40-0.50 | 0.4 | Non-saline | 8.0 | Moderately Alkaline | 2.4 | Non sodic |
| 0.65-0.75 | 0.6 | Non-saline | 8.3 | Moderately Alkaline | 3.5 | Non sodic |

| Site Description – Site M2 | | | | |
|---|---|---|---|---|
| **Site Reference** | M2 | **ASC Name** | Brown Dermosol | |
| **Average Slope** | 6% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 685697 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288278 |

**Plate 1 –** Soil Profile (M2)

**Plate 2 –** Surface (M2)

**Plate 3 –** Landscape (M2)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark brown Clay Loam (field texture), with moderate pedality. No coarse fragments. Many roots and well drained. Gradual boundary. |
| A2 | 0.15 – 0.40 | Light brown Silty Clay Loam (field texture), with moderate pedality. No coarse fragments. Common roots and well drained. Gradual boundary. |
| B2 | 0.40 – 0.75 | Dark yellowish brown Medium Clay (field texture), with strong pedality. No coarse fragments. Very few roots and moderately drained. |

| Site Description – Site M3 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | M3 | **ASC Name** | Eutrophic Mesonatric Brown Sodosol (BFLMWNR) | | |
| **Average Slope** | 8% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately Low | MGA 55 | |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 686501 | |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288634 | |

**Plate 2 –** Surface (M3)

**Plate 1 –** Soil Profile (M3)

**Plate 3 –** Landscape (M3)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Very dark greyish brown (Munsell 10YR 3/2) Silty Loam, with moderate pedality. Strongly acidic pH, moderately saline. Sodic. No coarse fragments. Many roots and moderately drained. Gradual boundary. |
| A2 | 0.20 – 0.40 | Dark reddish grey (Munsell 2.5YR 4/1) Silty Loam, with weak pedality. Strongly acidic pH, moderately saline. Sodic. No coarse fragments. Very few roots and imperfectly drained. Clear boundary. |
| B2 | 0.40+ | Dark yellowish brown to brown (Munsell 10YR 4/4 to 10YR 4/3) Clay Loam, with strong pedality. Mildly alkaline trending to strongly alkaline pH, slightly saline trending to non-saline. Sodic. No coarse fragments. 30% distinct grey mottles. No roots and imperfectly drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 6.6 | Moderately saline | 5.5 | Strongly Acidic | 13.5 | Sodic |
| 0.20-0.30 | 6.5 | Moderately saline | 6.5 | Slightly Acidic | 19.6 | Sodic |
| 0.40-0.50 | 3.1 | Slightly saline | 7.6 | Mildly Alkaline | 16.0 | Sodic |
| 0.65-0.75 | 1.6 | Non-saline | 8.7 | Strongly Alkaline | 17.4 | Sodic |

| Site Description – Site M4 | | | | |
|---|---|---|---|---|
| **Site Reference** | M4 | **ASC Name** | Haplic Eutrophic Brown Chromosol (BFLOWNR) | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 686420 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6288574 |

**Plate 2 –** Surface (M4)

**Plate 1 –** Soil Profile (M4)

**Plate 3 –** Landscape (M4)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very dark brown (Munsell 7.5YR 2.5/3) Loam, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Clear boundary. |
| B21 | 0.15 – 0.30 | Very dark brown (Munsell 7.5YR 2.5/3) Light Medium Clay with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. Clear boundary. |
| B22 | 0.30+ | Strong brown (Munsell 7.5YR 4/6) Light Medium Clay to Medium Clay, with strong pedality. Mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. Very few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.8 | Non-saline | 6.1 | Slightly Acidic | 1.3 | Non sodic |
| 0.20-0.30 | 0.4 | Non-saline | 6.6 | Neutral | 1.1 | Non sodic |
| 0.40-0.50 | 0.4 | Non-saline | 7.4 | Mildly Alkaline | 2.6 | Non sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.6 | Mildly Alkaline | 3.4 | Non sodic |

| Site Description – Site M5 | | | | |
|---|---|---|---|---|
| **Site Reference** | M5 | **ASC Name** | Haplic Hypocalcic Brown Chromosol (BEKOWNR) | |
| **Average Slope** | 4% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 686442 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288477 |

**Plate 1 –** Soil Profile (M5)

**Plate 2 –** Surface (M5)

**Plate 3 –** Landscape (M5)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very dark brown (Munsell 10YR 2/2) Silty Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Clear boundary. |
| A2 | 0.15 – 0.25 | Very dark greyish brown (Munsell 10YR 3/2) Loam, with weak pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. Clear boundary. |
| B2 | 0.25+ | Dark yellowish brown to brown (Munsell 10YR 4/4 to 10YR 4/3) Medium Clay to Sandy Clay Loam, with strong pedality. Mildly alkaline trending to moderately alkaline pH, slightly saline trending to moderately saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.2 | Non-saline | 5.8 | Moderately Acidic | 0.6 | Non sodic |
| 0.15-0.25 | 1.0 | Non-saline | 6.4 | Slightly Acidic | 1.6 | Non sodic |
| 0.40-0.50 | 3.2 | Slightly saline | 7.6 | Mildly Alkaline | 1.6 | Non sodic |
| 0.65-0.75 | 5.3 | Moderately saline | 7.8 | Moderately Alkaline | 2.8 | Non sodic |

| Site Description – Site M6 | | | | |
|---|---|---|---|---|
| **Site Reference** | M6 | **ASC Name** | Brown Dermosol | |
| **Average Slope** | 3% | **Land Use** | Road Verge | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope/Crest | **BSAL Site Status** | Verified Non-BSAL | X: 686202 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6288362 |

**Plate 1 –** Soil Profile (M6)

**Plate 2 –** Surface (M6)

**Plate 3 –** Landscape (M6)

| Horizon | Depth (m) | Description |
|---|---|---|
| A | 0.00 – 0.15 | Dark brown Silty Clay Loam (field assessment), with strong pedality. 30% coarse fragments 60 – 100mm. Many roots and well drained. Gradual boundary. |
| B | 0.15 – 0.30 | Dark reddish brown Light Clay (field assessment), with moderate pedality. 50% coarse fragments 60 – 100mm. Many roots and well drained. |
| C | 0.35 – 0.50 | Parent material |

| Site Description – Site M7 | | | | |
|---|---|---|---|---|
| **Site Reference** | M7 | **ASC Name** | Haplic Hypocalcic Brown Chromosol (BEKMVNR) | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 687637 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6289264 |

**Plate 1 –** Soil Profile (M7)

**Plate 2 –** Surface (M7)

**Plate 3 –** Landscape (M7)

| Horizon | Depth (m) | Description |
|---|---|---|
| A | 0.00 – 0.10 | Dark Brown (Munsell 10YR 3/3) Silty Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Clear boundary. |
| B21 | 0.10 – 0.50 | Dark yellowish brown (Munsell 10YR 4/4) Clay Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Many roots an10YR 4/4d moderately drained. Clear boundary. |
| B22 | 0.50 – 0.60 | Dark drown (Munsell 10YR 3/3) Silty Loam, with weak pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Very few and moderately drained. Clear boundary. |
| C | 0.60+ | Parent material. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.1 | Non-saline | 6.6 | Neutral | 0.5 | Non sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.7 | Neutral | 0.6 | Non sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.1 | Neutral | 0.8 | Non sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.4 | Mildly Alkaline | 1.7 | Non sodic |

| Site Description – Site M8 | | | | |
|---|---|---|---|---|
| **Site Reference** | M8 | **ASC Name** | Haplic Eutrophic Brown Chromosol (BEKOWNR) | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid - Lower Slope | **BSAL Site Status** | Verified Non-BSAL | X: 687437 |
| **Surface Condition** | Soft | **Mapped as BSAL** | No | Y: 6289333 |

**Plate 2 –** Surface (M8)

**Plate 1 –** Soil Profile (M8)

**Plate 3 –** Landscape (M8)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very dark brown (Munsell 7.5YR 2.5/3) Loam, with strong pedality. Neutral pH, moderately saline. Non-sodic. No coarse fragments. Many roots and well drained. Clear boundary. |
| A2 | 0.10 – 0.40 | Dark reddish brown (Munsell 5YR 3/4) Loamy Sand, with strong pedality. Neutral pH, slightly saline. Non-sodic. No coarse fragments. Common roots and moderately drained. Clear boundary. |
| B2 | 0.40 + | Brown to strong brown (Munsell 7.5YR 4/4 to 7.5YR 5/6) Light Medium Clay to Light Clay, with strong pedality. Mildly alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 4.3 | Moderately saline | 6.6 | Neutral | 0.2 | Non sodic |
| 0.20-0.30 | 3.2 | Slightly saline | 6.6 | Neutral | 0.5 | Non sodic |
| 0.40-0.50 | 0.4 | Non-saline | 7.5 | Mildly Alkaline | 2.1 | Non sodic |
| 0.65-0.75 | 0.4 | Non-saline | 7.8 | Mildly Alkaline | 2.6 | Non sodic |

| Site Description – Site M9 | | | | |
|---|---|---|---|---|
| **Site Reference** | M9 | **ASC Name** | Brown Chromosol | |
| **Average Slope** | 9% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 687173 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6289289 |

**Plate 2 –** Surface (M9)

**Plate 1 –** Soil Profile (M9)

**Plate 3 –** Landscape (M9)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Dark brown Loam (field assessment), with strong pedality. 10% coarse fragments 20 – 200mm. Many roots and well drained. Gradual boundary. |
| A2 | 0.10 – 0.25 | Light reddish brown Sandy Clay Loam (field assessment), with moderate pedality. No coarse fragments. Many roots and well drained. Clear boundary. |
| B21 | 0.25 – 0.50 | Yellowish brown Medium Clay (field assessment), with strong pedality. No coarse fragments. Few roots and well drained. Gradual boundary. |
| B22 | 0.50+ | Yellow Heavy Clay (field assessment), with strong pedality. No coarse fragments. No roots and moderately drained. |

| Site Description – Site M10 | | | | |
|---|---|---|---|---|
| **Site Reference** | M10 | **ASC Name** | Haplic Eutrophic Brown Chromosol (BFLOWNR) | |
| **Average Slope** | 8% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **BSAL Site Status** | Verified BSAL | X: 687495 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6289227 |


**Plate 2 –** Surface (M10)

**Plate 1 –** Soil Profile (M10)

**Plate 3 –** Landscape (M10)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very dark brown (Munsell 7.5YR 2.5/2) Silty Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Gradual boundary. |
| A2 | 0.15 – 0.30 | Very dark brown (Munsell 7.5YR 2.5/3) Clay Loam, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Many roots and well drained. Clear boundary. |
| B21 | 0.30 – 0.50 | Dark yellowish brown (Munsell 10YR 4/4) Light Medium Clay, with strong pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. Very few roots and well drained. Clear boundary. |
| B22 | 0.50+ | Dark yellowish brown (Munsell 10YR 4/4) Light Medium Clay, with strong pedality. Moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. No roots and moderately drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.0 | Non-saline | 6.6 | Neutral | 0.4 | Non sodic |
| 0.20-0.30 | 0.6 | Non-saline | 6.9 | Neutral | 0.5 | Non sodic |
| 0.40-0.50 | 0.6 | Non-saline | 7.9 | Moderately Alkaline | 0.9 | Non sodic |
| 0.65-0.75 | 0.6 | Non-saline | 8.3 | Moderately Alkaline | 1.4 | Non sodic |

| Site Description – Site M11 | | | | |
|---|---|---|---|---|
| **Site Reference** | M11 | **ASC Name** | Haplic Eutrophic Red Chromosol (BEMOWNR) | |
| **Average Slope** | 6% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 684220 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6289536 |

**Plate 1 –** Soil Profile (M11)

**Plate 2 –** Surface (M11)

**Plate 3 –** Landscape (M11)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.10 | Very Dark Brown (Munsell 10YR 2/2) Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Many roots and moderately drained. Gradual boundary. |
| B2 | 0.10 – 0.80 | Dark Reddish Brown to Light Olive Brown (Munsell 5YR 3/4 to 2.5Y 5/6) Heavy Clay with strong pedality. Neutral trending to slightly alkaline pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.4 | Non-saline | 6.0 | Moderately Acidic | 1.8 | Non sodic |
| 0.20-0.30 | 0.1 | Non-saline | 6.8 | Neutral | 1.0 | Non sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.3 | Neutral | 1.2 | Non sodic |
| 0.65-0.75 | 0.3 | Non-saline | 7.7 | Mildly Alkaline | 2.1 | Non sodic |

| Site Description – Site M12 | | | | |
|---|---|---|---|---|
| **Site Reference** | M12 | **ASC Name** | Haplic Eutrophic Red Chromosol (BEMOWNR) | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillcrest | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Crest | **BSAL Site Status** | Verified BSAL | X: 683962 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6290230 |

**Plate 2 –** Surface (M12)

**Plate 1 –** Soil Profile (M12)

**Plate 3 –** Landscape (M12)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very Dark Brown (Munsell 7.5YR 2.5/3) Silty Loam with strong pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Clear boundary. |
| B21 | 0.15 – 0.40 | Dark Reddish Brown (Munsell 5YR 3/4) Heavy Clay with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40 – 0.80 | Olive to Olive Brown (Munsell 5YR 5/6 to 2.5Y 4/3) Heavy Clay with strong pedality. Moderately alkaline trending to strongly alkaline pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1-5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.4 | Non-saline | 5.7 | Moderately Acidic | 1.1 | Non sodic |
| 0.20-0.30 | 0.3 | Non-saline | 7.2 | Neutral | 1.2 | Non sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.9 | Moderately Alkaline | 1.6 | Non sodic |
| 0.65-0.75 | 0.5 | Non-saline | 8.4 | Strongly Alkaline | 2.6 | Non sodic |

| Site Description – Site M13 | | | | |
|---|---|---|---|---|
| **Site Reference** | M13 | **ASC Name** | Haplic Eutrophic Red Chromosol (BEMOWNR) | |
| **Average Slope** | 5% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **BSAL Site Status** | Verified BSAL | X: 684292 |
| **Surface Condition** | Soft | **Mapped as BSAL** | Yes | Y: 6289325 |


**Plate 1 –** Soil Profile (M13)

**Plate 2 –** Surface (M13)

**Plate 3 –** Landscape (M13)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark Brown (Munsell 7.5YR 3/4) Silty Clay Loam with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Clear boundary. |
| B21 | 0.15 – 0.40 | Red (Munsell 2.5YR 4/8) Heavy Clay with strong pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Common fine roots and moderately drained. Gradual boundary. |
| B22 | 0.40 – 0.80 | Reddish-yellow to Yellowish-red (Munsell 5YR 6/8 to 5YR 5/8) Silty Clay with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.7 | Non-saline | 6.0 | Moderately Acidic | 1.0 | Non sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.4 | Slightly Acidic | 1.0 | Non sodic |
| 0.40-0.50 | 0.5 | Non-saline | 6.7 | Neutral | 1.5 | Non sodic |
| 0.65-0.75 | 0.5 | Non-saline | 6.7 | Neutral | 1.6 | Non sodic |

| Site Description – Site 12 | | | | |
|---|---|---|---|---|
| **Site Reference** | 12 | **ASC Name** | Haplic Mellic Black Kandosol (BFLLWNR) | |
| **Average Slope** | 2% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Alluvial Flat | **Soil Fertility** | Moderate | MGA 55 |
| **Landform Element** | Depositional Bench | **Permeability** | High | X: 682793 |
| **Surface Condition** | Soft | **ERD** | 1.0m | Y: 6288162 |

**Plate 1 –** Soil Profile (12)

**Plate 2 –** Surface (12)

**Plate 3 –** Landscape (12)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very dark brown (Munsell 10YR 2/2) Loam, with moderate pedality. Neutral pH, non-saline. Non-sodic. 10% coarse fragments 20 – 50mm. Many roots and well drained. Gradual boundary. |
| B21 | 0.15 – 0.50 | Very dark brown (Munsell 10YR 2/2) Loamy Sand, with weak pedality. Mildly alkaline pH, non-saline. Non-sodic. 10% coarse fragments 20 – 50mm. Many roots and well drained. Gradual boundary. |
| B22 | 0.50 – 0.70 | Very dark brown (Munsell 10YR 2/2) Loam, with weak pedality. Mildly alkaline pH, non-saline. Non-sodic. 20% coarse fragments 20 – 100mm. Many roots and well drained. Clear boundary. |
| B23 | 0.70+ | Rock layer. 90% coarse fragments 50 – 100m. |

| Sample Depth | ECe | | pH$_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 7.1 | Neutral | 0.5 | Non sodic |
| 0.20-0.30 | 0.8 | Non-saline | 7.4 | Mildly Alkaline | 0.6 | Non sodic |
| 0.50-0.60 | 0.3 | Non-saline | 7.8 | Mildly Alkaline | 0.7 | Non sodic |

| Site Description – Site 13 | | | | |
|---|---|---|---|---|
| **Site Reference** | 13 | **ASC Name** | Haplic Eutrophic Brown Dermosol (BGKOW) | |
| **Average Slope** | 24% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Lower Slope | **Permeability** | Moderate | X: 682772 |
| **Surface Condition** | Soft | **ERD** | 1.0m | Y: 6287939 |

**Plate 1 –** Soil Profile (13)

**Plate 2 –** Surface (13)

**Plate 3 –** Landscape (13)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very dark brown (Munsell 10YR 2/2) Loamy Sand, with strong pedality. Neutral pH, non-saline. Non-sodic. 5% coarse fragments 10 – 20mm. Many roots and well drained. Gradual boundary. |
| A2 | 0.15 – 0.35 | Very dark brown (Munsell 7.5YR 2.5/3) Loam, with moderate pedality. Neutral pH, non-saline. Non-sodic. 5% coarse fragments 10 – 20mm. Common roots and well drained. Gradual boundary. |
| B22 | 0.35 – 0.80 | Dark Brown (Munsell 7.5YR 3/4) Clay Loam, with strong pedality. Neutral pH, non-saline. Non-sodic. 5% coarse fragments 10 – 20mm. Common roots and moderately drained. Clear boundary. |
| B22 | 0.80+ | Very dark brown (Munsell 7.5YR 2.5/2) Light-medium Clay, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. No coarse fragments. Common roots and moderately drained. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 1.1 | Non-saline | 7.0 | Neutral | 0.3 | Non sodic |
| 0.20-0.30 | 0.3 | Non-saline | 6.9 | Neutral | 0.5 | Non sodic |
| 0.50-0.60 | 0.2 | Non-saline | 6.9 | Neutral | 1.5 | Non sodic |
| 0.80-0.90 | 0.1 | Non-saline | 6.4 | Slightly Acidic | 1.4 | Non sodic |

| Site Description – Site 14 | | | | |
|---|---|---|---|---|
| **Site Reference** | 14 | **ASC Name** | Haplic Eutrophic Red Dermosol (BHMOV) | |
| **Average Slope** | 21% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **Permeability** | Moderate | X: 682403 |
| **Surface Condition** | Soft | **ERD** | 0.55 | Y: 6287650 |

**Plate 1 –** Soil Profile (14)

**Plate 2 –** Surface (14)

**Plate 3 –** Landscape (14)

| Horizon | Depth (m) | Description |
|---|---|---|
| A | 0.00 – 0.15 | Dark reddish-brown (Munsell 5YR 3/4) Clay Loam, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. 40% coarse fragments 10 – 50mm. Many roots and well drained. Gradual boundary. |
| B2 | 0.15 – 0.55 | Yellowish-red (Munsell 5YR 4/6) Medium Clay, with strong pedality. Mildly alkaline pH, non-saline. Non-sodic. 80% coarse fragments 10 – 50mm. Few roots and well drained. Clear boundary. |
| C | 0.55 + | Parent material. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 6.1 | Slightly Acidic | 0.4 | Non sodic |
| 0.30-0.40 | 0.3 | Non-saline | 7.7 | Mildly Alkaline | 0.4 | Non sodic |

| Site Description – Site 15 | | | | |
|---|---|---|---|---|
| **Site Reference** | 15 | **ASC Name** | Basic Paralithic Leptic Tenosol (BHL-UNR) | |
| **Average Slope** | 24% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Low | MGA 55 |
| **Landform Element** | Mid Slope | **Permeability** | Moderate | X: 682798 |
| **Surface Condition** | Soft | **ERD** | 0.15 | Y: 6288794 |

**Plate 2 –** Surface (15)

**Plate 1 –** Soil Profile (15)

**Plate 3 –** Landscape (15)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Very dark brown (Munsell 7.5YR 2.5/2) Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. 20% coarse fragments 20 – 60mm. Many roots and well drained. Clear boundary. |
| C | 0.15+ | Weathered parent material. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.6 | Non-saline | 5.7 | Moderately Acidic | 0.4 | Non sodic |

| Site Description – Site 16 | | | | | |
|---|---|---|---|---|---|
| **Site Reference** | 16 | **ASC Name** | Haplic Eutrophic Red Chromosol (BGMOUNR) | | |
| **Average Slope** | 30% | **Land Use** | Grazing | **Coordinates** | |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 | |
| **Landform Element** | Mid Slope | **Permeability** | High | X: 683592 | |
| **Surface Condition** | Soft | **ERD** | 0.3m | Y: 6288629 | |

**Plate 1 –** Soil Profile (16)

**Plate 2 –** Surface (16)

**Plate 3 –** Landscape (16)

| Horizon | Depth (m) | Description |
|---|---|---|
| A | 0.00 – 0.10 | Dark brown (Munsell 7.5YR 3/4) Clay Loam, with moderate pedality. Moderately acidic pH, non-saline. Non-sodic. 10% coarse fragments 50 – 150mm. Common roots and well drained. Clear boundary. |
| B | 0.10 – 0.30 | Yellowish-red (Munsell 5YR 4/6) Light Clay, with moderate pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. Few roots and moderately drained. Clear boundary. |
| C | 0.30 + | Parent material. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 5.8 | Moderately Acidic | 0.8 | Non sodic |
| 0.20-0.30 | 0.2 | Non-saline | 6.6 | Neutral | 1.2 | Non sodic |
| 0.40-0.50 | 0.1 | Non-saline | 6.6 | Neutral | 1.1 | Non sodic |

| Site Description – Site 17 | | | | |
|---|---|---|---|---|
| **Site Reference** | 17 | **ASC Name** | Mottled Eutrophic Red Chromosol (BEOOWNR) | |
| **Average Slope** | 8% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Upper Slope | **Permeability** | High | X: 684036 |
| **Surface Condition** | Soft | **ERD** | 0.8m | Y: 6288478 |


**Plate 1 –** Soil Profile (17)

**Plate 2 –** Surface (17)

**Plate 3 –** Landscape (17)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark brown (Munsell 7.5YR 3/2) Clay Loam, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. 10% coarse fragments 20 – 50mm. Many roots and well drained. Clear boundary. |
| B21 | 0.15 – 0.50 | Dark reddish-brown (Munsell 5YR 4/4) Heavy Clay, with strong pedality. Neutral pH, non-saline. Non-sodic. No coarse fragments. 10% faint yellow mottles. Few roots and moderately drained. Gradual boundary. |
| B22 | 0.50 – 1.00 | Dark brown to yellowish brown (Munsell 7.5YR 3/4 to 10YR 5/4) Medium Clay to Heavy Clay, with strong pedality. Neutral trending to moderately alkaline pH, non-saline. Non-sodic. No coarse fragments. 20% faint red mottles. Few roots and moderately drained. |
| C | 1.00+ | Parent material |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.3 | Non-saline | 6.3 | Slightly Acidic | 0.9 | Non sodic |
| 0.20-0.30 | 0.2 | Non-saline | 7.3 | Neutral | 1.4 | Non sodic |
| 0.40-0.50 | 0.3 | Non-saline | 7.1 | Neutral | 1.3 | Non sodic |
| 0.65-0.75 | 0.2 | Non-saline | 7.8 | Moderately Alkaline | 1.8 | Non sodic |

| Site Description – Site 18 | | | | |
|---|---|---|---|---|
| **Site Reference** | 18 | **ASC Name** | Haplic Eutrophic Red Chromosol (BGMOVNR) | |
| **Average Slope** | 22% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **Permeability** | Moderate | X: 683599 |
| **Surface Condition** | Soft | **ERD** | 0.6m | Y: 6287597 |


**Plate 1 –** Soil Profile (18)

**Plate 2 –** Surface (18)

**Plate 3 –** Landscape (18)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.20 | Dark brown (Munsell 7.5YR 3/3) Clay Loam, with strong pedality. Moderately acidic pH, non-saline. Non-sodic. 20% coarse fragments 20 – 200mm. Many roots and well drained. Clear boundary. |
| B2 | 0.20 – 0.60 | Dark red (Munsell 2.5YR 3/6) Heavy Clay, with moderate pedality. Slightly acidic pH, non-saline. Non-sodic. 20% coarse fragments 20 – 200mm. Few roots and well drained. Clear boundary. |
| C | 0.60+ | Parent material. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.4 | Non-saline | 5.8 | Moderately Acidic | 1.4 | Non sodic |
| 0.30-0.40 | 0.1 | Non-saline | 6.3 | Slightly Acidic | 0.9 | Non sodic |
| 0.70-0.80 | 0.1 | Non-saline | 6.6 | Neutral | 0.3 | Non sodic |

| Site Description – Site 19 | | | | |
|---|---|---|---|---|
| **Site Reference** | 19 | **ASC Name** | Haplic Eutrophic Brown Dermosol (BHOOU) | |
| **Average Slope** | 15% | **Land Use** | Grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **Permeability** | High | X: 684296 |
| **Surface Condition** | Soft | **ERD** | 0.4m | Y: 6287724 |


**Plate 1 –** Soil Profile (19)

**Plate 2 –** Surface (19)

**Plate 3 –** Landscape (19)

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Dark brown (Munsell 7.5YR 3/4) Silty Clay, with strong pedality. Slightly acidic pH, non-saline. Non-sodic. 20% coarse fragments 20 – 200mm. Many roots and well drained. Gradual boundary. |
| B2 | 0.15 – 0.40 | Very dark brown (Munsell 7.5YR 2.5/3) Heavy Clay, with moderate pedality. Neutral pH, non-saline. Non-sodic. 30% coarse fragments 20 – 200mm. Common roots and well drained. Clear boundary. |
| C | 0.40+ | Parent material. |

| Sample Depth | ECe | | $pH_{(1\text{-}5water)}$ | | ESP | |
|---|---|---|---|---|---|---|
| | dS/m | Rating | Value | Rating | Value | Rating |
| 0-0.10 | 0.5 | Non-saline | 6.1 | Slightly Acidic | 0.9 | Non sodic |
| 0.25-0.35 | 0.1 | Non-saline | 6.9 | Neutral | 0.7 | Non sodic |

| Site Description – Site 8 (2023) | | | | |
|---|---|---|---|---|
| **Site Reference** | 8 (2023) | **ASC Name** | Yellow Chromosol | |
| **Average Slope** | 6% | **Land Use** | Pasture for grazing | **Coordinates** |
| **Landform Pattern** | Hillslope | **Soil Fertility** | Moderately High | MGA 55 |
| **Landform Element** | Mid Slope | **Permeability** | Moderate | X: 684509 |
| **Surface Condition** | Soft | **ERD** | 0.6 | Y: 6294259 |

**Plate 1 –** Soil Profile

**Plate 2 –** Landscape

**Plate 3 –** Surface

| Horizon | Depth (m) | Description |
|---|---|---|
| A1 | 0.00 – 0.15 | Brown (Munsell 10YR 4/3) Loam with moderate pedality. No coarse fragments. Many roots and well drained. Clear boundary. |
| A2 | 0.20 – 0.30 | Bleached light brown (Munsell 10YR 7/1) Loamy Sand with weak pedality. No coarse fragments. Common roots and imperfectly drained. Clear boundary. |
| B2 | 0.30 + | Olive yellow (Munsell 2.5Y 6/6)) Heavy Clay with strong pedality. No coarse fragments. Trace roots and imperfectly drained. 20% distinct grey mottling. |

# Appendix 3
## Certificates of Analysis

Environmental Analysis Laboratory

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# AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUED

58 samples supplied by Minesoils Pty. Ltd. on 17/05/2022. Lab Job No.M8725 re-issued
Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 1 | 1 | 1 | 1 | 2 | 2 |
| | | Sample Depth: | 0-10 | 20-30 | 50-60 | 80-90 | 0-10 | 20-30 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **M8725/1** | **M8725/2** | **M8725/3** | **M8725/4** | **M8725/5** | **M8725/6** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.05 | 7.31 | 8.53 | 8.64 | 5.46 | 7.11 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.074 | 0.039 | 0.105 | 0.216 | 0.068 | 0.025 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 14 | 18 | 20 | 20 | 3.3 | 6.3 |
| | (kg/ha) | | 6,269 | 7,886 | 8,968 | 8,963 | 1,503 | 2,834 |
| | (mg/kg) | | 2,799 | 3,521 | 4,004 | 4,001 | 671 | 1,265 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 4.3 | 7.8 | 19 | 22 | 1.8 | 3.3 |
| | (kg/ha) | | 1,183 | 2,128 | 5,158 | 5,957 | 491 | 886 |
| | (mg/kg) | | 528 | 950 | 2,303 | 2,659 | 219 | 396 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 2.3 | 1.6 | 0.99 | 0.72 | 0.57 | 0.26 |
| | (kg/ha) | | 2,006 | 1,420 | 866 | 629 | 496 | 227 |
| | (mg/kg) | | 896 | 634 | 386 | 281 | 222 | 101 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.12 | 0.12 | 0.72 | 1.6 | 0.17 | 0.12 |
| | (kg/ha) | | 61 | 62 | 370 | 829 | 90 | 60 |
| | (mg/kg) | | 27 | 28 | 165 | 370 | 40 | 27 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | 0.01 | <0.01 | <0.01 | <0.01 | 0.81 | 0.02 |
| | (kg/ha) | | 2.5 | 1.3 | 1.2 | <1 | 164 | 3.5 |
| | (mg/kg) | | 1.1 | <1 | <1 | <1 | 73 | 1.6 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.07 | <0.01 | <0.01 | <0.01 | 0.40 | <0.01 |
| | (kg/ha) | | 1.6 | <1 | <1 | <1 | 9.0 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | 4.0 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 21 | 27 | 41 | 44 | 7.1 | 10.0 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 67 | 65 | 49 | 45 | 47 | 63 |
| Magnesium (%) | | | 21 | 29 | 47 | 50 | 25 | 33 |
| Potassium (%) | | | 11 | 6.0 | 2.4 | 1.6 | 8.0 | 2.6 |
| Sodium - ESP (%) | | | 0.57 | 0.45 | 1.8 | 3.6 | 2.5 | 1.2 |
| Aluminium (%) | | | 0.06 | 0.02 | 0.01 | 0.01 | 11 | 0.17 |
| Hydrogen (%) | | | 0.34 | 0.00 | 0.00 | 0.00 | 5.6 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 3.2 | 2.2 | 1.1 | 0.91 | 1.9 | 1.9 |

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Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 1 | 1 | 1 | 1 | 2 | 2 |
| | | Sample Depth: | 0-10 | 20-30 | 50-60 | 80-90 | 0-10 | 20-30 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | M8725/1 | M8725/2 | M8725/3 | M8725/4 | M8725/5 | M8725/6 |

**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 issued 30/5/22 replaces the report issued on 27/05/2022.

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

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
KS

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## AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

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PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 7 | Sample 8 | Sample 9 | Sample 10 | Sample 11 | Sample 12 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 2 | 2 | 3 | 3 | 4 | 4 |
| | | Sample Depth: | 60-70 | 80-90 | 0-10 | 20-30 | 0-10 | 20-30 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | M8725/7 | M8725/8 | M8725/9 | M8725/10 | M8725/11 | M8725/12 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.45 | 7.45 | 6.35 | 6.25 | 5.33 | 6.29 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.026 | 0.025 | 0.056 | 0.043 | 0.034 | 0.018 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.2 | 8.8 | 7.6 | 8.7 | 1.7 | 2.2 |
| | (kg/ha) | | 3,221 | 3,968 | 3,394 | 3,918 | 751 | 995 |
| | (mg/kg) | | 1,438 | 1,771 | 1,515 | 1,749 | 335 | 444 |
| Exchangeable Magnesium | (cmol+/kg) | | 10 | 15 | 1.4 | 1.6 | 0.59 | 0.66 |
| | (kg/ha) | | 2,734 | 4,068 | 379 | 445 | 162 | 179 |
| | (mg/kg) | | 1,221 | 1,816 | 169 | 199 | 72 | 80 |
| Exchangeable Potassium | (cmol+/kg) | | 0.35 | 0.48 | 1.4 | 1.5 | 0.51 | 0.40 |
| | (kg/ha) | | 309 | 422 | 1,212 | 1,282 | 449 | 348 |
| | (mg/kg) | | 138 | 188 | 541 | 572 | 200 | 156 |
| Exchangeable Sodium | (cmol+/kg) | | 0.21 | 0.45 | <0.065 | 0.10 | <0.065 | <0.065 |
| | (kg/ha) | | 110 | 233 | <33 | 50 | <33 | <33 |
| | (mg/kg) | | 49 | 104 | <15 | 23 | <15 | <15 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | <0.01 | <0.01 | 0.37 | 0.19 | 0.45 | 0.08 |
| | (kg/ha) | | 1.0 | 1.0 | 75 | 39 | 91 | 17 |
| | (mg/kg) | | <1 | <1 | 34 | 18 | 41 | 7.5 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.21 | 0.12 | 0.26 | 0.06 |
| | (kg/ha) | | <1 | <1 | 4.6 | 2.7 | 5.8 | 1.3 |
| | (mg/kg) | | <1 | <1 | 2.1 | 1.2 | 2.6 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 18 | 25 | 11 | 12 | 3.5 | 3.4 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 40 | 36 | 69 | 71 | 47 | 64 |
| Magnesium (%) | | | 56 | 60 | 13 | 13 | 17 | 19 |
| Potassium (%) | | | 2.0 | 1.9 | 13 | 12 | 14 | 12 |
| Sodium - ESP (%) | | | 1.2 | 1.8 | 0.50 | 0.80 | 1.4 | 0.96 |
| Aluminium (%) | | | 0.03 | 0.02 | 3.4 | 1.6 | 13 | 2.4 |
| Hydrogen (%) | | | 0.00 | 0.00 | 1.9 | 0.97 | 7.4 | 1.7 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 0.71 | 0.59 | 5.4 | 5.3 | 2.8 | 3.4 |

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Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 7 | Sample 8 | Sample 9 | Sample 10 | Sample 11 | Sample 12 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 2 | 2 | 3 | 3 | 4 | 4 |
| | Sample Depth: | 60-70 | 80-90 | 0-10 | 20-30 | 0-10 | 20-30 |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | M8725/7 | M8725/8 | M8725/9 | M8725/10 | M8725/11 | M8725/12 |

**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: Collingwo
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.
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 Conditio
17. This report issued 30/5/22 replaces the report issued on 27/05/2022.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

KS

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## AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

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PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 13 | Sample 14 | Sample 15 | Sample 16 | Sample 17 | Sample 18 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 5 | 5 | 6 | 6 | 6 | 7 |
| | | Sample Depth: | 0-10 | 20-30 | 0-10 | 30-40 | 80-90 | 0-10 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **M8725/13** | **M8725/14** | **M8725/15** | **M8725/16** | **M8725/17** | **M8725/18** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.64 | 7.28 | 6.89 | 6.67 | 6.42 | 7.05 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.089 | 0.062 | 0.043 | 0.028 | 0.016 | 0.071 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 25 | 29 | 18 | 17 | 15 | 19 |
| | (kg/ha) | | 11,280 | 12,925 | 7,859 | 7,417 | 6,772 | 8,681 |
| | (mg/kg) | | 5,036 | 5,770 | 3,508 | 3,311 | 3,023 | 3,875 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 7.6 | 7.6 | 3.8 | 4.6 | 5.1 | 4.9 |
| | (kg/ha) | | 2,060 | 2,063 | 1,044 | 1,257 | 1,388 | 1,344 |
| | (mg/kg) | | 920 | 921 | 466 | 561 | 620 | 600 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 0.43 | <0.12 | 0.20 | 0.18 | 0.21 | 0.32 |
| | (kg/ha) | | 378 | <112 | 173 | 160 | 186 | 278 |
| | (mg/kg) | | 169 | <50 | 77 | 72 | 83 | 124 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.10 | 0.45 | 0.30 | 0.41 | 0.21 | 0.28 |
| | (kg/ha) | | 50 | 234 | 152 | 211 | 109 | 146 |
| | (mg/kg) | | 22 | 104 | 68 | 94 | 49 | 65 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | 1.7 | 2.4 | <1 | <1 | 2.0 | <1 |
| | (mg/kg) | | <1 | 1.1 | <1 | <1 | <1 | <1 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 33 | 37 | 22 | 22 | 21 | 25 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 76 | 78 | 80 | 76 | 73 | 78 |
| Magnesium (%) | | | 23 | 21 | 18 | 21 | 25 | 20 |
| Potassium (%) | | | 1.3 | 0.30 | 0.91 | 0.84 | 1.0 | 1.3 |
| Sodium - ESP (%) | | | 0.29 | 1.2 | 1.4 | 1.9 | 1.0 | 1.1 |
| Aluminium (%) | | | 0.03 | 0.03 | 0.02 | 0.02 | 0.05 | 0.02 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 3.3 | 3.8 | 4.6 | 3.6 | 3.0 | 3.9 |

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# AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

58 samples supplied by Minesoils Pty. Ltd. on 17/05/2022. Lab Job No.M8725 re-issued
Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 13 | Sample 14 | Sample 15 | Sample 16 | Sample 17 | Sample 18 |
|---|---|---|---|---|---|---|---|
| | **Sample ID:** | 5 | 5 | 6 | 6 | 6 | 7 |
| | **Sample Depth:** | 0-10 | 20-30 | 0-10 | 30-40 | 80-90 | 0-10 |
| | **Client:** | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | M8725/13 | M8725/14 | M8725/15 | M8725/16 | M8725/17 | M8725/18 |

**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: Collingwo
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 res
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.
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 Conditio
17. This report issued 30/5/22 replaces the report issued on 27/05/2022.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
KS

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PO BOX 11034 TAMWORTH NSW 2340

| Parameter | Unit | Method reference | Sample 19 | Sample 20 | Sample 21 | Sample 22 | Sample 23 | Sample 24 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 7 | 9 | 9 | 9 | 10 | 10 |
| | | Sample Depth: | 20-30 | 0-10 | 20-30 | 40-50 | 0-10 | 20-30 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | M8725/19 | M8725/20 | M8725/21 | M8725/22 | M8725/23 | M8725/24 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.28 | 6.83 | 7.15 | 7.64 | 6.45 | 6.77 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.049 | 0.114 | 0.064 | 0.054 | 0.085 | 0.033 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 22 | 19 | 25 | 38 | 15 | 15 |
| | (kg/ha) | | 10,017 | 8,617 | 11,431 | 17,175 | 6,707 | 6,733 |
| | (mg/kg) | | 4,472 | 3,847 | 5,103 | 7,667 | 2,994 | 3,006 |
| Exchangeable Magnesium | (cmol+/kg) | | 6.0 | 4.6 | 5.1 | 6.5 | 5.3 | 7.9 |
| | (kg/ha) | | 1,644 | 1,256 | 1,392 | 1,767 | 1,440 | 2,153 |
| | (mg/kg) | | 734 | 561 | 621 | 789 | 643 | 961 |
| Exchangeable Potassium | (cmol+/kg) | | 0.18 | 5.0 | 3.3 | 1.6 | 1.2 | 0.26 |
| | (kg/ha) | | 155 | 4,345 | 2,930 | 1,429 | 1,057 | 229 |
| | (mg/kg) | | 69 | 1,940 | 1,308 | 638 | 472 | 102 |
| Exchangeable Sodium | (cmol+/kg) | | 0.37 | <0.065 | 0.15 | 0.30 | 0.11 | 0.21 |
| | (kg/ha) | | 190 | <33 | 77 | 155 | 59 | 108 |
| | (mg/kg) | | 85 | <15 | 34 | 69 | 26 | 48 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| | (kg/ha) | | <1 | 1.2 | 1.5 | <1 | 1.5 | 2.4 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | 1.1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | <0.01 | <0.01 | 0.06 | <0.01 |
| | (kg/ha) | | <1 | <1 | <1 | <1 | 1.2 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 29 | 29 | 34 | 47 | 22 | 23 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 77 | 67 | 75 | 82 | 69 | 64 |
| Magnesium (%) | | | 21 | 16 | 15 | 14 | 24 | 34 |
| Potassium (%) | | | 0.61 | 17 | 9.8 | 3.5 | 5.6 | 1.1 |
| Sodium - ESP (%) | | | 1.3 | 0.12 | 0.44 | 0.65 | 0.53 | 0.90 |
| Aluminium (%) | | | 0.01 | 0.02 | 0.02 | 0.01 | 0.03 | 0.05 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.7 | 4.2 | 5.0 | 5.9 | 2.8 | 1.9 |

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# AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

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Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 19 | Sample 20 | Sample 21 | Sample 22 | Sample 23 | Sample 24 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 7 | 9 | 9 | 9 | 10 | 10 |
| | Sample Depth: | 20-30 | 0-10 | 20-30 | 40-50 | 0-10 | 20-30 |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | M8725/19 | M8725/20 | M8725/21 | M8725/22 | M8725/23 | M8725/24 |

**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: Collingwo
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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11. Conversions to kg/ha = mg/kg x 2.24
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*Quality Checked: Kris Saville*
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PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 25 | Sample 26 | Sample 27 | Sample 28 | Sample 29 | Sample 30 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 10 | 10 | 11 | 11 | 11 | 11 |
| | | Sample Depth: | 50-60 | 70-80 | 0-10 | 15-25 | 30-40 | 50-60 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **M8725/25** | **M8725/26** | **M8725/27** | **M8725/28** | **M8725/29** | **M8725/30** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.69 | 7.41 | 6.41 | 6.66 | 6.76 | 8.13 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.024 | 0.028 | 0.045 | 0.023 | 0.025 | 0.060 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 17 | 22 | 7.0 | 5.6 | 12 | 14 |
| | (kg/ha) | | 7,539 | 9,779 | 3,154 | 2,496 | 5,404 | 6,306 |
| | (mg/kg) | | 3,366 | 4,366 | 1,408 | 1,114 | 2,412 | 2,815 |
| Exchangeable Magnesium | (cmol+/kg) | | 14 | 18 | 2.9 | 3.3 | 12 | 18 |
| | (kg/ha) | | 3,739 | 4,801 | 788 | 894 | 3,318 | 4,917 |
| | (mg/kg) | | 1,669 | 2,143 | 352 | 399 | 1,481 | 2,195 |
| Exchangeable Potassium | (cmol+/kg) | | 0.29 | 0.29 | 0.72 | 0.22 | 0.41 | 0.46 |
| | (kg/ha) | | 255 | 253 | 632 | 192 | 363 | 404 |
| | (mg/kg) | | 114 | 113 | 282 | 86 | 162 | 180 |
| Exchangeable Sodium | (cmol+/kg) | | 0.54 | 1.1 | 0.07 | 0.11 | 0.50 | 1.5 |
| | (kg/ha) | | 276 | 548 | 39 | 56 | 260 | 791 |
| | (mg/kg) | | 123 | 245 | 17 | 25 | 116 | 353 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.09 | 0.04 | 0.01 | 0.01 | 0.04 | 0.02 |
| | (kg/ha) | | 19 | 8.2 | 2.9 | 2.1 | 8.9 | 3.4 |
| | (mg/kg) | | 8.4 | 3.7 | 1.3 | <1 | 4.0 | 1.5 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 31 | 41 | 11 | 9.2 | 25 | 34 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 53 | 53 | 65 | 61 | 48 | 41 |
| Magnesium (%) | | | 44 | 43 | 27 | 36 | 48 | 53 |
| Potassium (%) | | | 0.93 | 0.71 | 6.7 | 2.4 | 1.6 | 1.4 |
| Sodium - ESP (%) | | | 1.7 | 2.6 | 0.70 | 1.2 | 2.0 | 4.5 |
| Aluminium (%) | | | 0.30 | 0.10 | 0.13 | 0.11 | 0.18 | 0.05 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.2 | 1.2 | 2.4 | 1.7 | 0.99 | 0.78 |

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# AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

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Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 25 | Sample 26 | Sample 27 | Sample 28 | Sample 29 | Sample 30 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 10 | 10 | 11 | 11 | 11 | 11 |
| | Sample Depth: | 50-60 | 70-80 | 0-10 | 15-25 | 30-40 | 50-60 |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | M8725/25 | M8725/26 | M8725/27 | M8725/28 | M8725/29 | M8725/30 |

**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: Collingwo
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,
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9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil re
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12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimat
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*Quality Checked: Kris Saville*
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# AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUED

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Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | Unit | Method reference | Sample 31 | Sample 32 | Sample 33 | Sample 34 | Sample 35 | Sample 36 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 12 | 12 | 12 | 13 | 13 | 13 |
| | | Sample Depth: | 0-10 | 20-30 | 50-60 | 0-10 | 20-30 | 50-60 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | M8725/31 | M8725/32 | M8725/33 | M8725/34 | M8725/35 | M8725/36 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.13 | 7.43 | 7.75 | 6.96 | 6.90 | 6.86 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.054 | 0.034 | 0.027 | 0.046 | 0.028 | 0.019 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 16 | 14 | 14 | 18 | 14 | 15 |
| | (kg/ha) | | 7,144 | 6,353 | 6,500 | 7,909 | 6,233 | 6,805 |
| | (mg/kg) | | 3,189 | 2,836 | 2,902 | 3,531 | 2,783 | 3,038 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.6 | 3.2 | 3.5 | 2.6 | 1.7 | 2.5 |
| | (kg/ha) | | 703 | 879 | 941 | 695 | 469 | 669 |
| | (mg/kg) | | 314 | 393 | 420 | 310 | 209 | 299 |
| Exchangeable Potassium | (cmol+/kg) | | 0.75 | 0.32 | 0.35 | 0.43 | 0.22 | 0.35 |
| | (kg/ha) | | 659 | 284 | 310 | 374 | 189 | 305 |
| | (mg/kg) | | 294 | 127 | 138 | 167 | 84 | 136 |
| Exchangeable Sodium | (cmol+/kg) | | 0.10 | 0.12 | 0.12 | 0.07 | 0.08 | 0.27 |
| | (kg/ha) | | 52 | 60 | 62 | 35 | 41 | 139 |
| | (mg/kg) | | 23 | 27 | 28 | 16 | 18 | 62 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 |
| | (kg/ha) | | 2.9 | 2.6 | 3.5 | 4.0 | 3.3 | 4.6 |
| | (mg/kg) | | 1.3 | 1.1 | 1.6 | 1.8 | 1.5 | 2.1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 19 | 18 | 18 | 21 | 16 | 18 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 82 | 79 | 79 | 85 | 87 | 83 |
| Magnesium (%) | | | 13 | 18 | 19 | 12 | 11 | 13 |
| Potassium (%) | | | 3.9 | 1.8 | 1.9 | 2.1 | 1.4 | 1.9 |
| Sodium - ESP (%) | | | 0.52 | 0.65 | 0.65 | 0.33 | 0.50 | 1.5 |
| Aluminium (%) | | | 0.07 | 0.07 | 0.09 | 0.10 | 0.10 | 0.12 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 6.2 | 4.4 | 4.2 | 6.9 | 8.1 | 6.2 |

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## AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

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Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 31 | Sample 32 | Sample 33 | Sample 34 | Sample 35 | Sample 36 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 12 | 12 | 12 | 13 | 13 | 13 |
| | Sample Depth: | 0-10 | 20-30 | 50-60 | 0-10 | 20-30 | 50-60 |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | M8725/31 | M8725/32 | M8725/33 | M8725/34 | M8725/35 | M8725/36 |

**Notes:**

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17. This report issued 30/5/22 replaces the report issued on 27/05/2022.

*Quality Checked: Kris Saville*
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# AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

58 samples supplied by Minesoils Pty. Ltd. on 17/05/2022. Lab Job No.M8725 re-issued
Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 37 | Sample 38 | Sample 39 | Sample 40 | Sample 41 | Sample 42 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 13 | 14 | 14 | 15 | 16 | 16 |
| | | Sample Depth: | 80-90 | 0-10 | 20-30 | 0-10 | 0-10 | 20-30 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | M8725/37 | M8725/38 | M8725/39 | M8725/40 | M8725/41 | M8725/42 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.43 | 6.09 | 7.74 | 5.73 | 5.84 | 6.57 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.016 | 0.056 | 0.037 | 0.062 | 0.063 | 0.028 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 19 | 8.5 | 9.8 | 8.3 | 13 | 16 |
| | (kg/ha) | | 8,627 | 3,824 | 4,416 | 3,727 | 5,760 | 7,187 |
| | (mg/kg) | | 3,851 | 1,707 | 1,971 | 1,664 | 2,572 | 3,208 |
| Exchangeable Magnesium | (cmol+/kg) | | 3.2 | 2.0 | 1.6 | 1.9 | 5.2 | 9.4 |
| | (kg/ha) | | 879 | 551 | 436 | 525 | 1,421 | 2,558 |
| | (mg/kg) | | 393 | 246 | 195 | 235 | 634 | 1,142 |
| Exchangeable Potassium | (cmol+/kg) | | 0.29 | 0.96 | 0.26 | 0.85 | 0.45 | 0.16 |
| | (kg/ha) | | 254 | 842 | 231 | 749 | 397 | 141 |
| | (mg/kg) | | 113 | 376 | 103 | 334 | 177 | 63 |
| Exchangeable Sodium | (cmol+/kg) | | 0.33 | <0.065 | <0.065 | <0.065 | 0.15 | 0.30 |
| | (kg/ha) | | 169 | <33 | <33 | <33 | 75 | 154 |
| | (mg/kg) | | 75 | <15 | <15 | <15 | 34 | 69 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.05 | 0.03 | 0.02 | 0.06 | 0.08 | 0.10 |
| | (kg/ha) | | 10 | 6.2 | 4.1 | 11 | 16 | 21 |
| | (mg/kg) | | 4.5 | 2.8 | 1.8 | 5.1 | 7.3 | 9.4 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.01 | <0.01 | <0.01 | 0.05 | 0.09 | <0.01 |
| | (kg/ha) | | <1 | <1 | <1 | 1.2 | 2.1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 23 | 12 | 12 | 11 | 19 | 26 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 83 | 74 | 84 | 74 | 68 | 62 |
| Magnesium (%) | | | 14 | 17 | 14 | 17 | 28 | 36 |
| Potassium (%) | | | 1.3 | 8.3 | 2.2 | 7.6 | 2.4 | 0.62 |
| Sodium - ESP (%) | | | 1.4 | 0.41 | 0.44 | 0.45 | 0.77 | 1.2 |
| Aluminium (%) | | | 0.22 | 0.27 | 0.17 | 0.51 | 0.43 | 0.40 |
| Hydrogen (%) | | | 0.05 | 0.00 | 0.00 | 0.47 | 0.49 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 6.0 | 4.2 | 6.1 | 4.3 | 2.5 | 1.7 |

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# AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

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| | | Sample 37 | Sample 38 | Sample 39 | Sample 40 | Sample 41 | Sample 42 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 13 | 14 | 14 | 15 | 16 | 16 |
| | Sample Depth: | 80-90 | 0-10 | 20-30 | 0-10 | 0-10 | 20-30 |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | M8725/37 | M8725/38 | M8725/39 | M8725/40 | M8725/41 | M8725/42 |

**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: Collingwo
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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| Parameter | | Method reference | Sample 43 | Sample 44 | Sample 45 | Sample 46 | Sample 47 | Sample 48 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 16 | 17 | 17 | 17 | 17 | 18 |
| | | Sample Depth: | 40-50 | 0-10 | 20-30 | 50-60 | 80-90 | 0-10 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | M8725/43 | M8725/44 | M8725/45 | M8725/46 | M8725/47 | M8725/48 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.63 | 6.32 | 7.27 | 7.07 | 7.81 | 5.84 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.015 | 0.040 | 0.032 | 0.034 | 0.031 | 0.048 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 17 | 11 | 15 | 16 | 22 | 10 |
| | (kg/ha) | | 7,589 | 4,813 | 6,860 | 7,155 | 9,867 | 4,570 |
| | (mg/kg) | | 3,388 | 2,149 | 3,062 | 3,194 | 4,405 | 2,040 |
| Exchangeable Magnesium | (cmol+/kg) | | 9.3 | 4.0 | 12 | 9.6 | 17 | 2.7 |
| | (kg/ha) | | 2,530 | 1,102 | 3,136 | 2,624 | 4,544 | 742 |
| | (mg/kg) | | 1,130 | 492 | 1,400 | 1,172 | 2,029 | 331 |
| Exchangeable Potassium | (cmol+/kg) | | 0.13 | 0.77 | 0.41 | 0.57 | 0.27 | 0.22 |
| | (kg/ha) | | 116 | 674 | 358 | 496 | 239 | 191 |
| | (mg/kg) | | 52 | 301 | 160 | 221 | 106 | 85 |
| Exchangeable Sodium | (cmol+/kg) | | 0.30 | 0.14 | 0.39 | 0.33 | 0.71 | 0.19 |
| | (kg/ha) | | 156 | 74 | 203 | 172 | 365 | 96 |
| | (mg/kg) | | 70 | 33 | 91 | 77 | 163 | 43 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.55 | 0.03 | 0.02 | 0.02 | 0.02 | 0.12 |
| | (kg/ha) | | 111 | 6.1 | 4.0 | 4.7 | 4.0 | 25 |
| | (mg/kg) | | 50 | 2.7 | 1.8 | 2.1 | 1.8 | 11 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.09 |
| | (kg/ha) | | <1 | <1 | <1 | <1 | <1 | 2.0 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 27 | 16 | 28 | 27 | 40 | 14 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 62 | 68 | 55 | 60 | 55 | 75 |
| Magnesium (%) | | | 34 | 26 | 42 | 36 | 42 | 20 |
| Potassium (%) | | | 0.49 | 4.9 | 1.5 | 2.1 | 0.69 | 1.6 |
| Sodium - ESP (%) | | | 1.1 | 0.92 | 1.4 | 1.3 | 1.8 | 1.4 |
| Aluminium (%) | | | 2.0 | 0.19 | 0.07 | 0.09 | 0.05 | 0.90 |
| Hydrogen (%) | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.67 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.8 | 2.6 | 1.3 | 1.7 | 1.3 | 3.7 |

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## AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

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PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 43 | Sample 44 | Sample 45 | Sample 46 | Sample 47 | Sample 48 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 16 | 17 | 17 | 17 | 17 | 18 |
| | Sample Depth: | 40-50 | 0-10 | 20-30 | 50-60 | 80-90 | 0-10 |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | M8725/43 | M8725/44 | M8725/45 | M8725/46 | M8725/47 | M8725/48 |

**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: Collingwo
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 res
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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
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| Parameter | | Method reference | Sample 49 | Sample 50 | Sample 51 | Sample 52 | Sample 53 | Sample 54 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 18 | 18 | 19 | 19 | 20 | 20 |
| | | Sample Depth: | 30-40 | 70-80 | 0-10 | 25-35 | 0-10 | 20-30 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | M8725/49 | M8725/50 | M8725/51 | M8725/52 | M8725/53 | M8725/54 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.27 | 6.56 | 6.07 | 6.93 | 5.05 | 5.41 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.016 | 0.017 | 0.054 | 0.024 | 0.166 | 0.087 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 15 | 17 | 15 | 14 | 5.2 | 6.9 |
| | (kg/ha) | | 6,689 | 7,670 | 6,619 | 6,319 | 2,320 | 3,095 |
| | (mg/kg) | | 2,986 | 3,424 | 2,955 | 2,821 | 1,036 | 1,382 |
| Exchangeable Magnesium | (cmol+/kg) | | 10 | 8.5 | 6.6 | 8.5 | 1.3 | 1.6 |
| | (kg/ha) | | 2,773 | 2,301 | 1,801 | 2,301 | 366 | 426 |
| | (mg/kg) | | 1,238 | 1,027 | 804 | 1,027 | 163 | 190 |
| Exchangeable Potassium | (cmol+/kg) | | 0.30 | 0.12 | 0.59 | 0.30 | 1.8 | 0.52 |
| | (kg/ha) | | 262 | <112 | 519 | 262 | 1,599 | 457 |
| | (mg/kg) | | 117 | <50 | 232 | 117 | 714 | 204 |
| Exchangeable Sodium | (cmol+/kg) | | 0.22 | 0.07 | 0.20 | 0.16 | 0.10 | 0.22 |
| | (kg/ha) | | 114 | 36 | 102 | 84 | 53 | 115 |
| | (mg/kg) | | 51 | 16 | 46 | 37 | 24 | 52 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.26 | 0.32 | 0.06 | 0.01 | 0.46 | 0.23 |
| | (kg/ha) | | 53 | 65 | 12 | 2.8 | 93 | 46 |
| | (mg/kg) | | 24 | 29 | 5.5 | 1.3 | 41 | 20 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.16 | <0.01 | 0.05 | <0.01 | 0.20 | 0.11 |
| | (kg/ha) | | 3.5 | <1 | 1.0 | <1 | 4.5 | 2.5 |
| | (mg/kg) | | 1.6 | <1 | <1 | <1 | 2.0 | 1.1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 26 | 26 | 22 | 23 | 9.1 | 9.5 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 57 | 66 | 66 | 61 | 57 | 72 |
| Magnesium (%) | | | 39 | 32 | 30 | 37 | 15 | 16 |
| Potassium (%) | | | 1.1 | 0.48 | 2.7 | 1.3 | 20 | 5.5 |
| Sodium - ESP (%) | | | 0.85 | 0.27 | 0.89 | 0.71 | 1.1 | 2.3 |
| Aluminium (%) | | | 1.0 | 1.2 | 0.27 | 0.06 | 5.0 | 2.4 |
| Hydrogen (%) | | | 0.61 | 0.00 | 0.20 | 0.00 | 2.2 | 1.1 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.5 | 2.0 | 2.2 | 1.7 | 3.8 | 4.4 |

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| | | Sample 49 | Sample 50 | Sample 51 | Sample 52 | Sample 53 | Sample 54 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 18 | 18 | 19 | 19 | 20 | 20 |
| | Sample Depth: | 30-40 | 70-80 | 0-10 | 25-35 | 0-10 | 20-30 |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | M8725/49 | M8725/50 | M8725/51 | M8725/52 | M8725/53 | M8725/54 |

**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: Collingwo
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.
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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
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| Parameter | | Method reference | Sample 55 | Sample 56 | Sample 57 | Sample 58 |
|---|---|---|---|---|---|---|
| | | Sample ID: | 21 | 21 | 21 | 21 |
| | | Sample Depth: | 0-10 | 30-40 | 50-60 | 90-100 |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | M8725/55 | M8725/56 | M8725/57 | M8725/58 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.93 | 6.31 | 6.99 | 7.42 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.087 | 0.032 | 0.036 | 0.043 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 5.9 | 2.7 | 3.1 | 11 |
| | (kg/ha) | | 2,627 | 1,196 | 1,389 | 4,736 |
| | (mg/kg) | | 1,173 | 534 | 620 | 2,114 |
| Exchangeable Magnesium | (cmol+/kg) | | 1.6 | 0.94 | 2.5 | 18 |
| | (kg/ha) | | 425 | 255 | 674 | 4,933 |
| | (mg/kg) | | 190 | 114 | 301 | 2,202 |
| Exchangeable Potassium | (cmol+/kg) | | 1.7 | 0.59 | 0.46 | 0.51 |
| | (kg/ha) | | 1,486 | 521 | 402 | 443 |
| | (mg/kg) | | 664 | 232 | 180 | 198 |
| Exchangeable Sodium | (cmol+/kg) | | 0.13 | <0.065 | 0.15 | 1.7 |
| | (kg/ha) | | 67 | <33 | 76 | 901 |
| | (mg/kg) | | 30 | <15 | 34 | 402 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.03 | 0.02 | 0.01 | <0.01 |
| | (kg/ha) | | 6.5 | 4.7 | 2.1 | 1.9 |
| | (mg/kg) | | 2.9 | 2.1 | <1 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.05 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | 1.2 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 9.3 | 4.3 | 6.2 | 31 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 63 | 63 | 50 | 34 |
| Magnesium (%) | | | 17 | 22 | 40 | 59 |
| Potassium (%) | | | 18 | 14 | 7.4 | 1.6 |
| Sodium - ESP (%) | | | 1.4 | 0.91 | 2.4 | 5.7 |
| Aluminium (%) | | | 0.35 | 0.55 | 0.17 | 0.03 |
| Hydrogen (%) | | | 0.58 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.7 | 2.8 | 1.3 | 0.58 |

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| | | Sample 55 | Sample 56 | Sample 57 | Sample 58 |
|---|---|---|---|---|---|
| | Sample ID: | 21 | 21 | 21 | 21 |
| | Sample Depth: | 0-10 | 30-40 | 50-60 | 90-100 |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | M8725/55 | M8725/56 | M8725/57 | M8725/58 |

**Notes:**

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3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
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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 res
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.
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 Conditio
17. This report issued 30/5/22 replaces the report issued on 27/05/2022.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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## AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

58 samples supplied by Minesoils Pty. Ltd. on 17/05/2022. Lab Job No.M8725 re-issued
Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | | ***Heavy Soil*** | ***Medium Soil*** | ***Light Soil*** | ***Sandy Soil*** |
|---|---|---|---|---|---|---|
| | | **Sample ID:** | | | | |
| | | **Sample Depth:** | | | | |
| | | **Client:** | *Clay* | *Clay Loam* | *Loam* | *Loamy Sand* |
| **Parameter** | | **Method reference** | **Indicative guidelines - refer to Notes 6 and 8** | | | |
| **pH** | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.5 | 6.5 | 6.3 | 6.3 |
| **Electrical Conductivity (dS/m)** | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.200 | 0.150 | 0.120 | 0.100 |
| **Exchangeable Calcium** | **(cmol$_+$/kg)** | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 15.6 | 10.8 | 5.0 | 1.9 |
| | **(kg/ha)** | | 7000 | 4816 | 2240 | 840 |
| | **(mg/kg)** | | 3125 | 2150 | 1000 | 375 |
| **Exchangeable Magnesium** | **(cmol$_+$/kg)** | | 2.4 | 1.7 | 1.2 | 0.60 |
| | **(kg/ha)** | | 650 | 448 | 325 | 168 |
| | **(mg/kg)** | | 290 | 200 | 145 | 75 |
| **Exchangeable Potassium** | **(cmol$_+$/kg)** | | 0.60 | 0.50 | 0.40 | 0.30 |
| | **(kg/ha)** | | 526 | 426 | 336 | 224 |
| | **(mg/kg)** | | 235 | 190 | 150 | 100 |
| **Exchangeable Sodium** | **(cmol$_+$/kg)** | | 0.3 | 0.26 | 0.22 | 0.11 |
| | **(kg/ha)** | | 155 | 134 | 113 | 57 |
| | **(mg/kg)** | | 69 | 60 | 51 | 25 |
| **Exchangeable Aluminium** | **(cmol$_+$/kg)** | **Inhouse S37 (KCl) | 0.6 | 0.5 | 0.4 | 0.2 |
| | **(kg/ha)** | | 121 | 101 | 73 | 30 |
| | **(mg/kg)** | | 54 | 45 | 32 | 14 |
| **Exchangeable Hydrogen** | **(cmol$_+$/kg)** | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.6 | 0.5 | 0.4 | 0.2 |
| | **(kg/ha)** | | 13 | 11 | 8 | 3 |
| | **(mg/kg)** | | 6 | 5 | 4 | 2 |
| **Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)** | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 20.1 | 14.3 | 7.8 | 3.3 |
| **Calcium (%)** | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 77.6 | 75.7 | 65.6 | 57.4 |
| **Magnesium (%)** | | | 11.9 | 11.9 | 15.7 | 18.1 |
| **Potassium (%)** | | | 3.0 | 3.5 | 5.2 | 9.1 |
| **Sodium - ESP (%)** | | | 1.5 | 1.8 | 2.9 | 3.3 |
| **Aluminium (%)**<br>**Hydrogen (%)** | | | 6.0 | 7.1 | 10.5 | 12.1 |
| **Calcium/Magnesium Ratio** | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 6.5 | 6.4 | 4.2 | 3.2 |

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## AGRICULTURAL SOIL ANALYSIS REPORT - RE-ISSUEI

58 samples supplied by Minesoils Pty. Ltd. on 17/05/2022. Lab Job No.M8725 re-issued
Analysis requested by Clayton Richards. Your Job: MS-051 Soils
PO BOX 11034 TAMWORTH NSW 2340

| | | Heavy Soil | Medium Soil | Light Soil | Sandy Soil |
|---|---|---|---|---|---|
| Sample ID: | | | | | |
| Sample Depth: | | | | | |
| Client: | | *Clay* | *Clay Loam* | *Loam* | *Loamy Sand* |
| **Parameter** | **Method reference** | **Indicative guidelines - refer to Notes 6 and 8** | | | |

**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: Collingwo
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 res
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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16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditio
17. This report issued 30/5/22 replaces the report issued on 27/05/2022.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
KS

## GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

58 soil samples supplied by Minesoils Pty. Ltd. on 17 May, 2022 - Lab Job No. M8725
Analysis requested by Clayton Richards. Job ref. MS-062 Soils
PO BOX 11034 TAMWORTH NSW 2340

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) |
|---|---|---|---|---|---|---|---|---|---|
| **1 0-10 cm** | M8725/1 | 20.4% | 2.1% | 0.4% | 1.6% | 7.3% | 38.6% | 23.5% | 28.5% |
| **1 20-30 cm** | M8725/2 | 21.6% | 0.9% | 0.0% | 0.9% | 6.6% | 31.3% | 18.6% | 42.7% |
| **1 50-60 cm** | M8725/3 | 22.4% | 1.4% | 0.0% | 1.4% | 4.1% | 23.7% | 10.2% | 60.7% |
| **1 80-90 cm** | M8725/4 | 18.7% | 0.5% | 0.0% | 0.5% | 4.3% | 24.9% | 10.0% | 60.2% |
| **2 0-10 cm** | M8725/5 | 16.4% | 1.3% | 0.3% | 1.1% | 16.3% | 46.4% | 18.8% | 17.1% |
| **2 20-30 cm** | M8725/6 | 16.1% | 3.5% | 0.3% | 3.2% | 18.8% | 44.6% | 15.0% | 18.1% |
| **2 60-70 cm** | M8725/7 | 14.4% | 10.2% | 2.7% | 7.5% | 11.3% | 39.8% | 11.4% | 27.4% |
| **2 80-90 cm** | M8725/8 | 19.6% | 3.4% | 1.8% | 1.6% | 5.8% | 42.6% | 11.3% | 36.9% |
| **3 0-10 cm** | M8725/9 | 21.8% | 33.0% | 25.3% | 7.8% | 16.8% | 22.5% | 15.2% | 12.5% |
| **3 20-30 cm** | M8725/10 | 18.9% | 8.4% | 0.0% | 8.4% | 24.3% | 29.9% | 20.5% | 16.9% |
| **4 0-10 cm** | M8725/11 | 12.8% | 16.7% | 3.1% | 13.6% | 17.6% | 38.3% | 14.4% | 13.0% |
| **4 20-30 cm** | M8725/12 | 11.2% | 16.8% | 9.3% | 7.4% | 12.6% | 36.4% | 22.6% | 11.6% |
| **5 0-10 cm** | M8725/13 | 19.3% | 23.5% | 11.7% | 11.8% | 12.7% | 21.3% | 14.2% | 28.2% |
| **5 20-30 cm** | M8725/14 | 16.1% | 12.5% | 6.6% | 5.9% | 12.6% | 17.5% | 30.0% | 27.4% |
| **6 0-10 cm** | M8725/15 | 18.7% | 0.3% | 0.0% | 0.3% | 40.6% | 24.3% | 15.2% | 19.6% |
| **6 30-40 cm** | M8725/16 | 19.7% | 0.3% | 0.0% | 0.3% | 6.5% | 40.8% | 21.9% | 30.5% |
| **6 80-90 cm** | M8725/17 | 12.6% | 1.1% | 0.0% | 1.1% | 11.0% | 48.8% | 18.4% | 20.7% |
| **7 0-10 cm** | M8725/18 | 15.6% | 22.6% | 14.3% | 8.3% | 17.3% | 27.9% | 15.5% | 16.7% |
| **7 20-30 cm** | M8725/19 | 14.9% | 22.4% | 10.0% | 12.3% | 20.4% | 19.5% | 18.4% | 19.4% |
| **9 0-10 cm** | M8725/20 | 24.2% | 2.1% | 0.0% | 2.1% | 8.3% | 50.9% | 21.4% | 17.3% |
| **9 20-30 cm** | M8725/21 | 22.3% | 9.2% | 0.0% | 9.2% | 2.4% | 34.8% | 13.9% | 39.6% |
| **9 40-50 cm** | M8725/22 | 22.8% | 6.5% | 0.0% | 6.5% | 26.8% | 9.7% | 9.1% | 48.0% |
| **10 0-10 cm** | M8725/23 | 8.0% | 11.5% | 0.0% | 11.5% | 17.4% | 32.5% | 16.5% | 22.1% |
| **10 20-30 cm** | M8725/24 | 5.2% | 15.2% | 4.3% | 11.0% | 13.9% | 20.2% | 19.2% | 31.5% |
| **10 50-60 cm** | M8725/25 | 15.3% | 2.4% | 0.0% | 2.4% | 5.9% | 15.6% | 7.9% | 68.2% |
| **10 70-80 cm** | M8725/26 | 22.9% | 2.9% | 0.0% | 2.9% | 8.3% | 28.2% | 6.1% | 54.5% |
| **11 0-10 cm** | M8725/27 | 17.5% | 10.0% | 0.0% | 10.0% | 17.9% | 42.4% | 15.6% | 14.0% |
| **11 15-25 cm** | M8725/28 | 15.3% | 12.0% | 3.6% | 8.5% | 10.3% | 42.2% | 16.5% | 18.9% |
| **11 30-40 cm** | M8725/29 | 23.0% | 7.5% | 1.0% | 6.5% | 9.5% | 4.3% | 16.0% | 62.6% |
| **11 50-60 cm** | M8725/30 | 15.6% | 0.6% | 0.0% | 0.6% | 22.1% | 10.7% | 13.7% | 52.9% |
| **12 0-10 cm** | M8725/31 | 15.0% | 2.2% | 0.0% | 2.2% | 21.2% | 51.9% | 14.3% | 10.5% |
| **12 20-30 cm** | M8725/32 | 13.5% | 8.4% | 2.3% | 6.1% | 36.5% | 39.6% | 11.8% | 3.7% |
| **12 50-60 cm** | M8725/33 | 13.4% | 18.1% | 5.7% | 12.4% | 26.8% | 31.0% | 8.8% | 15.3% |
| **13 0-10 cm** | M8725/34 | 15.9% | 14.8% | 2.5% | 12.2% | 17.3% | 43.9% | 21.2% | 2.9% |
| **13 20-30 cm** | M8725/35 | 15.3% | 14.6% | 3.2% | 11.4% | 17.9% | 36.5% | 17.5% | 13.5% |
| **13 50-60 cm** | M8725/36 | 15.4% | 14.0% | 4.8% | 9.2% | 16.7% | 32.0% | 14.2% | 23.2% |
| **13 80-90 cm** | M8725/37 | 17.1% | 3.4% | 0.6% | 2.8% | 24.9% | 16.3% | 13.4% | 42.0% |
| **14 0-10 cm** | M8725/38 | 16.1% | 24.1% | 12.5% | 11.6% | 24.8% | 18.2% | 12.2% | 20.8% |
| **14 20-30 cm** | M8725/39 | 16.1% | 9.7% | 0.0% | 9.7% | 19.3% | 10.5% | 16.4% | 44.2% |
| **15 0-10 cm** | M8725/40 | 18.1% | 26.9% | 10.2% | 16.7% | 25.4% | 19.0% | 15.0% | 13.8% |
| **16 0-10 cm** | M8725/41 | 18.4% | 16.9% | 10.1% | 6.9% | 13.4% | 24.8% | 19.9% | 25.0% |
| **16 20-30 cm** | M8725/42 | 19.3% | 4.6% | 0.0% | 4.6% | 22.4% | 22.6% | 14.0% | 36.3% |
| **16 40-50 cm** | M8725/43 | 11.8% | 3.4% | 0.0% | 3.4% | 35.9% | 26.3% | 8.5% | 25.8% |
| **17 0-10 cm** | M8725/44 | 16.8% | 7.7% | 3.7% | 3.9% | 7.4% | 31.7% | 19.7% | 33.5% |
| **17 20-30 cm** | M8725/45 | 24.1% | 1.5% | 0.0% | 1.5% | 2.8% | 20.0% | 3.1% | 72.5% |
| **17 50-60 cm** | M8725/46 | 22.4% | 1.0% | 0.0% | 1.0% | 3.8% | 31.6% | 15.6% | 48.1% |
| **17 80-90 cm** | M8725/47 | 20.8% | 9.5% | 0.0% | 9.5% | 3.5% | 13.3% | 17.3% | 56.4% |
| **18 0-10 cm** | M8725/48 | 15.4% | 17.8% | 8.7% | 9.2% | 16.2% | 29.1% | 15.5% | 21.4% |
| **18 30-40 cm** | M8725/49 | 22.7% | 0.6% | 0.0% | 0.6% | 3.4% | 23.6% | 13.9% | 58.5% |
| **18 70-80 cm** | M8725/50 | 9.9% | 21.6% | 2.8% | 18.8% | 45.6% | 6.3% | 7.8% | 18.6% |
| **19 0-10 cm** | M8725/51 | 18.6% | 26.0% | 21.1% | 4.9% | 5.0% | 17.0% | 21.5% | 30.5% |
| **19 25-35 cm** | M8725/52 | 22.1% | 16.3% | 11.9% | 4.4% | 5.5% | 12.1% | 16.7% | 49.4% |
| **20 0-10 cm** | M8725/53 | 17.0% | 1.9% | 0.0% | 1.9% | 12.2% | 50.2% | 11.5% | 24.1% |
| **20 20-30 cm** | M8725/54 | 17.8% | 1.4% | 0.0% | 1.4% | 13.9% | 48.2% | 15.1% | 21.4% |
| **21 0-10 cm** | M8725/55 | 19.0% | 2.6% | 0.0% | 2.6% | 7.8% | 49.5% | 19.6% | 20.5% |
| **21 30-40 cm** | M8725/56 | 14.1% | 4.9% | 2.1% | 2.8% | 5.8% | 41.5% | 19.4% | 28.4% |
| **21 50-60 cm** | M8725/57 | 11.8% | 18.2% | 7.3% | 10.9% | 6.8% | 36.9% | 10.4% | 27.7% |
| **21 90-100 cm** | M8725/58 | 23.2% | 1.7% | 0.0% | 1.7% | 1.3% | 6.8% | 12.1% | 78.0% |

**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.
4. This report is not to be reproduced except in full. Results only relate to the item tested.
5. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal).
6. This final report was issued on 15/06/2022 and replaces the report issued on 10/06/2022. The report now includes the data for M8725/51.

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

## Munsell Colour

58 soil samples supplied by Minesoils Pty. Ltd. on 17 May, 2022 - Lab Job No. M8725
Analysis requested by Clayton Richards. Job ref. MS-062 Soils
PO BOX 11034 TAMWORTH NSW 2340

| SAMPLE ID | Lab Code | MOIST MUNSELL COLOUR | | MOTTLE MUNSELL COLOUR | | DEGREE OF MOTTLING (%) |
|---|---|---|---|---|---|---|
| | | Code | Description | Code | Description | |
| **1 0-10 cm** | M8725/1 | 5YR 2.5/2 | DARK REDDISH BROWN | .. | .. | .. |
| **1 20-30 cm** | M8725/2 | 2.5YR 2.5/2 | VERY DUSKY RED | .. | .. | .. |
| **1 50-60 cm** | M8725/3 | 10YR 4/6 | DARK YELLOWISH BROWN | .. | .. | .. |
| **1 80-90 cm** | M8725/4 | 10YR 5/6 | YELLOWISH BROWN | 7.5YR 3/1 | VERY DARK GRAY | 40 |
| **2 0-10 cm** | M8725/5 | 7.5YR 3/4 | DARK BROWN | .. | .. | .. |
| **2 20-30 cm** | M8725/6 | 7.5YR 3/4 | DARK BROWN | | .. | .. |
| **2 60-70 cm** | M8725/7 | 10YR 3/4 | DARK YELLOWISH BROWN | .. | .. | .. |
| **2 80-90 cm** | M8725/8 | 10YR 4/6 | DARK YELLOWISH BROWN | .. | .. | .. |
| **3 0-10 cm** | M8725/9 | 7.5YR 3/3 | DARK BROWN | .. | .. | .. |
| **3 20-30 cm** | M8725/10 | 7.5YR 3/3 | DARK BROWN | .. | .. | .. |
| **4 0-10 cm** | M8725/11 | 10YR 4/4 | DARK YELLOWISH BROWN | .. | .. | .. |
| **4 20-30 cm** | M8725/12 | 7.5YR 5/4 | BROWN | .. | .. | .. |
| **5 0-10 cm** | M8725/13 | 10YR 3/3 | DARK BROWN | 5YR 5/6 | YELLOWISH RED | 15 |
| **5 20-30 cm** | M8725/14 | 10YR 4/6 | DARK YELLOWISH BROWN | .. | .. | .. |
| **6 0-10 cm** | M8725/15 | 10YR 2/2 | VERY DARK BROWN | .. | .. | .. |
| **6 30-40 cm** | M8725/16 | 10YR 2/2 | VERY DARK BROWN | .. | .. | .. |
| **6 80-90 cm** | M8725/17 | 10YR 2/2 | VERY DARK BROWN | .. | .. | .. |
| **7 0-10 cm** | M8725/18 | 10YR 3/3 | DARK BROWN | .. | .. | .. |
| **7 20-30 cm** | M8725/19 | 7.5YR 2.5/3 | VERY DARK BROWN | .. | .. | .. |
| **9 0-10 cm** | M8725/20 | 7.5YR 2.5/3 | VERY DARK BROWN | .. | .. | .. |
| **9 20-30 cm** | M8725/21 | 7.5YR 3/3 | DARK BROWN | .. | .. | .. |
| **9 40-50 cm** | M8725/22 | 7.5YR 3/2 | DARK BROWN | .. | .. | .. |
| **10 0-10 cm** | M8725/23 | 7.5YR 3/4 | DARK BROWN | .. | .. | .. |
| **10 20-30 cm** | M8725/24 | 5YR 4/6 | YELLOWISH RED | .. | .. | .. |
| **10 50-60 cm** | M8725/25 | 5YR 4/6 | YELLOWISH RED | .. | .. | .. |
| **10 70-80 cm** | M8725/26 | 7.5YR 4/6 | STRONG BROWN | 7.5YR 2.5/1 | BLACK | 7 |
| **11 0-10 cm** | M8725/27 | 7.5YR 2.5/2 | VERY DARK BROWN | .. | .. | .. |
| **11 15-25 cm** | M8725/28 | 10YR 4/3 | BROWN | .. | .. | .. |
| **11 30-40 cm** | M8725/29 | 5YR 4/4 | REDDISH BROWN | .. | .. | .. |
| **11 50-60 cm** | M8725/30 | 10YR 5/4 | YELLOWISH BROWN | .. | .. | .. |
| **12 0-10 cm** | M8725/31 | 10YR 2/2 | VERY DARK BROWN | .. | .. | .. |
| **12 20-30 cm** | M8725/32 | 10YR 2/2 | VERY DARK BROWN | .. | .. | .. |
| **12 50-60 cm** | M8725/33 | 10YR 2/2 | VERY DARK BROWN | .. | .. | .. |
| **13 0-10 cm** | M8725/34 | 10YR 2/2 | VERY DARK BROWN | .. | .. | .. |
| **13 20-30 cm** | M8725/35 | 7.5YR 2.5/3 | VERY DARK BROWN | .. | .. | .. |
| **13 50-60 cm** | M8725/36 | 7.5YR 3/4 | DARK BROWN | .. | .. | .. |
| **13 80-90 cm** | M8725/37 | 7.5YR 2.5/2 | VERY DARK BROWN | .. | .. | .. |
| **14 0-10 cm** | M8725/38 | 5YR 3/4 | DARK REDDISH BROWN | .. | .. | .. |
| **14 20-30 cm** | M8725/39 | 5YR 4/6 | YELLOWISH RED | 10YR 8/8 | YELLOW | 3 |
| **15 0-10 cm** | M8725/40 | 7.5YR 2.5/2 | VERY DARK BROWN | .. | .. | .. |
| **16 0-10 cm** | M8725/41 | 7.5YR 3/4 | DARK BROWN | .. | .. | .. |
| **16 20-30 cm** | M8725/42 | 5YR 4/6 | YELLOWISH RED | .. | .. | .. |
| **16 40-50 cm** | M8725/43 | 10YR 6/6 | BROWNISH YELLOW | .. | .. | .. |
| **17 0-10 cm** | M8725/44 | 7.5YR 3/2 | DARK BROWN | .. | .. | .. |
| **17 20-30 cm** | M8725/45 | 5YR 4/4 | REDDISH BROWN | .. | .. | .. |
| **17 50-60 cm** | M8725/46 | 7.5YR 3/4 | DARK BROWN | .. | .. | .. |
| **17 80-90 cm** | M8725/47 | 10YR 5/4 | YELLOWISH BROWN | .. | .. | .. |
| **18 0-10 cm** | M8725/48 | 7.5YR 3/3 | DARK BROWN | .. | .. | .. |
| **18 30-40 cm** | M8725/49 | 2.5YR 3/6 | DARK RED | .. | .. | .. |
| **18 70-80 cm** | M8725/50 | 7.5YR 5/6 | STRONG BROWN | .. | .. | .. |
| **19 0-10 cm** | M8725/51 | 7.5YR 3/4 | DARK BROWN | .. | .. | .. |
| **19 25-35 cm** | M8725/52 | 7.5YR 2.5/3 | VERY DARK BROWN | 2.5YR 8/8 | YELLOW | 30 |
| **20 0-10 cm** | M8725/53 | 7.5YR 2.5/3 | VERY DARK BROWN | .. | .. | .. |
| **20 20-30 cm** | M8725/54 | 7.5YR 3/3 | DARK BROWN | .. | .. | .. |
| **21 0-10 cm** | M8725/55 | 7.5YR 2.5/3 | VERY DARK BROWN | .. | .. | .. |
| **21 30-40 cm** | M8725/56 | 5YR 5/8 | YELLOWISH RED | .. | .. | .. |
| **21 50-60 cm** | M8725/57 | 10YR 3/6 | DARK YELLOWISH BROWN | .. | .. | .. |
| **21 90-100 cm** | M8725/58 | 7.5YR 3/4 | DARK BROWN | .. | .. | .. |

**Note:**
1: The Munsell Colour Chart was used to determine the colour
2. Analysis conducted between sample arrival date and reporting date.
3. This report is not to be reproduced except in full. Results only relate to the item tested.
4. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal).
5. This report was issued on 10/06/2022.

# GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

224 soil samples supplied by Minesoils Pty Ltd on 3 May, 2021 - Lab Job No. K6461.
Analysis requested by Clayton Richards. Your project: MS-051 BSAL
PO Box 11034 TAMWORTH NSW 2340.

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **1 0-10cm** | K6461/1 | 20.3% | 2.2% | 0.0% | 2.2% | 7.0% | 48.4% | 27.6% | 14.7% | 100.0% |
| **1 20-30cm** | K6461/2 | 18.3% | 0.8% | 0.0% | 0.8% | 7.8% | 44.1% | 32.2% | 15.1% | 100.0% |
| **1 40-50cm** | K6461/3 | 15.3% | 0.2% | 0.0% | 0.2% | 8.3% | 38.3% | 31.2% | 22.1% | 100.0% |
| **1 65-75cm** | K6461/4 | 10.4% | 1.7% | 0.0% | 1.7% | 9.7% | 35.6% | 25.4% | 27.6% | 100.0% |
| **2 0-10cm** | K6461/5 | 16.5% | 1.6% | 0.0% | 1.6% | 8.7% | 42.6% | 17.5% | 29.6% | 100.0% |
| **2 20-30cm** | K6461/6 | 25.2% | 0.6% | 0.0% | 0.6% | 4.3% | 24.4% | 10.4% | 60.3% | 100.0% |
| **2 40-50cm** | K6461/7 | 23.9% | 0.9% | 0.0% | 0.9% | 4.9% | 29.4% | 13.1% | 51.7% | 100.0% |
| **2 65-75cm** | K6461/8 | 19.4% | 0.8% | 0.0% | 0.8% | 5.7% | 29.2% | 12.0% | 52.3% | 100.0% |
| **3 0-10cm** | K6461/9 | 18.5% | 3.9% | 0.0% | 3.9% | 8.7% | 40.6% | 22.5% | 24.3% | 100.0% |
| **3 20-30cm** | K6461/10 | 24.8% | 1.1% | 0.0% | 1.1% | 5.0% | 23.6% | 7.2% | 63.0% | 100.0% |
| **3 40-50cm** | K6461/11 | 21.2% | 0.4% | 0.0% | 0.4% | 4.5% | 25.0% | 7.6% | 62.5% | 100.0% |
| **3 65-75cm** | K6461/12 | 17.4% | 0.3% | 0.0% | 0.3% | 5.9% | 22.9% | 17.9% | 53.0% | 100.0% |
| **4 0-10cm** | K6461/13 | 17.8% | 1.6% | 0.0% | 1.6% | 8.9% | 53.0% | 19.8% | 16.6% | 100.0% |
| **4 20-30cm** | K6461/14 | 24.8% | 3.9% | 0.0% | 3.9% | 8.0% | 31.9% | 21.9% | 34.2% | 100.0% |
| **4 40-50cm** | K6461/15 | 16.5% | 4.3% | 0.0% | 4.3% | 7.8% | 29.1% | 19.8% | 39.0% | 100.0% |
| **4 65-75cm** | K6461/16 | 11.0% | 6.0% | 0.0% | 6.0% | 11.0% | 41.5% | 18.4% | 23.1% | 100.0% |
| **5 0-10cm** | K6461/17 | 17.7% | 1.7% | 0.0% | 1.7% | 4.9% | 55.8% | 21.1% | 16.5% | 100.0% |
| **5 20-30cm** | K6461/18 | 14.7% | 7.2% | 0.0% | 7.2% | 3.2% | 56.0% | 17.7% | 15.9% | 100.0% |
| **5 40-50cm** | K6461/19 | 12.5% | 11.1% | 0.0% | 11.1% | 5.3% | 35.3% | 15.3% | 33.0% | 100.0% |
| **5 65-75cm** | K6461/20 | 14.7% | 2.3% | 0.0% | 2.3% | 5.9% | 36.0% | 14.3% | 41.6% | 100.0% |
| **6 0-10cm** | K6461/21 | 16.4% | 2.7% | 0.0% | 2.7% | 7.9% | 47.6% | 21.1% | 20.6% | 100.0% |
| **6 20-30cm** | K6461/22 | 23.4% | 0.7% | 0.0% | 0.7% | 2.9% | 19.9% | 11.2% | 65.2% | 100.0% |
| **6 40-50cm** | K6461/23 | 11.7% | 2.1% | 0.0% | 2.1% | 2.8% | 31.0% | 12.8% | 51.3% | 100.0% |
| **6 65-75cm** | K6461/24 | 21.3% | 3.7% | 0.0% | 3.7% | 4.5% | 30.2% | 11.2% | 50.4% | 100.0% |
| **7 0-10cm** | K6461/25 | 17.8% | 1.2% | 0.0% | 1.2% | 4.5% | 63.9% | 10.6% | 19.8% | 100.0% |

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

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **7 20-30cm** | K6461/26 | 17.7% | 0.0% | 0.0% | 0.0% | 2.1% | 47.0% | 11.1% | 39.8% | 100.0% |
| **7 40-50cm** | K6461/27 | 20.2% | 0.4% | 0.0% | 0.4% | 0.9% | 35.3% | 8.4% | 54.9% | 100.0% |
| **7 65-75cm** | K6461/28 | 15.6% | 0.5% | 0.0% | 0.5% | 1.0% | 36.4% | 15.7% | 46.4% | 100.0% |
| **10 0-10cm** | K6461/29 | 13.5% | 0.6% | 0.0% | 0.6% | 4.8% | 64.0% | 16.4% | 14.1% | 100.0% |
| **10 20-30cm** | K6461/30 | 13.6% | 7.6% | 0.0% | 7.6% | 3.3% | 53.1% | 14.2% | 21.7% | 100.0% |
| **10 40-50cm** | K6461/31 | 11.8% | 3.0% | 0.0% | 3.0% | 3.9% | 43.5% | 12.9% | 36.6% | 100.0% |
| **10 65-75cm** | K6461/32 | 10.5% | 59.9% | 53.0% | 6.8% | 4.6% | 18.3% | 7.1% | 10.1% | 100.0% |
| **11 0-10cm** | K6461/33 | 13.5% | 22.4% | 0.0% | 22.4% | 10.0% | 40.8% | 16.5% | 10.3% | 100.0% |
| **11 20-30cm** | K6461/34 | 13.7% | 66.5% | 56.9% | 9.5% | 2.6% | 9.6% | 7.4% | 14.0% | 100.0% |
| **11 40-50cm** | K6461/35 | 25.5% | 4.8% | 0.0% | 4.8% | 2.7% | 12.4% | 10.4% | 69.8% | 100.0% |
| **11 65-75cm** | K6461/36 | 23.0% | 4.4% | 0.0% | 4.4% | 2.2% | 11.0% | 11.9% | 70.5% | 100.0% |
| **12 0-10cm** | K6461/37 | 13.2% | 1.1% | 0.0% | 1.1% | 3.7% | 65.2% | 13.1% | 17.0% | 100.0% |
| **12 20-30cm** | K6461/38 | 14.0% | 0.3% | 0.0% | 0.3% | 2.2% | 49.5% | 16.0% | 31.9% | 100.0% |
| **12 40-50cm** | K6461/39 | 12.9% | 1.7% | 0.0% | 1.7% | 1.4% | 40.8% | 14.3% | 41.7% | 100.0% |
| **12 65-75cm** | K6461/40 | 15.1% | 1.4% | 0.0% | 1.4% | 1.9% | 38.2% | 14.9% | 43.6% | 100.0% |
| **13 0-10cm** | K6461/41 | 15.5% | 0.9% | 0.0% | 0.9% | 5.8% | 62.4% | 9.6% | 21.2% | 100.0% |
| **13 20-30cm** | K6461/42 | 14.4% | 7.6% | 6.0% | 1.6% | 3.8% | 50.4% | 9.2% | 29.0% | 100.0% |
| **13 40-50cm** | K6461/43 | 16.3% | 11.4% | 0.0% | 11.4% | 5.5% | 34.2% | 12.7% | 36.2% | 100.0% |
| **13 65-75cm** | K6461/44 | 16.5% | 7.0% | 2.7% | 4.3% | 5.0% | 37.6% | 13.9% | 36.5% | 100.0% |
| **18 0-10cm** | K6461/45 | 28.6% | 4.1% | 0.0% | 4.1% | 8.8% | 39.4% | 27.1% | 20.6% | 100.0% |
| **18 20-30cm** | K6461/46 | 23.0% | 7.8% | 1.9% | 5.9% | 3.7% | 41.8% | 30.4% | 16.4% | 100.0% |
| **18 40-50cm** | K6461/47 | 17.3% | 15.5% | 0.0% | 15.5% | 4.7% | 38.3% | 24.9% | 16.5% | 100.0% |
| **18 65-75cm** | K6461/48 | 26.2% | 0.3% | 0.0% | 0.3% | 1.4% | 21.4% | 21.6% | 55.3% | 100.0% |
| **19 0-10cm** | K6461/49 | 22.7% | 0.9% | 0.0% | 0.9% | 2.6% | 52.7% | 33.6% | 10.2% | 100.0% |
| **19 20-30cm** | K6461/50 | 20.1% | 23.1% | 7.2% | 15.9% | 2.2% | 35.4% | 27.3% | 12.0% | 100.0% |

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

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **19 40-50cm** | K6461/51 | 25.0% | 0.1% | 0.0% | 0.1% | 2.1% | 23.3% | 19.9% | 54.5% | 100.0% |
| **19 65-75cm** | K6461/52 | 21.7% | 7.0% | 0.0% | 7.0% | 3.1% | 57.1% | 28.7% | 4.0% | 100.0% |
| **20 0-10cm** | K6461/53 | 21.2% | 3.9% | 0.0% | 3.9% | 3.7% | 58.0% | 28.2% | 6.2% | 100.0% |
| **20 20-30cm** | K6461/54 | 13.8% | 21.0% | 0.0% | 21.0% | 6.8% | 41.2% | 24.9% | 6.1% | 100.0% |
| **20 40-50cm** | K6461/55 | 24.4% | 1.0% | 0.0% | 1.0% | 3.4% | 24.3% | 8.1% | 63.2% | 100.0% |
| **20 65-75cm** | K6461/56 | 17.7% | 8.1% | 0.0% | 8.1% | 6.3% | 31.2% | 14.0% | 40.3% | 100.0% |
| **21 0-10cm** | K6461/57 | 17.2% | 4.4% | 0.0% | 4.4% | 13.1% | 48.5% | 24.1% | 9.8% | 100.0% |
| **21 15-25cm** | K6461/58 | 14.7% | 7.7% | 0.0% | 7.7% | 13.5% | 51.1% | 23.2% | 4.6% | 100.0% |
| **21 40-50cm** | K6461/59 | 26.2% | 1.2% | 0.0% | 1.2% | 3.8% | 13.3% | 15.8% | 66.0% | 100.0% |
| **21 65-75cm** | K6461/60 | 22.3% | 2.4% | 0.0% | 2.4% | 4.1% | 20.3% | 20.7% | 52.6% | 100.0% |
| **22 0-10cm** | K6461/61 | 17.5% | 1.5% | 0.0% | 1.5% | 26.9% | 43.3% | 16.9% | 11.4% | 100.0% |
| **22 20-30cm** | K6461/62 | 17.1% | 0.5% | 0.0% | 0.5% | 9.6% | 13.7% | 10.3% | 65.9% | 100.0% |
| **22 40-50cm** | K6461/63 | 12.5% | 0.3% | 0.0% | 0.3% | 9.7% | 17.9% | 21.0% | 51.0% | 100.0% |
| **22 65-75cm** | K6461/64 | 12.7% | 0.0% | 0.0% | 0.0% | 11.1% | 21.7% | 16.4% | 50.9% | 100.0% |
| **24 0-10cm** | K6461/65 | 15.2% | 0.5% | 0.0% | 0.5% | 8.9% | 47.0% | 16.7% | 26.9% | 100.0% |
| **24 20-30cm** | K6461/66 | 12.9% | 1.6% | 0.0% | 1.6% | 4.7% | 38.3% | 13.0% | 42.4% | 100.0% |
| **24 40-50cm** | K6461/67 | 14.2% | 3.0% | 0.0% | 3.0% | 3.4% | 29.2% | 16.1% | 48.3% | 100.0% |
| **24 65-75cm** | K6461/68 | 12.2% | 6.3% | 4.3% | 2.0% | 4.4% | 37.0% | 15.3% | 36.9% | 100.0% |
| **25 0-10cm** | K6461/69 | 17.7% | 3.8% | 0.0% | 3.8% | 4.8% | 39.2% | 18.0% | 34.1% | 100.0% |
| **25 20-30cm** | K6461/70 | 12.6% | 14.4% | 0.0% | 14.4% | 6.1% | 50.1% | 10.6% | 18.8% | 100.0% |
| **25 40-50cm** | K6461/71 | 15.1% | 3.1% | 0.0% | 3.1% | 5.0% | 30.1% | 15.6% | 46.1% | 100.0% |
| **25 65-75cm** | K6461/72 | 17.3% | 11.1% | 0.0% | 11.1% | 4.9% | 28.6% | 7.1% | 48.3% | 100.0% |
| **26 0-10cm** | K6461/73 | 13.7% | 4.3% | 0.0% | 4.3% | 18.5% | 48.1% | 13.2% | 15.8% | 100.0% |
| **26 20-30cm** | K6461/74 | 19.2% | 2.6% | 0.0% | 2.6% | 11.0% | 22.2% | 11.4% | 52.8% | 100.0% |
| **26 40-50cm** | K6461/75 | 22.6% | 1.5% | 0.0% | 1.5% | 6.0% | 13.5% | 11.1% | 67.9% | 100.0% |

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

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **26 65-75cm** | K6461/76 | 24.1% | 13.9% | 0.0% | 13.9% | 18.6% | 16.3% | 16.0% | 35.2% | 100.0% |
| **28 0-10cm** | K6461/77 | 14.6% | 4.2% | 0.0% | 4.2% | 3.5% | 47.5% | 31.2% | 13.6% | 100.0% |
| **28 20-30cm** | K6461/78 | 10.4% | 24.8% | 0.0% | 24.8% | 5.2% | 41.3% | 21.6% | 7.1% | 100.0% |
| **28 40-50cm** | K6461/79 | 12.3% | 7.5% | 0.0% | 7.5% | 12.3% | 32.6% | 4.9% | 42.6% | 100.0% |
| **28 65-75cm** | K6461/80 | 15.3% | 0.5% | 0.0% | 0.5% | 1.0% | 21.6% | 19.2% | 57.8% | 100.0% |
| **29 0-10cm** | K6461/81 | 19.7% | 1.1% | 0.0% | 1.1% | 6.1% | 51.5% | 21.4% | 19.9% | 100.0% |
| **29 20-30cm** | K6461/82 | 13.9% | 5.1% | 0.0% | 5.1% | 5.0% | 36.9% | 13.7% | 39.3% | 100.0% |
| **29 40-50cm** | K6461/83 | 14.9% | 15.8% | 0.0% | 15.8% | 7.1% | 21.1% | 12.1% | 43.8% | 100.0% |
| **29 65-75cm** | K6461/84 | 19.6% | 6.9% | 0.0% | 6.9% | 2.2% | 8.8% | 14.5% | 67.7% | 100.0% |
| **30 0-10cm** | K6461/85 | 19.8% | 0.2% | 0.0% | 0.2% | 2.7% | 18.1% | 14.1% | 65.0% | 100.0% |
| **30 20-30cm** | K6461/86 | 23.1% | 0.7% | 0.0% | 0.7% | 2.0% | 7.6% | 16.8% | 73.0% | 100.0% |
| **30 40-50cm** | K6461/87 | 18.9% | 1.5% | 0.0% | 1.5% | 7.3% | 1.3% | 8.0% | 81.9% | 100.0% |
| **30 65-75cm** | K6461/88 | 17.4% | 0.9% | 0.0% | 0.9% | 6.3% | 0.7% | 9.0% | 83.2% | 100.0% |
| **31 0-10cm** | K6461/89 | 17.5% | 0.9% | 0.0% | 0.9% | 4.1% | 41.6% | 19.7% | 33.8% | 100.0% |
| **31 20-30cm** | K6461/90 | 16.6% | 1.0% | 0.0% | 1.0% | 3.1% | 28.2% | 15.5% | 52.2% | 100.0% |
| **31 40-50cm** | K6461/91 | 19.0% | 1.3% | 0.0% | 1.3% | 2.5% | 32.2% | 19.2% | 44.9% | 100.0% |
| **31 65-75cm** | K6461/92 | 19.5% | 1.1% | 0.0% | 1.1% | 1.7% | 37.4% | 11.4% | 48.5% | 100.0% |
| **32 0-10cm** | K6461/93 | 16.3% | 0.2% | 0.0% | 0.2% | 3.0% | 59.5% | 17.8% | 19.4% | 100.0% |
| **32 20-30cm** | K6461/94 | 16.7% | 0.6% | 0.0% | 0.6% | 1.8% | 45.7% | 17.1% | 34.8% | 100.0% |
| **32 40-50cm** | K6461/95 | 17.7% | 1.6% | 0.0% | 1.6% | 1.7% | 42.3% | 18.0% | 36.4% | 100.0% |
| **32 65-75cm** | K6461/96 | 16.1% | 3.3% | 0.0% | 3.3% | 4.5% | 31.0% | 21.8% | 39.4% | 100.0% |
| **33 0-10cm** | K6461/97 | 16.1% | 0.2% | 0.0% | 0.2% | 2.5% | 55.5% | 25.9% | 15.8% | 100.0% |
| **33 20-30cm** | K6461/98 | 16.9% | 3.0% | 2.0% | 0.9% | 1.5% | 39.0% | 21.0% | 35.5% | 100.0% |
| **33 40-50cm** | K6461/99 | 18.9% | 1.2% | 0.0% | 1.2% | 2.0% | 40.8% | 18.1% | 37.9% | 100.0% |
| **33 65-75cm** | K6461/100 | 16.1% | 2.0% | 0.0% | 2.0% | 1.1% | 28.8% | 21.7% | 46.4% | 100.0% |

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

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **34 0-10cm** | K6461/101 | 15.0% | 6.3% | 0.0% | 6.3% | 10.2% | 45.8% | 23.4% | 14.3% | 100.0% |
| **34 20-30cm** | K6461/102 | 13.8% | 5.5% | 0.0% | 5.5% | 10.8% | 42.4% | 21.3% | 20.1% | 100.0% |
| **34 40-50cm** | K6461/103 | 14.7% | 23.9% | 0.0% | 23.9% | 6.6% | 30.6% | 16.1% | 22.8% | 100.0% |
| **34 65-75cm** | K6461/104 | 14.0% | 15.5% | 0.0% | 15.5% | 8.1% | 26.8% | 16.5% | 33.0% | 100.0% |
| **36 0-10cm** | K6461/105 | 13.0% | 14.5% | 0.0% | 14.5% | 11.8% | 39.0% | 24.7% | 10.0% | 100.0% |
| **36 20-30cm** | K6461/106 | 11.9% | 28.2% | 0.0% | 28.2% | 13.2% | 35.9% | 13.9% | 8.8% | 100.0% |
| **36 40-50cm** | K6461/107 | 20.7% | 1.5% | 0.0% | 1.5% | 3.2% | 20.3% | 9.5% | 65.6% | 100.0% |
| **36 65-75cm** | K6461/108 | 18.2% | 4.3% | 0.0% | 4.3% | 3.1% | 19.7% | 12.3% | 60.6% | 100.0% |
| **37 0-10cm** | K6461/109 | 13.4% | 7.8% | 0.0% | 7.8% | 10.1% | 52.3% | 22.4% | 7.4% | 100.0% |
| **37 20-30cm** | K6461/110 | 11.7% | 22.9% | 15.0% | 7.9% | 10.2% | 38.2% | 20.6% | 8.1% | 100.0% |
| **37 40-50cm** | K6461/111 | 16.5% | 2.7% | 0.0% | 2.7% | 7.0% | 28.3% | 12.2% | 49.8% | 100.0% |
| **37 65-75cm** | K6461/112 | 19.0% | 0.9% | 0.0% | 0.9% | 4.5% | 26.1% | 12.2% | 56.2% | 100.0% |
| **39 0-10cm** | K6461/113 | 16.1% | 1.9% | 0.0% | 1.9% | 14.2% | 44.9% | 18.9% | 20.1% | 100.0% |
| **39 20-30cm** | K6461/114 | 14.2% | 4.9% | 0.0% | 4.9% | 14.2% | 36.4% | 17.9% | 26.6% | 100.0% |
| **39 40-50cm** | K6461/115 | 18.4% | 0.9% | 0.0% | 0.9% | 5.1% | 16.6% | 14.1% | 63.3% | 100.0% |
| **39 65-75cm** | K6461/116 | 18.0% | 0.7% | 0.0% | 0.7% | 4.1% | 17.3% | 11.7% | 66.1% | 100.0% |
| **40 0-10cm** | K6461/117 | 17.9% | 4.4% | 0.0% | 4.4% | 4.1% | 34.0% | 22.8% | 34.7% | 100.0% |
| **40 20-30cm** | K6461/118 | 21.3% | 1.3% | 0.0% | 1.3% | 3.3% | 20.1% | 12.7% | 62.6% | 100.0% |
| **40 40-50cm** | K6461/119 | 20.0% | 0.7% | 0.0% | 0.7% | 3.4% | 18.2% | 14.2% | 63.4% | 100.0% |
| **40 65-75cm** | K6461/120 | 18.7% | 1.7% | 0.0% | 1.7% | 3.9% | 17.3% | 16.3% | 60.7% | 100.0% |
| **41 0-10cm** | K6461/121 | 10.4% | 7.9% | 0.0% | 7.9% | 7.6% | 43.9% | 29.5% | 11.2% | 100.0% |
| **41 10-20cm** | K6461/122 | 6.8% | 16.1% | 0.0% | 16.1% | 11.0% | 41.0% | 25.5% | 6.4% | 100.0% |
| **41 30-40cm** | K6461/123 | 19.5% | 0.0% | 0.0% | 0.0% | 2.0% | 27.0% | 15.9% | 55.1% | 100.0% |
| **41 65-75cm** | K6461/124 | 15.1% | 0.7% | 0.0% | 0.7% | 2.4% | 27.1% | 13.3% | 56.4% | 100.0% |
| **42 0-10cm** | K6461/125 | 11.7% | 2.5% | 0.0% | 2.5% | 5.9% | 44.4% | 21.7% | 25.5% | 100.0% |

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Laboratory Manager

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **42 20-30cm** | K6461/126 | 19.1% | 0.5% | 0.0% | 0.5% | 3.1% | 26.0% | 16.1% | 54.3% | 100.0% |
| **42 40-50cm** | K6461/127 | 21.3% | 0.4% | 0.0% | 0.4% | 2.5% | 24.2% | 10.7% | 62.2% | 100.0% |
| **42 65-75cm** | K6461/128 | 16.5% | 0.7% | 0.0% | 0.7% | 2.5% | 25.4% | 11.4% | 60.0% | 100.0% |
| **43 0-10cm** | K6461/129 | 6.1% | 13.9% | 0.0% | 13.9% | 7.9% | 51.2% | 18.6% | 8.4% | 100.0% |
| **43 20-30cm** | K6461/130 | 9.0% | 35.8% | 23.9% | 11.9% | 7.6% | 35.1% | 17.0% | 4.6% | 100.0% |
| **43 40-50cm** | K6461/131 | 16.7% | 3.4% | 0.0% | 3.4% | 4.6% | 25.1% | 13.7% | 53.2% | 100.0% |
| **43 65-75cm** | K6461/132 | 18.0% | 1.5% | 0.0% | 1.5% | 2.6% | 19.8% | 11.9% | 64.1% | 100.0% |
| **46 0-10cm** | K6461/133 | 10.6% | 1.9% | 0.0% | 1.9% | 10.2% | 53.5% | 18.8% | 15.7% | 100.0% |
| **46 20-30cm** | K6461/134 | 11.2% | 7.6% | 0.0% | 7.6% | 11.5% | 47.3% | 15.9% | 17.7% | 100.0% |
| **46 40-50cm** | K6461/135 | 11.4% | 4.3% | 0.0% | 4.3% | 9.5% | 41.1% | 14.3% | 30.7% | 100.0% |
| **46 65-75cm** | K6461/136 | 16.0% | 0.9% | 0.0% | 0.9% | 3.7% | 25.0% | 13.6% | 56.8% | 100.0% |
| **47 0-10cm** | K6461/137 | 12.8% | 2.0% | 0.0% | 2.0% | 9.3% | 38.7% | 27.5% | 22.5% | 100.0% |
| **47 20-30cm** | K6461/138 | 18.3% | 9.2% | 0.0% | 9.2% | 8.1% | 27.3% | 26.4% | 29.1% | 100.0% |
| **47 40-50cm** | K6461/139 | 16.5% | 6.0% | 0.0% | 6.0% | 8.5% | 27.3% | 18.8% | 39.4% | 100.0% |
| **47 65-75cm** | K6461/140 | 18.4% | 2.1% | 0.0% | 2.1% | 4.3% | 13.4% | 17.2% | 63.0% | 100.0% |
| **49 0-10cm** | K6461/141 | 8.5% | 3.9% | 0.0% | 3.9% | 8.0% | 45.9% | 27.0% | 15.3% | 100.0% |
| **49 20-30cm** | K6461/142 | 15.4% | 1.6% | 0.0% | 1.6% | 7.0% | 38.3% | 26.2% | 27.0% | 100.0% |
| **49 40-50cm** | K6461/143 | 22.8% | 1.6% | 0.0% | 1.6% | 2.4% | 19.8% | 14.9% | 61.3% | 100.0% |
| **49 65-75cm** | K6461/144 | 19.3% | 2.5% | 0.0% | 2.5% | 3.4% | 20.2% | 19.0% | 54.9% | 100.0% |
| **50 0-10cm** | K6461/145 | 10.6% | 9.6% | 0.0% | 9.6% | 6.2% | 39.7% | 17.7% | 26.8% | 100.0% |
| **50 20-30cm** | K6461/146 | 14.7% | 8.7% | 0.0% | 8.7% | 5.4% | 34.5% | 17.5% | 33.9% | 100.0% |
| **50 40-50cm** | K6461/147 | 17.5% | 2.1% | 0.0% | 2.1% | 4.2% | 31.2% | 11.3% | 51.1% | 100.0% |
| **50 65-75cm** | K6461/148 | 20.9% | 0.6% | 0.0% | 0.6% | 2.9% | 19.4% | 14.2% | 63.0% | 100.0% |
| **51 0-10cm** | K6461/149 | 9.9% | 9.3% | 0.0% | 9.3% | 4.2% | 52.8% | 25.6% | 8.1% | 100.0% |
| **51 20-30cm** | K6461/150 | 9.0% | 16.1% | 0.0% | 16.1% | 4.5% | 47.5% | 26.0% | 5.9% | 100.0% |

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Laboratory Manager

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **51 40-50cm** | K6461/151 | 13.5% | 42.0% | 0.0% | 42.0% | 2.2% | 11.0% | 15.7% | 29.1% | 100.0% |
| **51 65-75cm** | K6461/152 | 20.8% | 1.4% | 0.0% | 1.4% | 1.2% | 15.1% | 14.9% | 67.4% | 100.0% |
| **52 0-10cm** | K6461/153 | 14.0% | 2.4% | 0.0% | 2.4% | 5.6% | 40.1% | 25.9% | 25.9% | 100.0% |
| **52 20-30cm** | K6461/154 | 23.5% | 0.1% | 0.0% | 0.1% | 2.5% | 21.3% | 11.1% | 65.0% | 100.0% |
| **52 40-50cm** | K6461/155 | 21.9% | 0.7% | 0.0% | 0.7% | 2.9% | 21.7% | 10.9% | 63.9% | 100.0% |
| **52 65-75cm** | K6461/156 | 20.3% | 0.5% | 0.0% | 0.5% | 2.9% | 22.6% | 12.8% | 61.2% | 100.0% |
| **53 0-10cm** | K6461/157 | 12.7% | 5.1% | 0.0% | 5.1% | 5.5% | 55.4% | 23.2% | 10.8% | 100.0% |
| **53 20-30cm** | K6461/158 | 10.1% | 36.0% | 0.0% | 36.0% | 11.9% | 24.1% | 18.0% | 9.9% | 100.0% |
| **53 40-50cm** | K6461/159 | 22.0% | 2.0% | 0.0% | 2.0% | 1.4% | 7.4% | 14.6% | 74.7% | 100.0% |
| **53 65-75cm** | K6461/160 | 20.5% | 2.0% | 0.0% | 2.0% | 1.2% | 1.3% | 7.8% | 87.8% | 100.0% |
| **54 0-10cm** | K6461/161 | 14.0% | 2.0% | 0.0% | 2.0% | 6.7% | 60.2% | 17.8% | 13.4% | 100.0% |
| **54 20-30cm** | K6461/162 | 15.1% | 3.8% | 0.0% | 3.8% | 5.4% | 39.9% | 15.8% | 35.1% | 100.0% |
| **54 40-50cm** | K6461/163 | 23.5% | 0.7% | 0.0% | 0.7% | 2.2% | 20.8% | 10.5% | 65.8% | 100.0% |
| **54 65-75cm** | K6461/164 | 24.6% | 0.5% | 0.0% | 0.5% | 1.9% | 17.0% | 9.2% | 71.4% | 100.0% |
| **55 0-10cm** | K6461/165 | 9.7% | 15.3% | 0.0% | 15.3% | 13.4% | 0.3% | 38.1% | 33.0% | 100.0% |
| **55 20-30cm** | K6461/166 | 8.9% | 11.3% | 0.0% | 11.3% | 6.5% | 45.0% | 18.9% | 18.3% | 100.0% |
| **55 40-50cm** | K6461/167 | 10.7% | 36.1% | 0.0% | 36.1% | 6.4% | 24.5% | 11.3% | 21.7% | 100.0% |
| **55 65-75cm** | K6461/168 | 16.8% | 0.8% | 0.0% | 0.8% | 3.1% | 27.5% | 11.8% | 56.8% | 100.0% |
| **59 0-10cm** | K6461/169 | 10.1% | 5.3% | 0.0% | 5.3% | 22.8% | 36.9% | 22.1% | 12.8% | 100.0% |
| **59 20-30cm** | K6461/170 | 22.8% | 0.1% | 0.0% | 0.1% | 6.5% | 18.0% | 21.8% | 53.6% | 100.0% |
| **59 40-50cm** | K6461/171 | 18.1% | 0.9% | 0.0% | 0.9% | 5.8% | 24.0% | 21.2% | 48.1% | 100.0% |
| **59 65-75cm** | K6461/172 | 12.0% | 37.0% | 17.9% | 19.1% | 24.9% | 22.6% | 7.8% | 7.7% | 100.0% |
| **60 0-10cm** | K6461/173 | 13.2% | 4.5% | 0.0% | 4.5% | 12.4% | 37.7% | 27.9% | 17.5% | 100.0% |
| **60 20-30cm** | K6461/174 | 15.7% | 19.4% | 9.3% | 10.1% | 7.6% | 33.5% | 17.5% | 22.0% | 100.0% |
| **60 40-50cm** | K6461/175 | 18.9% | 3.7% | 0.0% | 3.7% | 7.6% | 21.9% | 17.3% | 49.6% | 100.0% |

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Laboratory Manager

| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **60 65-75cm** | K6461/176 | 22.7% | 2.5% | 0.0% | 2.5% | 5.4% | 21.1% | 12.5% | 58.5% | 100.0% |
| **61 0-10cm** | K6461/177 | 11.2% | 2.1% | 0.5% | 1.6% | 12.3% | 38.5% | 25.8% | 21.3% | 100.0% |
| **61 20-30cm** | K6461/178 | 18.7% | 3.6% | 0.0% | 3.6% | 8.4% | 19.8% | 15.7% | 52.4% | 100.0% |
| **61 40-50cm** | K6461/179 | 18.2% | 2.2% | 0.0% | 2.2% | 7.1% | 23.0% | 15.4% | 52.2% | 100.0% |
| **61 65-75cm** | K6461/180 | 14.2% | 2.7% | 0.0% | 2.7% | 14.1% | 20.9% | 15.7% | 46.6% | 100.0% |
| **62 0-10cm** | K6461/181 | 10.9% | 5.0% | 0.0% | 5.0% | 7.3% | 39.4% | 26.2% | 22.2% | 100.0% |
| **62 20-30cm** | K6461/182 | 19.1% | 0.6% | 0.0% | 0.6% | 4.0% | 28.0% | 13.0% | 54.4% | 100.0% |
| **62 40-50cm** | K6461/183 | 19.3% | 0.7% | 0.0% | 0.7% | 3.2% | 23.4% | 12.0% | 60.6% | 100.0% |
| **62 65-75cm** | K6461/184 | 18.2% | 1.6% | 0.7% | 1.0% | 4.3% | 13.3% | 12.4% | 68.2% | 100.0% |
| **63 0-10cm** | K6461/185 | 14.3% | 1.8% | 0.4% | 1.4% | 5.5% | 43.6% | 24.6% | 24.5% | 100.0% |
| **63 20-30cm** | K6461/186 | 21.0% | 0.0% | 0.0% | 0.0% | 2.2% | 18.9% | 17.8% | 61.1% | 100.0% |
| **63 40-50cm** | K6461/187 | 19.1% | 0.6% | 0.0% | 0.6% | 2.1% | 18.1% | 17.9% | 61.3% | 100.0% |
| **63 65-75cm** | K6461/188 | 18.9% | 0.2% | 0.0% | 0.2% | 2.4% | 18.3% | 21.5% | 57.6% | 100.0% |
| **64 0-10cm** | K6461/189 | 12.1% | 3.4% | 0.0% | 3.4% | 9.1% | 41.1% | 22.5% | 23.8% | 100.0% |
| **64 20-30cm** | K6461/190 | 19.6% | 1.5% | 0.0% | 1.5% | 6.6% | 25.6% | 14.3% | 52.0% | 100.0% |
| **64 40-50cm** | K6461/191 | 21.8% | 4.5% | 0.0% | 4.5% | 6.1% | 20.9% | 14.8% | 53.7% | 100.0% |
| **64 65-75cm** | K6461/192 | 15.1% | 0.6% | 0.0% | 0.6% | 9.7% | 25.2% | 20.2% | 44.3% | 100.0% |
| **66 0-10cm** | K6461/193 | 15.3% | 4.3% | 1.7% | 2.5% | 7.7% | 52.2% | 19.2% | 16.6% | 100.0% |
| **66 20-30cm** | K6461/194 | 19.3% | 4.9% | 0.0% | 4.9% | 7.0% | 27.5% | 21.5% | 39.1% | 100.0% |
| **66 40-50cm** | K6461/195 | 20.2% | 2.0% | 0.0% | 2.0% | 4.9% | 20.9% | 15.1% | 57.1% | 100.0% |
| **66 65-75cm** | K6461/196 | 18.5% | 1.9% | 0.0% | 1.9% | 3.9% | 35.9% | 9.2% | 49.1% | 100.0% |
| **67 0-10cm** | K6461/197 | 17.8% | 1.1% | 0.0% | 1.1% | 12.0% | 35.8% | 32.7% | 18.3% | 100.0% |
| **67 20-30cm** | K6461/198 | 16.1% | 2.0% | 0.0% | 2.0% | 13.2% | 32.9% | 31.6% | 20.3% | 100.0% |
| **67 40-50cm** | K6461/199 | 17.0% | 2.8% | 0.0% | 2.8% | 13.4% | 43.5% | 21.7% | 18.6% | 100.0% |
| **67 65-75cm** | K6461/200 | 15.4% | 2.5% | 0.0% | 2.5% | 16.0% | 19.7% | 24.0% | 37.7% | 100.0% |

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| 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|
| **68 0-10cm** | K6461/201 | 12.4% | 3.0% | 0.0% | 3.0% | 9.1% | 46.9% | 27.1% | 13.8% | 100.0% |
| **68 20-30cm** | K6461/202 | 21.5% | 7.1% | 4.5% | 2.6% | 4.8% | 35.8% | 16.3% | 36.0% | 100.0% |
| **68 40-50cm** | K6461/203 | 20.4% | 1.3% | 0.7% | 0.6% | 4.9% | 23.9% | 12.5% | 57.3% | 100.0% |
| **68 65-75cm** | K6461/204 | 16.9% | 0.1% | 0.0% | 0.1% | 3.7% | 23.8% | 19.6% | 52.7% | 100.0% |
| **69 0-10cm** | K6461/205 | 12.5% | 4.0% | 0.0% | 4.0% | 15.1% | 49.6% | 19.0% | 12.3% | 100.0% |
| **69 20-30cm** | K6461/206 | 12.6% | 26.9% | 21.6% | 5.3% | 7.8% | 41.2% | 12.9% | 11.3% | 100.0% |
| **69 40-50cm** | K6461/207 | 22.8% | 2.0% | 0.0% | 2.0% | 8.4% | 17.1% | 11.3% | 61.2% | 100.0% |
| **69 65-75cm** | K6461/208 | 20.5% | 1.6% | 0.0% | 1.6% | 6.3% | 18.0% | 11.0% | 63.1% | 100.0% |
| **70 0-10cm** | K6461/209 | 12.7% | 2.3% | 0.0% | 2.3% | 7.2% | 50.4% | 23.3% | 16.8% | 100.0% |
| **70 20-30cm** | K6461/210 | 13.6% | 1.8% | 0.0% | 1.8% | 7.6% | 43.6% | 20.7% | 26.2% | 100.0% |
| **70 40-50cm** | K6461/211 | 18.4% | 1.0% | 0.0% | 1.0% | 2.7% | 38.3% | 11.8% | 46.3% | 100.0% |
| **70 65-75cm** | K6461/212 | 18.6% | 1.7% | 0.0% | 1.7% | 2.3% | 12.2% | 17.2% | 66.5% | 100.0% |
| **71 0-10cm** | K6461/213 | 13.5% | 3.8% | 0.0% | 3.8% | 7.0% | 28.9% | 34.1% | 26.2% | 100.0% |
| **71 20-30cm** | K6461/214 | 12.4% | 3.7% | 0.0% | 3.7% | 9.9% | 38.5% | 25.3% | 22.6% | 100.0% |
| **71 40-50cm** | K6461/215 | 24.0% | 3.9% | 0.0% | 3.9% | 5.2% | 20.7% | 13.2% | 57.0% | 100.0% |
| **71 65-75cm** | K6461/216 | 20.3% | 2.2% | 0.0% | 2.2% | 4.2% | 16.8% | 11.0% | 65.7% | 100.0% |
| **72 0-10cm** | K6461/217 | 10.5% | 2.8% | 0.0% | 2.8% | 9.6% | 58.2% | 20.2% | 9.2% | 100.0% |
| **72 20-30cm** | K6461/218 | 11.4% | 2.2% | 0.0% | 2.2% | 9.6% | 52.7% | 20.4% | 15.1% | 100.0% |
| **72 40-50cm** | K6461/219 | 10.1% | 1.7% | 0.0% | 1.7% | 7.3% | 40.3% | 17.0% | 33.7% | 100.0% |
| **72 65-75cm** | K6461/220 | 8.9% | 5.4% | 0.0% | 5.4% | 8.0% | 41.4% | 19.3% | 25.9% | 100.0% |
| **73 0-10cm** | K6461/221 | 12.2% | 2.1% | 0.0% | 2.1% | 19.2% | 33.5% | 18.6% | 26.6% | 100.0% |
| **73 20-30cm** | K6461/222 | 21.0% | 2.7% | 0.0% | 2.7% | 10.8% | 12.5% | 17.6% | 56.4% | 100.0% |
| **73 40-50cm** | K6461/223 | 21.1% | 4.6% | 0.0% | 4.6% | 9.3% | 18.4% | 15.3% | 52.4% | 100.0% |
| **73 65-75cm** | K6461/224 | 19.9% | 1.5% | 0.0% | 1.5% | 4.6% | 49.7% | 14.8% | 29.3% | 100.0% |

**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.

4. This report is not to be reproduced except in full. Results only relate to the item tested.

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 25/06/2021.

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

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ABN: 41 995 651 524

# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 1 0-10cm | 1 20-30cm | 1 40-50cm | 1 65-75cm | 2 0-10cm | 2 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/1 | K6461/2 | K6461/3 | K6461/4 | K6461/5 | K6461/6 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.39 | 6.33 | 6.75 | 6.92 | 5.68 | 6.92 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.171 | 0.037 | 0.016 | 0.014 | 0.055 | 0.038 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.2 | 6.9 | 7.0 | 8.1 | 9.7 | 16 |
| | (kg/ha) | | 3,210 | 3,117 | 3,156 | 3,622 | 4,369 | 7,108 |
| | (mg/kg) | | 1,433 | 1,391 | 1,409 | 1,617 | 1,950 | 3,173 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.1 | 2.5 | 4.3 | 6.4 | 6.0 | 15 |
| | (kg/ha) | | 577 | 668 | 1,183 | 1,740 | 1,642 | 4,005 |
| | (mg/kg) | | 258 | 298 | 528 | 777 | 733 | 1,788 |
| Exchangeable Potassium | (cmol+/kg) | | 0.77 | 0.24 | 0.32 | 0.43 | 0.43 | 0.45 |
| | (kg/ha) | | 673 | 212 | 277 | 378 | 379 | 398 |
| | (mg/kg) | | 301 | 95 | 124 | 169 | 169 | 178 |
| Exchangeable Sodium | (cmol+/kg) | | 0.18 | 0.09 | 0.11 | 0.18 | 0.13 | 0.37 |
| | (kg/ha) | | 95 | 46 | 55 | 95 | 66 | 189 |
| | (mg/kg) | | 42 | 21 | 24 | 42 | 30 | 84 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.03 | <0.01 | 0.01 | 0.01 | 0.04 | 0.01 |
| | (kg/ha) | | 5.1 | 1.9 | 2.6 | 2.6 | 8.3 | 2.2 |
| | (mg/kg) | | 2.3 | <1 | 1.2 | 1.2 | 3.7 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.13 | 0.05 | <0.01 | <0.01 | 0.13 | <0.01 |
| | (kg/ha) | | 2.8 | 1.1 | <1 | <1 | 2.8 | <1 |
| | (mg/kg) | | 1.3 | <1 | <1 | <1 | 1.3 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 10 | 9.8 | 12 | 15 | 16 | 31 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 69 | 71 | 60 | 53 | 59 | 50 |
| Magnesium (%) | | | 20 | 25 | 37 | 42 | 37 | 47 |
| Potassium (%) | | | 7.4 | 2.5 | 2.7 | 2.9 | 2.6 | 1.4 |
| Sodium - ESP (%) | | | 1.8 | 0.92 | 0.90 | 1.2 | 0.78 | 1.2 |
| Aluminium (%) | | | 0.24 | 0.10 | 0.11 | 0.08 | 0.25 | 0.03 |
| Hydrogen (%) | | | 1.2 | 0.50 | 0.00 | 0.00 | 0.77 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.4 | 2.8 | 1.6 | 1.3 | 1.6 | 1.1 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/3 | 10YR 4/4 | 7.5YR 4/6 | 7.5YR 4/4 | 7.5YR 2.5/2 | 10YR 4/4 |
| | | | Dark brown | Dark yellowish brown | Strong brown | Brown | Very dark brown | Dark yellowish brown |
| Mottles Munsell Colour | | | .. | .. | .. | 7.5YR 2.5/2 | .. | .. |
| | | | .. | .. | .. | Very dark brown | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | 80 | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 1 0-10cm | 1 20-30cm | 1 40-50cm | 1 65-75cm | 2 0-10cm | 2 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | **Parameter** | **Method reference** | K6461/1 | K6461/2 | K6461/3 | K6461/4 | K6461/5 | K6461/6 |

**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).
17. This report was issued on 09/07/2021.

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

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
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| | | | Sample 7 | Sample 8 | Sample 9 | Sample 10 | Sample 11 | Sample 12 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 2 40-50cm | 2 65-75cm | 3 0-10cm | 3 20-30cm | 3 40-50cm | 3 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/7** | **K6461/8** | **K6461/9** | **K6461/10** | **K6461/11** | **K6461/12** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.18 | 7.44 | 5.90 | 6.84 | 7.36 | 7.75 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.033 | 0.038 | 0.074 | 0.033 | 0.042 | 0.039 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 15 | 15 | 12 | 17 | 17 | 19 |
| | (kg/ha) | | 6,773 | 6,579 | 5,204 | 7,646 | 7,471 | 8,451 |
| | (mg/kg) | | 3,024 | 2,937 | 2,323 | 3,413 | 3,335 | 3,773 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 16 | 16 | 3.9 | 14 | 16 | 19 |
| | (kg/ha) | | 4,358 | 4,343 | 1,071 | 3,774 | 4,360 | 5,092 |
| | (mg/kg) | | 1,945 | 1,939 | 478 | 1,685 | 1,947 | 2,273 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 0.41 | 0.41 | 0.57 | 0.50 | 0.41 | 0.33 |
| | (kg/ha) | | 362 | 363 | 497 | 435 | 362 | 290 |
| | (mg/kg) | | 161 | 162 | 222 | 194 | 162 | 130 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.42 | 0.47 | 0.11 | 0.27 | 0.32 | 0.48 |
| | (kg/ha) | | 216 | 245 | 54 | 137 | 164 | 245 |
| | (mg/kg) | | 96 | 109 | 24 | 61 | 73 | 109 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | 0.01 | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | 2.7 | 1.3 | 3.5 | 1.9 | 1.4 | 1.6 |
| | (mg/kg) | | 1.2 | <1 | 1.6 | <1 | <1 | <1 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.08 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 1.9 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 32 | 32 | 16 | 32 | 33 | 38 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 47 | 47 | 71 | 54 | 50 | 49 |
| Magnesium (%) | | | 50 | 51 | 24 | 44 | 48 | 49 |
| Potassium (%) | | | 1.3 | 1.3 | 3.5 | 1.6 | 1.2 | 0.86 |
| Sodium - ESP (%) | | | 1.3 | 1.5 | 0.65 | 0.84 | 0.96 | 1.2 |
| Aluminium (%) | | | 0.04 | 0.02 | 0.11 | 0.03 | 0.02 | 0.02 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.51 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 0.94 | 0.92 | 2.9 | 1.2 | 1.0 | 1.0 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 4/3 | 10YR 4/2 | 10YR 3/3 | 10YR 4/4 | 10YR 5/4 | 10YR 5/4 |
| | | | Brown | Dark greyish brown | Dark brown | Dark yellowish brown | Yellowish brown | Yellowish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 7 | Sample 8 | Sample 9 | Sample 10 | Sample 11 | Sample 12 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 2 40-50cm | 2 65-75cm | 3 0-10cm | 3 20-30cm | 3 40-50cm | 3 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/7 | K6461/8 | K6461/9 | K6461/10 | K6461/11 | K6461/12 |

**Notes:**

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
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5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
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8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
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## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 13 | Sample 14 | Sample 15 | Sample 16 | Sample 17 | Sample 18 |
|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | 4 0-10cm | 4 20-30cm | 4 40-50cm | 4 65-75cm | 5 0-10cm | 5 20-30cm |
| Crop: | | | Soil | Soil | Soil | Soil | Soil | Soil |
| Client: | | | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/13 | K6461/14 | K6461/15 | K6461/16 | K6461/17 | K6461/18 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.31 | 6.53 | 6.73 | 6.78 | 4.76 | 6.49 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.104 | 0.025 | 0.024 | 0.019 | 0.133 | 0.024 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.2 | 8.2 | 9.0 | 6.8 | 3.5 | 5.6 |
| | (kg/ha) | | 3,245 | 3,686 | 4,053 | 3,065 | 1,592 | 2,496 |
| | (mg/kg) | | 1,449 | 1,646 | 1,809 | 1,368 | 711 | 1,114 |
| Exchangeable Magnesium | (cmol+/kg) | | 1.4 | 2.1 | 3.6 | 3.9 | 0.77 | 1.4 |
| | (kg/ha) | | 383 | 576 | 985 | 1,059 | 211 | 368 |
| | (mg/kg) | | 171 | 257 | 440 | 473 | 94 | 164 |
| Exchangeable Potassium | (cmol+/kg) | | 0.29 | 0.21 | 0.22 | 0.17 | 0.26 | 0.18 |
| | (kg/ha) | | 252 | 184 | 193 | 151 | 231 | 153 |
| | (mg/kg) | | 112 | 82 | 86 | 67 | 103 | 69 |
| Exchangeable Sodium | (cmol+/kg) | | 0.12 | 0.07 | 0.08 | 0.09 | 0.15 | 0.15 |
| | (kg/ha) | | 61 | 34 | 42 | 49 | 79 | 79 |
| | (mg/kg) | | 27 | 15 | 19 | 22 | 35 | 35 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.08 | 0.02 | 0.02 | 0.02 | 0.82 | 0.03 |
| | (kg/ha) | | 16 | 3.3 | 3.5 | 5.0 | 166 | 6.9 |
| | (mg/kg) | | 7.0 | 1.5 | 1.6 | 2.2 | 74 | 3.1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.19 | <0.01 | <0.01 | <0.01 | 1.1 | 0.04 |
| | (kg/ha) | | 4.3 | <1 | <1 | <1 | 24 | <1 |
| | (mg/kg) | | 1.9 | <1 | <1 | <1 | 11 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 9.3 | 11 | 13 | 11 | 6.6 | 7.3 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 78 | 77 | 70 | 62 | 53 | 76 |
| Magnesium (%) | | | 15 | 20 | 28 | 35 | 12 | 18 |
| Potassium (%) | | | 3.1 | 2.0 | 1.7 | 1.6 | 4.0 | 2.4 |
| Sodium - ESP (%) | | | 1.3 | 0.62 | 0.63 | 0.86 | 2.3 | 2.1 |
| Aluminium (%) | | | 0.83 | 0.15 | 0.14 | 0.23 | 12 | 0.47 |
| Hydrogen (%) | | | 2.1 | 0.00 | 0.00 | 0.00 | 16 | 0.57 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 5.1 | 3.9 | 2.5 | 1.8 | 4.6 | 4.1 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/4 | 7.5YR 3/4 | 7.5YR 3/4 | 7.5YR 3/4 | 10YR 3/2 | 10YR 4/3 |
| | | | Dark brown | Dark brown | Dark brown | Dark brown | Very dark greyish brown | Brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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| | | Sample 13 | Sample 14 | Sample 15 | Sample 16 | Sample 17 | Sample 18 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 4 0-10cm | 4 20-30cm | 4 40-50cm | 4 65-75cm | 5 0-10cm | 5 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/13 | K6461/14 | K6461/15 | K6461/16 | K6461/17 | K6461/18 |

**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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7. Total Acid Extractable Nutrients indicate a store of nutrients.
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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| | | | Sample 19 | Sample 20 | Sample 21 | Sample 22 | Sample 23 | Sample 24 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 5 40-50cm | 5 65-75cm | 6 0-10cm | 6 20-30cm | 6 40-50cm | 6 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/19** | **K6461/20** | **K6461/21** | **K6461/22** | **K6461/23** | **K6461/24** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.18 | 7.41 | 5.29 | 6.74 | 6.99 | 7.80 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.027 | 0.040 | 0.069 | 0.021 | 0.025 | 0.044 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 8.2 | 9.4 | 6.5 | 15 | 14 | 15 |
| | (kg/ha) | | 3,666 | 4,235 | 2,934 | 6,534 | 6,507 | 6,557 |
| | (mg/kg) | | 1,637 | 1,891 | 1,310 | 2,917 | 2,905 | 2,927 |
| Exchangeable Magnesium | (cmol+/kg) | | 3.9 | 6.0 | 1.6 | 7.9 | 9.0 | 12 |
| | (kg/ha) | | 1,050 | 1,624 | 446 | 2,152 | 2,448 | 3,320 |
| | (mg/kg) | | 469 | 725 | 199 | 961 | 1,093 | 1,482 |
| Exchangeable Potassium | (cmol+/kg) | | 0.24 | 0.32 | 0.27 | 0.42 | 0.44 | 0.45 |
| | (kg/ha) | | 213 | 277 | 238 | 371 | 383 | 391 |
| | (mg/kg) | | 95 | 124 | 106 | 166 | 171 | 174 |
| Exchangeable Sodium | (cmol+/kg) | | 0.25 | 0.46 | 0.08 | 0.12 | 0.14 | 0.18 |
| | (kg/ha) | | 128 | 237 | 41 | 59 | 71 | 94 |
| | (mg/kg) | | 57 | 106 | 18 | 27 | 32 | 42 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.02 | 0.02 | 0.15 | 0.04 | 0.02 | 0.02 |
| | (kg/ha) | | 5.0 | 3.7 | 30 | 7.1 | 4.5 | 3.6 |
| | (mg/kg) | | 2.2 | 1.6 | 13 | 3.2 | 2.0 | 1.6 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.28 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 6.2 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 2.8 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 13 | 16 | 9.0 | 23 | 24 | 27 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 65 | 58 | 73 | 63 | 60 | 53 |
| Magnesium (%) | | | 31 | 37 | 18 | 34 | 37 | 44 |
| Potassium (%) | | | 1.9 | 2.0 | 3.0 | 1.8 | 1.8 | 1.6 |
| Sodium - ESP (%) | | | 2.0 | 2.8 | 0.88 | 0.50 | 0.58 | 0.66 |
| Aluminium (%) | | | 0.20 | 0.11 | 1.7 | 0.15 | 0.09 | 0.06 |
| Hydrogen (%) | | | 0.00 | 0.00 | 3.1 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 2.1 | 1.6 | 4.0 | 1.8 | 1.6 | 1.2 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 5/4 | 10YR 5/4 | 7.5YR 3/3 | 7.5YR 4/6 | 7.5YR 5/6 | 10YR 5/6 |
| | | | Yellowish brown | Yellowish brown | Dark brown | Strong brown | Strong brown | Yellowish brown |
| Mottles Munsell Colour | | | .. | 7.5YR 5/6 | .. | .. | .. | .. |
| | | | .. | Strong brown | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | 40 | .. | .. | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 19 | Sample 20 | Sample 21 | Sample 22 | Sample 23 | Sample 24 |
|---|---|---|---|---|---|---|---|---|
| | | **Sample ID:** | 5 40-50cm | 5 65-75cm | 6 0-10cm | 6 20-30cm | 6 40-50cm | 6 65-75cm |
| | | **Crop:** | Soil | Soil | Soil | Soil | Soil | Soil |
| | | **Client:** | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | **Parameter** | **Method reference** | K6461/19 | K6461/20 | K6461/21 | K6461/22 | K6461/23 | K6461/24 |

**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: Collingwo
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 res
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.
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 sc
17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
KS

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| | | | Sample 25 | Sample 26 | Sample 27 | Sample 28 | Sample 29 | Sample 30 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 7 0-10cm | 7 20-30cm | 7 40-50cm | 7 65-75cm | 10 0-10cm | 10 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/25** | **K6461/26** | **K6461/27** | **K6461/28** | **K6461/29** | **K6461/30** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.81 | 6.74 | 6.69 | 6.86 | 5.03 | 5.21 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.119 | 0.032 | 0.034 | 0.024 | 0.072 | 0.045 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.5 | 7.6 | 7.7 | 6.8 | 2.4 | 3.5 |
| | (kg/ha) | | 3,368 | 3,398 | 3,457 | 3,055 | 1,057 | 1,571 |
| | (mg/kg) | | 1,504 | 1,517 | 1,543 | 1,364 | 472 | 702 |
| Exchangeable Magnesium | (cmol+/kg) | | 1.6 | 2.1 | 3.3 | 3.9 | 0.49 | 0.86 |
| | (kg/ha) | | 447 | 582 | 890 | 1,063 | 132 | 234 |
| | (mg/kg) | | 200 | 260 | 397 | 474 | 59 | 104 |
| Exchangeable Potassium | (cmol+/kg) | | 1.4 | 0.97 | 0.88 | 0.44 | 0.88 | 0.48 |
| | (kg/ha) | | 1,237 | 850 | 770 | 381 | 771 | 420 |
| | (mg/kg) | | 552 | 380 | 344 | 170 | 344 | 187 |
| Exchangeable Sodium | (cmol+/kg) | | <0.065 | 0.08 | 0.11 | 0.15 | <0.065 | <0.065 |
| | (kg/ha) | | <33 | 40 | 57 | 76 | <33 | <33 |
| | (mg/kg) | | <15 | 18 | 25 | 34 | <15 | <15 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.03 | 0.02 | 0.03 | 0.04 | 0.63 | 0.52 |
| | (kg/ha) | | 5.7 | 4.9 | 5.9 | 7.2 | 127 | 106 |
| | (mg/kg) | | 2.5 | 2.2 | 2.6 | 3.2 | 57 | 47 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.11 | <0.01 | <0.01 | <0.01 | 0.77 | 0.64 |
| | (kg/ha) | | 2.6 | <1 | <1 | <1 | 17 | 14 |
| | (mg/kg) | | 1.1 | <1 | <1 | <1 | 7.7 | 6.4 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 11 | 11 | 12 | 11 | 5.2 | 6.0 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 70 | 70 | 64 | 60 | 46 | 58 |
| Magnesium (%) | | | 15 | 20 | 27 | 34 | 9.4 | 14 |
| Potassium (%) | | | 13 | 9.0 | 7.3 | 3.8 | 17 | 7.9 |
| Sodium - ESP (%) | | | 0.38 | 0.72 | 0.92 | 1.3 | 0.95 | 0.84 |
| Aluminium (%) | | | 0.26 | 0.22 | 0.24 | 0.32 | 12 | 8.7 |
| Hydrogen (%) | | | 1.1 | 0.00 | 0.00 | 0.00 | 15 | 11 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 4.6 | 3.5 | 2.4 | 1.7 | 4.8 | 4.1 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 3/4 Dark reddish brown | 2.5YR 2.5/4 Dark reddish brown | 2.5YR 5/4 Dark reddish brown | 2.5YR 5/4 Dark reddish brown | 10YR 4/4 Dark yellowish brown | 7.5YR 4/4 Brown |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 25 | Sample 26 | Sample 27 | Sample 28 | Sample 29 | Sample 30 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 7 0-10cm | 7 20-30cm | 7 40-50cm | 7 65-75cm | 10 0-10cm | 10 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | K6461/25 | K6461/26 | K6461/27 | K6461/28 | K6461/29 | K6461/30 |

**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: Collingwo
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,
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9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil res
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12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimat
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
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| Parameter | | Method reference | Sample 31 | Sample 32 | Sample 33 | Sample 34 | Sample 35 | Sample 36 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 10 40-50cm | 10 65-75cm | 11 0-10cm | 11 20-30cm | 11 40-50cm | 11 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/31 | K6461/32 | K6461/33 | K6461/34 | K6461/35 | K6461/36 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.61 | 6.98 | 5.23 | 6.38 | 6.87 | 5.98 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.017 | 0.016 | 0.074 | 0.026 | 0.037 | 0.029 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 6.0 | 3.7 | 3.3 | 9.0 | 11 | 10 |
| | (kg/ha) | | 2,710 | 1,673 | 1,476 | 4,041 | 4,782 | 4,539 |
| | (mg/kg) | | 1,210 | 747 | 659 | 1,804 | 2,135 | 2,026 |
| Exchangeable Magnesium | (cmol+/kg) | | 3.0 | 3.0 | 0.76 | 6.8 | 12 | 13 |
| | (kg/ha) | | 816 | 820 | 206 | 1,850 | 3,320 | 3,646 |
| | (mg/kg) | | 364 | 366 | 92 | 826 | 1,482 | 1,628 |
| Exchangeable Potassium | (cmol+/kg) | | 0.46 | 0.25 | 0.53 | 0.66 | 0.78 | 0.62 |
| | (kg/ha) | | 401 | 223 | 464 | 580 | 684 | 539 |
| | (mg/kg) | | 179 | 100 | 207 | 259 | 305 | 241 |
| Exchangeable Sodium | (cmol+/kg) | | 0.08 | 0.10 | <0.065 | 0.15 | 0.90 | 1.1 |
| | (kg/ha) | | 39 | 54 | <33 | 78 | 462 | 559 |
| | (mg/kg) | | 17 | 24 | <15 | 35 | 206 | 249 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.06 | 0.02 | 0.24 | 0.02 | 0.02 | 0.83 |
| | (kg/ha) | | 11 | 4.9 | 48 | 4.9 | 4.5 | 167 |
| | (mg/kg) | | 5.0 | 2.2 | 21 | 2.2 | 2.0 | 74 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.43 | 0.08 | <0.01 | 1.2 |
| | (kg/ha) | | <1 | <1 | 9.5 | 1.7 | <1 | 26 |
| | (mg/kg) | | <1 | <1 | 4.3 | <1 | <1 | 12 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 9.6 | 7.1 | 5.3 | 17 | 25 | 27 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 63 | 52 | 62 | 54 | 43 | 37 |
| Magnesium (%) | | | 31 | 42 | 14 | 41 | 50 | 49 |
| Potassium (%) | | | 4.8 | 3.6 | 10 | 4.0 | 3.2 | 2.3 |
| Sodium - ESP (%) | | | 0.78 | 1.5 | 0.83 | 0.91 | 3.7 | 4.0 |
| Aluminium (%) | | | 0.58 | 0.34 | 4.5 | 0.15 | 0.09 | 3.0 |
| Hydrogen (%) | | | 0.00 | 0.00 | 8.1 | 0.46 | 0.00 | 4.3 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 2.0 | 1.2 | 4.4 | 1.3 | 0.87 | 0.75 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 4/4 | 10YR 5/4 | 7.5YR 3/4 | 7.5YR 4/6 | 5YR 4/6 | 10YR 5/2 |
| | | | Reddish brown | Yellowish brown | Dark brown | Strong brown | Yellowish red | Greyish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | 2.5YR 3/6 |
| | | | .. | .. | .. | .. | .. | Dark red |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | 30 |

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## AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 31 | Sample 32 | Sample 33 | Sample 34 | Sample 35 | Sample 36 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 10 40-50cm | 10 65-75cm | 11 0-10cm | 11 20-30cm | 11 40-50cm | 11 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/31 | K6461/32 | K6461/33 | K6461/34 | K6461/35 | K6461/36 |

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: Collingwo
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.
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7. Total Acid Extractable Nutrients indicate a store of nutrients.
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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| Parameter | | Method reference | Sample 37 | Sample 38 | Sample 39 | Sample 40 | Sample 41 | Sample 42 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 12 0-10cm | 12 20-30cm | 12 40-50cm | 12 65-75cm | 13 0-10cm | 13 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/37 | K6461/38 | K6461/39 | K6461/40 | K6461/41 | K6461/42 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.18 | 5.86 | 6.34 | 6.78 | 4.85 | 5.79 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.098 | 0.063 | 0.095 | 0.078 | 0.190 | 0.033 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 2.9 | 4.5 | 6.4 | 6.8 | 3.5 | 5.5 |
| | (kg/ha) | | 1,284 | 2,026 | 2,853 | 3,038 | 1,578 | 2,464 |
| | (mg/kg) | | 573 | 905 | 1,274 | 1,356 | 704 | 1,100 |
| Exchangeable Magnesium | (cmol+/kg) | | 0.68 | 1.4 | 2.8 | 4.1 | 0.66 | 1.0 |
| | (kg/ha) | | 186 | 387 | 765 | 1,114 | 181 | 277 |
| | (mg/kg) | | 83 | 173 | 341 | 497 | 81 | 124 |
| Exchangeable Potassium | (cmol+/kg) | | 1.6 | 1.6 | 1.7 | 1.0 | 0.97 | 0.24 |
| | (kg/ha) | | 1,375 | 1,420 | 1,486 | 894 | 847 | 210 |
| | (mg/kg) | | 614 | 634 | 663 | 399 | 378 | 94 |
| Exchangeable Sodium | (cmol+/kg) | | <0.065 | <0.065 | 0.10 | 0.21 | <0.065 | 0.07 |
| | (kg/ha) | | <33 | <33 | 52 | 108 | <33 | 36 |
| | (mg/kg) | | <15 | <15 | 23 | 48 | <15 | 16 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.46 | 0.07 | 0.01 | 0.01 | 0.28 | 0.12 |
| | (kg/ha) | | 93 | 14 | 2.9 | 2.8 | 57 | 24 |
| | (mg/kg) | | 41 | 6.1 | 1.3 | 1.2 | 25 | 11 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.64 | 0.12 | 0.04 | <0.01 | 0.47 | 0.18 |
| | (kg/ha) | | 14 | 2.6 | <1 | <1 | 11 | 3.9 |
| | (mg/kg) | | 6.4 | 1.2 | <1 | <1 | 4.7 | 1.8 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 6.2 | 7.8 | 11 | 12 | 5.9 | 7.1 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 46 | 58 | 58 | 56 | 59 | 77 |
| Magnesium (%) | | | 11 | 18 | 25 | 34 | 11 | 14 |
| Potassium (%) | | | 25 | 21 | 15 | 8.4 | 16 | 3.4 |
| Sodium - ESP (%) | | | 0.45 | 0.60 | 0.92 | 1.7 | 0.62 | 0.97 |
| Aluminium (%) | | | 7.4 | 0.87 | 0.13 | 0.11 | 4.8 | 1.7 |
| Hydrogen (%) | | | 10 | 1.5 | 0.40 | 0.00 | 8.0 | 2.5 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 4.2 | 3.2 | 2.3 | 1.7 | 5.3 | 5.4 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/4 | 5YR 4/6 | 5YR 4/6 | 5YR 4/6 | 7.5YR 3/4 | 5YR 4/4 |
| | | | Dark brown | Yellowish red | Yellowish red | Yellowish red | Dark brown | Reddish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 37 | Sample 38 | Sample 39 | Sample 40 | Sample 41 | Sample 42 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 12 0-10cm | 12 20-30cm | 12 40-50cm | 12 65-75cm | 13 0-10cm | 13 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/37 | K6461/38 | K6461/39 | K6461/40 | K6461/41 | K6461/42 |

**Notes:**

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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 res
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.
14. Analysis conducted between sample arrival date and reporting date.
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17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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ABN: 41 995 651 524

# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 43 | Sample 44 | Sample 45 | Sample 46 | Sample 47 | Sample 48 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 13 40-50cm | 13 65-75cm | 18 0-10cm | 18 20-30cm | 18 40-50cm | 18 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/43 | K6461/44 | K6461/45 | K6461/46 | K6461/47 | K6461/48 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.71 | 6.97 | 6.38 | 6.59 | 7.62 | 7.62 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.024 | 0.017 | 0.197 | 0.270 | 0.134 | 0.186 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.2 | 6.1 | 11 | 7.6 | 6.0 | 16 |
| | (kg/ha) | | 3,240 | 2,728 | 4,938 | 3,422 | 2,710 | 7,362 |
| | (mg/kg) | | 1,446 | 1,218 | 2,204 | 1,528 | 1,210 | 3,287 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.3 | 3.5 | 8.3 | 6.6 | 6.6 | 19 |
| | (kg/ha) | | 622 | 956 | 2,247 | 1,805 | 1,784 | 5,136 |
| | (mg/kg) | | 278 | 427 | 1,003 | 806 | 796 | 2,293 |
| Exchangeable Potassium | (cmol+/kg) | | 0.30 | 0.27 | 0.20 | 0.16 | 0.23 | 0.65 |
| | (kg/ha) | | 264 | 237 | 179 | 142 | 200 | 566 |
| | (mg/kg) | | 118 | 106 | 80 | 63 | 89 | 253 |
| Exchangeable Sodium | (cmol+/kg) | | 0.10 | 0.17 | 0.56 | 0.49 | 0.38 | 0.69 |
| | (kg/ha) | | 51 | 86 | 291 | 254 | 198 | 355 |
| | (mg/kg) | | 23 | 39 | 130 | 113 | 88 | 159 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.02 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | 3.8 | 2.4 | 1.1 | 1.3 | 1.1 | <1 |
| | (mg/kg) | | 1.7 | 1.1 | <1 | <1 | <1 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.13 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 2.9 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 1.3 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 9.9 | 10 | 20 | 15 | 13 | 37 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 73 | 61 | 55 | 51 | 46 | 45 |
| Magnesium (%) | | | 23 | 35 | 41 | 44 | 50 | 52 |
| Potassium (%) | | | 3.0 | 2.7 | 1.0 | 1.1 | 1.7 | 1.8 |
| Sodium - ESP (%) | | | 0.99 | 1.7 | 2.8 | 3.3 | 2.9 | 1.9 |
| Aluminium (%) | | | 0.19 | 0.12 | 0.03 | 0.04 | 0.04 | 0.01 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.64 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.2 | 1.7 | 1.3 | 1.1 | 0.92 | 0.87 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 4/4 | 5YR 4/4 | 10YR 2/2 | 10YR 2/1 | 10YR 4/2 | 10YR 2/1 |
| | | | Reddish brown | Reddish brown | Very dark brown | Black | Dark greyish brown | Black |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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| | | | Sample 43 | Sample 44 | Sample 45 | Sample 46 | Sample 47 | Sample 48 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 13 40-50cm | 13 65-75cm | 18 0-10cm | 18 20-30cm | 18 40-50cm | 18 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | K6461/43 | K6461/44 | K6461/45 | K6461/46 | K6461/47 | K6461/48 |

**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: Collingwo
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,
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Environmental Analysis Laboratory

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| | | | Sample 49 | Sample 50 | Sample 51 | Sample 52 | Sample 53 | Sample 54 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 19 0-10cm | 19 20-30cm | 19 40-50cm | 19 65-75cm | 20 0-10cm | 20 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/49** | **K6461/50** | **K6461/51** | **K6461/52** | **K6461/53** | **K6461/54** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.61 | 8.12 | 8.03 | 8.11 | 7.19 | 8.43 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.143 | 0.108 | 1.271 | 3.544 | 0.145 | 0.103 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 11 | 5.1 | 18 | 66 | 7.3 | 2.6 |
| | (kg/ha) | | 4,728 | 2,294 | 7,892 | 29,780 | 3,287 | 1,170 |
| | (mg/kg) | | 2,111 | 1,024 | 3,523 | 13,295 | 1,467 | 522 |
| Exchangeable Magnesium | (cmol+/kg) | | 6.2 | 5.5 | 25 | 24 | 6.8 | 4.0 |
| | (kg/ha) | | 1,675 | 1,496 | 6,864 | 6,593 | 1,841 | 1,077 |
| | (mg/kg) | | 748 | 668 | 3,064 | 2,943 | 822 | 481 |
| Exchangeable Potassium | (cmol+/kg) | | 0.27 | 0.14 | 0.61 | 0.49 | 0.30 | <0.12 |
| | (kg/ha) | | 233 | 123 | 531 | 429 | 265 | <112 |
| | (mg/kg) | | 104 | 55 | 237 | 192 | 118 | <50 |
| Exchangeable Sodium | (cmol+/kg) | | 0.44 | 0.90 | 4.1 | 4.4 | 0.22 | 0.22 |
| | (kg/ha) | | 226 | 464 | 2,096 | 2,271 | 113 | 115 |
| | (mg/kg) | | 101 | 207 | 936 | 1,014 | 50 | 51 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | 1.0 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 17 | 12 | 47 | 95 | 15 | 6.9 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 61 | 44 | 37 | 69 | 50 | 38 |
| Magnesium (%) | | | 35 | 47 | 53 | 25 | 46 | 57 |
| Potassium (%) | | | 1.5 | 1.2 | 1.3 | 0.51 | 2.1 | 1.6 |
| Sodium - ESP (%) | | | 2.5 | 7.7 | 8.6 | 4.6 | 1.5 | 3.2 |
| Aluminium (%) | | | 0.03 | 0.04 | 0.01 | 0.00 | 0.03 | 0.05 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.7 | 0.93 | 0.70 | 2.7 | 1.1 | 0.66 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/1 | 10YR 4/1 | 10YR 3/1 | 10YR 4/1 | 10YR 2/2 | 10YR 5/2 |
| | | | Very dark grey | Dark grey | Very dark grey | Dark grey | Very dark brown | Greyish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 49 | Sample 50 | Sample 51 | Sample 52 | Sample 53 | Sample 54 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 19 0-10cm | 19 20-30cm | 19 40-50cm | 19 65-75cm | 20 0-10cm | 20 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | K6461/49 | K6461/50 | K6461/51 | K6461/52 | K6461/53 | K6461/54 |

**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: Collingwo
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| Parameter | Unit | Method reference | Sample 55 | Sample 56 | Sample 57 | Sample 58 | Sample 59 | Sample 60 |
|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | 20 40-50cm | 20 65-75cm | 21 0-10cm | 21 15-25cm | 21 40-50cm | 21 65-75cm |
| Crop: | | | Soil | Soil | Soil | Soil | Soil | Soil |
| Client: | | | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/55 | K6461/56 | K6461/57 | K6461/58 | K6461/59 | K6461/60 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 8.51 | 8.48 | 5.09 | 5.83 | 7.35 | 8.20 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.195 | 0.180 | 0.089 | 0.029 | 0.057 | 0.076 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.3 | 5.1 | 3.5 | 3.0 | 11 | 11 |
| | (kg/ha) | | 3,262 | 2,287 | 1,568 | 1,365 | 5,041 | 4,999 |
| | (mg/kg) | | 1,456 | 1,021 | 700 | 609 | 2,251 | 2,232 |
| Exchangeable Magnesium | (cmol+/kg) | | 24 | 18 | 2.3 | 2.8 | 25 | 27 |
| | (kg/ha) | | 6,637 | 4,956 | 616 | 761 | 6,681 | 7,430 |
| | (mg/kg) | | 2,963 | 2,213 | 275 | 340 | 2,983 | 3,317 |
| Exchangeable Potassium | (cmol+/kg) | | 0.58 | 0.39 | 0.45 | 0.24 | 0.54 | 0.44 |
| | (kg/ha) | | 512 | 340 | 397 | 210 | 476 | 389 |
| | (mg/kg) | | 229 | 152 | 177 | 94 | 213 | 174 |
| Exchangeable Sodium | (cmol+/kg) | | 1.3 | 0.72 | 0.18 | 0.15 | 1.0 | 1.6 |
| | (kg/ha) | | 689 | 370 | 93 | 79 | 526 | 825 |
| | (mg/kg) | | 308 | 165 | 42 | 35 | 235 | 368 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | <0.01 | <0.01 | 0.52 | 0.10 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | 1.1 | 104 | 19 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 46 | 8.6 | <1 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.74 | 0.30 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 17 | 6.7 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 7.4 | 3.0 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 34 | 24 | 7.6 | 6.6 | 37 | 40 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 22 | 21 | 46 | 46 | 30 | 28 |
| Magnesium (%) | | | 73 | 75 | 30 | 42 | 66 | 67 |
| Potassium (%) | | | 1.7 | 1.6 | 5.9 | 3.6 | 1.5 | 1.1 |
| Sodium - ESP (%) | | | 4.0 | 2.9 | 2.4 | 2.3 | 2.7 | 4.0 |
| Aluminium (%) | | | 0.01 | 0.02 | 6.8 | 1.4 | 0.01 | 0.00 |
| Hydrogen (%) | | | 0.00 | 0.00 | 9.6 | 4.5 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 0.30 | 0.28 | 1.5 | 1.1 | 0.46 | 0.41 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 4/3 | 10YR 5/2 | 7.5YR 3/4 | 7.5YR 3/3 | 10YR 4/4 | 10YR 5/4 |
| | | | Brown | Greyish brown | Dark brown | Dark brown | Dark yellowish brown | Yellowish brown |
| Mottles Munsell Colour | | | 7.5YR 4/6 | 10YR 5/6 | .. | .. | .. | .. |
| | | | Strong brown | Yellowish brown | .. | .. | .. | .. |
| Degree of Mottling (%) | | | 40 | 30 | .. | .. | .. | .. |

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| | | Sample 55 | Sample 56 | Sample 57 | Sample 58 | Sample 59 | Sample 60 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 20 40-50cm | 20 65-75cm | 21 0-10cm | 21 15-25cm | 21 40-50cm | 21 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/55 | K6461/56 | K6461/57 | K6461/58 | K6461/59 | K6461/60 |

**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: Collingwo
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
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| Parameter | | Method reference | Sample 61 | Sample 62 | Sample 63 | Sample 64 | Sample 65 | Sample 66 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 22 0-10cm | 22 20-30cm | 22 40-50cm | 22 65-75cm | 24 0-10cm | 24 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/61 | K6461/62 | K6461/63 | K6461/64 | K6461/65 | K6461/66 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 4.85 | 6.91 | 7.21 | 7.63 | 7.70 | 6.49 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.373 | 0.032 | 0.025 | 0.037 | 0.262 | 0.292 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 6.3 | 8.0 | 6.7 | 7.7 | 26 | 7.9 |
| | (kg/ha) | | 2,833 | 3,595 | 3,006 | 3,449 | 11,610 | 3,528 |
| | (mg/kg) | | 1,265 | 1,605 | 1,342 | 1,540 | 5,183 | 1,575 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.4 | 14 | 14 | 16 | 0.83 | 3.2 |
| | (kg/ha) | | 655 | 3,761 | 3,764 | 4,343 | 226 | 874 |
| | (mg/kg) | | 293 | 1,679 | 1,680 | 1,939 | 101 | 390 |
| Exchangeable Potassium | (cmol+/kg) | | 0.84 | 0.39 | 0.36 | 0.39 | 1.3 | 0.88 |
| | (kg/ha) | | 732 | 342 | 312 | 340 | 1,150 | 773 |
| | (mg/kg) | | 327 | 153 | 139 | 152 | 513 | 345 |
| Exchangeable Sodium | (cmol+/kg) | | 0.20 | 0.38 | 0.65 | 1.2 | <0.065 | 0.10 |
| | (kg/ha) | | 104 | 197 | 334 | 620 | <33 | 52 |
| | (mg/kg) | | 46 | 88 | 149 | 277 | <15 | 23 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.11 | 0.01 | 0.01 | <0.01 | 0.02 | <0.01 |
| | (kg/ha) | | 23 | 2.7 | 2.6 | 1.7 | 3.7 | <1 |
| | (mg/kg) | | 10 | 1.2 | 1.2 | <1 | 1.7 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.49 | <0.01 | <0.01 | <0.01 | <0.01 | 0.04 |
| | (kg/ha) | | 11 | <1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | 4.9 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 10 | 23 | 22 | 25 | 28 | 12 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 61 | 35 | 31 | 30 | 92 | 65 |
| Magnesium (%) | | | 23 | 61 | 64 | 63 | 3.0 | 27 |
| Potassium (%) | | | 8.1 | 1.7 | 1.7 | 1.5 | 4.7 | 7.3 |
| Sodium - ESP (%) | | | 1.9 | 1.7 | 3.0 | 4.8 | 0.23 | 0.83 |
| Aluminium (%) | | | 1.1 | 0.06 | 0.06 | 0.03 | 0.07 | 0.04 |
| Hydrogen (%) | | | 4.7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 2.6 | 0.58 | 0.48 | 0.48 | 31 | 2.4 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/4 | 7.5YR 4/6 | 10YR 5/8 | 7.5YR 6/8 | 10YR 2/2 | 5YR 5/8 |
| | | | Dark brown | Strong brown | Yellowish brown | Reddish yellow | Very dark brown | Yellowish red |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 61 | Sample 62 | Sample 63 | Sample 64 | Sample 65 | Sample 66 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 22 0-10cm | 22 20-30cm | 22 40-50cm | 22 65-75cm | 24 0-10cm | 24 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/61 | K6461/62 | K6461/63 | K6461/64 | K6461/65 | K6461/66 |

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: Collingwo
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 res
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.
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 sc
17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
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| Parameter | Unit | Method reference | Sample 67 | Sample 68 | Sample 69 | Sample 70 | Sample 71 | Sample 72 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 24 40-50cm | 24 65-75cm | 25 0-10cm | 25 20-30cm | 25 40-50cm | 25 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/67 | K6461/68 | K6461/69 | K6461/70 | K6461/71 | K6461/72 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.87 | 7.14 | 5.06 | 6.69 | 6.91 | 7.20 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.348 | 0.188 | 0.232 | 0.022 | 0.034 | 0.038 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.7 | 6.9 | 4.0 | 3.7 | 7.4 | 5.8 |
| | (kg/ha) | | 3,467 | 3,090 | 1,815 | 1,671 | 3,344 | 2,612 |
| | (mg/kg) | | 1,548 | 1,379 | 810 | 746 | 1,493 | 1,166 |
| Exchangeable Magnesium | (cmol+/kg) | | 6.1 | 8.1 | 0.90 | 0.88 | 5.1 | 5.8 |
| | (kg/ha) | | 1,670 | 2,209 | 245 | 241 | 1,379 | 1,586 |
| | (mg/kg) | | 746 | 986 | 110 | 107 | 616 | 708 |
| Exchangeable Potassium | (cmol+/kg) | | 0.87 | 0.72 | 1.1 | 0.28 | 0.32 | 0.29 |
| | (kg/ha) | | 760 | 633 | 980 | 241 | 284 | 254 |
| | (mg/kg) | | 339 | 283 | 438 | 108 | 127 | 114 |
| Exchangeable Sodium | (cmol+/kg) | | 0.17 | 0.32 | <0.065 | 0.11 | 0.20 | 0.53 |
| | (kg/ha) | | 85 | 166 | <33 | 59 | 103 | 271 |
| | (mg/kg) | | 38 | 74 | <15 | 26 | 46 | 121 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | <0.01 | <0.01 | 0.14 | 0.01 | <0.01 | 0.02 |
| | (kg/ha) | | 1.3 | 1.0 | 29 | 2.1 | <1 | 3.1 |
| | (mg/kg) | | <1 | <1 | 13 | <1 | <1 | 1.4 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.33 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 7.4 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 3.3 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 15 | 16 | 6.6 | 5.0 | 13 | 12 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 52 | 43 | 61 | 74 | 57 | 47 |
| Magnesium (%) | | | 41 | 51 | 14 | 18 | 39 | 47 |
| Potassium (%) | | | 5.8 | 4.5 | 17 | 5.5 | 2.5 | 2.3 |
| Sodium - ESP (%) | | | 1.1 | 2.0 | 0.78 | 2.3 | 1.5 | 4.2 |
| Aluminium (%) | | | 0.04 | 0.03 | 2.2 | 0.21 | 0.04 | 0.12 |
| Hydrogen (%) | | | 0.00 | 0.00 | 5.0 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.3 | 0.85 | 4.5 | 4.2 | 1.5 | 1.00 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5YR 2.5/4 | 5YR 4/6 | 5Y 4/1 | 2.5Y 4/2 | 10YR 5/4 | 2.5Y 5/3 |
| | | | Dark reddish brown | Yellowish red | Dark grey | Dark greyish brown | Yellowish brown | Light olive brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | 2.5Y 2.5/1 | 2.5YR 2.5/3 |
| | | | .. | .. | .. | .. | Black | Dark reddish brown |
| Degree of Mottling (%) | | | .. | .. | .. | .. | 5 | 5 |

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# AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 67 | Sample 68 | Sample 69 | Sample 70 | Sample 71 | Sample 72 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 24 40-50cm | 24 65-75cm | 25 0-10cm | 25 20-30cm | 25 40-50cm | 25 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/67 | K6461/68 | K6461/69 | K6461/70 | K6461/71 | K6461/72 |

**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: Collingwo
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 res
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
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17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
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Environmental Analysis Laboratory

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| Parameter | | Method reference | Sample 73 | Sample 74 | Sample 75 | Sample 76 | Sample 77 | Sample 78 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 26 0-10cm | 26 20-30cm | 26 40-50cm | 26 65-75cm | 28 0-10cm | 28 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/73 | K6461/74 | K6461/75 | K6461/76 | K6461/77 | K6461/78 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 4.85 | 5.82 | 6.37 | 7.13 | 5.29 | 5.70 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.108 | 0.036 | 0.047 | 0.040 | 0.101 | 0.027 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 4.4 | 8.0 | 11 | 18 | 3.9 | 1.6 |
| | (kg/ha) | | 1,968 | 3,583 | 5,132 | 8,040 | 1,772 | 714 |
| | (mg/kg) | | 879 | 1,599 | 2,291 | 3,589 | 791 | 319 |
| Exchangeable Magnesium | (cmol+/kg) | | 1.00 | 5.9 | 13 | 23 | 0.84 | 0.31 |
| | (kg/ha) | | 272 | 1,606 | 3,498 | 6,179 | 228 | 83 |
| | (mg/kg) | | 122 | 717 | 1,562 | 2,758 | 102 | 37 |
| Exchangeable Potassium | (cmol+/kg) | | 0.47 | 0.44 | 0.48 | 0.41 | 0.29 | <0.12 |
| | (kg/ha) | | 413 | 385 | 417 | 356 | 257 | <112 |
| | (mg/kg) | | 185 | 172 | 186 | 159 | 115 | <50 |
| Exchangeable Sodium | (cmol+/kg) | | <0.065 | 0.11 | 0.72 | 1.3 | 0.21 | 0.14 |
| | (kg/ha) | | <33 | 58 | 371 | 676 | 107 | 70 |
| | (mg/kg) | | <15 | 26 | 166 | 302 | 48 | 31 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.30 | 0.15 | 0.06 | 0.01 | 0.08 | 0.07 |
| | (kg/ha) | | 60 | 30 | 12 | 2.3 | 16 | 15 |
| | (mg/kg) | | 27 | 13 | 5.3 | 1.0 | 7.2 | 6.6 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.55 | 0.26 | 0.16 | <0.01 | 0.25 | 0.13 |
| | (kg/ha) | | 12 | 5.9 | 3.6 | <1 | 5.6 | 2.9 |
| | (mg/kg) | | 5.5 | 2.6 | 1.6 | <1 | 2.5 | 1.3 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 6.7 | 15 | 26 | 42 | 5.6 | 2.3 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 65 | 54 | 44 | 42 | 70 | 69 |
| Magnesium (%) | | | 15 | 40 | 50 | 54 | 15 | 13 |
| Potassium (%) | | | 7.0 | 3.0 | 1.9 | 0.96 | 5.2 | 3.6 |
| Sodium - ESP (%) | | | 0.66 | 0.76 | 2.8 | 3.1 | 3.7 | 5.9 |
| Aluminium (%) | | | 4.4 | 1.0 | 0.23 | 0.03 | 1.4 | 3.2 |
| Hydrogen (%) | | | 8.2 | 1.8 | 0.62 | 0.00 | 4.4 | 5.6 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 4.4 | 1.4 | 0.89 | 0.79 | 4.7 | 5.2 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 3/2 | 2.5YR 3/2 | 10R 4/8 | 2.5Y 4/2 | 2.5Y 4/2 | 5Y 7/1 |
| | | | Very dark greyish brown | Dusky red | Red | Dark greyish brown | Dark greyish brown | Light grey |
| Mottles Munsell Colour | | | .. | .. | .. | 10R 4/6 | .. | .. |
| | | | .. | .. | .. | Red | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | 25 | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 73 | Sample 74 | Sample 75 | Sample 76 | Sample 77 | Sample 78 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 26 0-10cm | 26 20-30cm | 26 40-50cm | 26 65-75cm | 28 0-10cm | 28 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/73 | K6461/74 | K6461/75 | K6461/76 | K6461/77 | K6461/78 |

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: Collingwo
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,
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

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| | | | Sample 79 | Sample 80 | Sample 81 | Sample 82 | Sample 83 | Sample 84 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 28 40-50cm | 28 65-75cm | 29 0-10cm | 29 20-30cm | 29 40-50cm | 29 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/79** | **K6461/80** | **K6461/81** | **K6461/82** | **K6461/83** | **K6461/84** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.73 | 7.00 | 4.63 | 5.26 | 6.71 | 7.06 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.037 | 0.067 | 0.168 | 0.134 | 0.023 | 0.032 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 3.9 | 6.4 | 3.7 | 5.0 | 6.0 | 8.5 |
| | (kg/ha) | | 1,769 | 2,851 | 1,647 | 2,252 | 2,708 | 3,834 |
| | (mg/kg) | | 790 | 1,273 | 735 | 1,005 | 1,209 | 1,712 |
| Exchangeable Magnesium | (cmol+/kg) | | 7.7 | 14 | 1.1 | 2.5 | 5.5 | 11 |
| | (kg/ha) | | 2,093 | 3,855 | 296 | 671 | 1,491 | 2,877 |
| | (mg/kg) | | 934 | 1,721 | 132 | 300 | 666 | 1,284 |
| Exchangeable Potassium | (cmol+/kg) | | 0.25 | 0.35 | 0.19 | 0.35 | 0.24 | 0.39 |
| | (kg/ha) | | 221 | 309 | 162 | 305 | 207 | 342 |
| | (mg/kg) | | 99 | 138 | 72 | 136 | 92 | 153 |
| Exchangeable Sodium | (cmol+/kg) | | 0.94 | 2.2 | 0.15 | 0.16 | 0.17 | 0.45 |
| | (kg/ha) | | 483 | 1,117 | 75 | 83 | 89 | 232 |
| | (mg/kg) | | 216 | 499 | 34 | 37 | 40 | 104 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.02 | <0.01 | 0.86 | 0.13 | 0.01 | <0.01 |
| | (kg/ha) | | 4.0 | 1.4 | 173 | 25 | 2.1 | 1.1 |
| | (mg/kg) | | 1.8 | <1 | 77 | 11 | <1 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 1.1 | 0.17 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 24 | 3.8 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 11 | 1.7 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 13 | 23 | 7.0 | 8.3 | 12 | 20 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 31 | 28 | 52 | 61 | 51 | 43 |
| Magnesium (%) | | | 60 | 61 | 16 | 30 | 46 | 53 |
| Potassium (%) | | | 2.0 | 1.5 | 2.6 | 4.2 | 2.0 | 2.0 |
| Sodium - ESP (%) | | | 7.3 | 9.4 | 2.1 | 1.9 | 1.5 | 2.3 |
| Aluminium (%) | | | 0.15 | 0.03 | 12 | 1.5 | 0.09 | 0.03 |
| Hydrogen (%) | | | 0.00 | 0.00 | 15 | 2.0 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 0.51 | 0.45 | 3.4 | 2.0 | 1.1 | 0.81 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5Y 4/2 | 10YR 4/2 | 10YR 3/4 | 10YR 4/3 | 10YR 3/4 | 2.5Y 6/6 |
| | | | Dark greyish brown | Dark greyish brown | Dark yellowish brown | Brown | Dark yellowish brown | Olive yellow |
| Mottles Munsell Colour | | | 10R 4/6 | 10R 4/6 | .. | .. | .. | 2.5 YR 3/6 |
| | | | Red | Red | .. | .. | .. | Dark red |
| Degree of Mottling (%) | | | 10 | 25 | .. | .. | .. | 10 |

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| | | Sample 79 | Sample 80 | Sample 81 | Sample 82 | Sample 83 | Sample 84 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 28 40-50cm | 28 65-75cm | 29 0-10cm | 29 20-30cm | 29 40-50cm | 29 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/79 | K6461/80 | K6461/81 | K6461/82 | K6461/83 | K6461/84 |

**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).
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.
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12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimat
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17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

CRICOS Provider: 01241G

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Environmental Analysis Laboratory

## AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 85 | Sample 86 | Sample 87 | Sample 88 | Sample 89 | Sample 90 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 30 0-10cm | 30 20-30cm | 30 40-50cm | 30 65-75cm | 31 0-10cm | 31 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/85** | **K6461/86** | **K6461/87** | **K6461/88** | **K6461/89** | **K6461/90** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.80 | 7.33 | 8.49 | 8.59 | 5.38 | 6.65 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.098 | 0.081 | 0.183 | 0.288 | 0.172 | 0.033 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 21 | 28 | 36 | 31 | 9.6 | 9.1 |
| | (kg/ha) | | 9,237 | 12,549 | 15,967 | 13,823 | 4,290 | 4,095 |
| | (mg/kg) | | 4,124 | 5,602 | 7,128 | 6,171 | 1,915 | 1,828 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 9.5 | 15 | 16 | 18 | 1.6 | 1.6 |
| | (kg/ha) | | 2,581 | 4,037 | 4,402 | 4,838 | 439 | 435 |
| | (mg/kg) | | 1,152 | 1,802 | 1,965 | 2,160 | 196 | 194 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 2.9 | 1.3 | 0.64 | 0.50 | 1.00 | 0.28 |
| | (kg/ha) | | 2,558 | 1,109 | 560 | 441 | 874 | 247 |
| | (mg/kg) | | 1,142 | 495 | 250 | 197 | 390 | 110 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.28 | 0.63 | 1.1 | 2.2 | 0.09 | 0.08 |
| | (kg/ha) | | 146 | 324 | 565 | 1,145 | 49 | 43 |
| | (mg/kg) | | 65 | 145 | 252 | 511 | 22 | 19 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | 0.02 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 |
| | (kg/ha) | | 3.4 | <1 | <1 | <1 | 4.1 | <1 |
| | (mg/kg) | | 1.5 | <1 | <1 | <1 | 1.8 | <1 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.19 | <0.01 | <0.01 | <0.01 | 0.17 | <0.01 |
| | (kg/ha) | | 4.3 | <1 | <1 | <1 | 3.9 | <1 |
| | (mg/kg) | | 1.9 | <1 | <1 | <1 | 1.7 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 33 | 45 | 53 | 51 | 12 | 11 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 61 | 63 | 67 | 60 | 77 | 82 |
| Magnesium (%) | | | 28 | 33 | 30 | 35 | 13 | 14 |
| Potassium (%) | | | 8.7 | 2.8 | 1.2 | 0.98 | 8.0 | 2.5 |
| Sodium - ESP (%) | | | 0.85 | 1.4 | 2.1 | 4.3 | 0.76 | 0.75 |
| Aluminium (%) | | | 0.05 | 0.01 | 0.01 | 0.01 | 0.16 | 0.04 |
| Hydrogen (%) | | | 0.58 | 0.00 | 0.00 | 0.00 | 1.4 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 2.2 | 1.9 | 2.2 | 1.7 | 5.9 | 5.7 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 2/2 | 10YR 3/2 | 2.5Y 3/3 | 5Y 3/1 | 10R 3/4 | 10R 3/6 |
| | | | Very dark brown | Very dark greyish brown | Dark olive brown | Very dark grey | Dusky red | Dark red |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 85 | Sample 86 | Sample 87 | Sample 88 | Sample 89 | Sample 90 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 30 0-10cm | 30 20-30cm | 30 40-50cm | 30 65-75cm | 31 0-10cm | 31 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/85 | K6461/86 | K6461/87 | K6461/88 | K6461/89 | K6461/90 |

**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: Collingwo
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.
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*Agricultural Co-Ordinator*

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| Parameter | | Method reference | Sample 91 | Sample 92 | Sample 93 | Sample 94 | Sample 95 | Sample 96 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 31 40-50cm | 31 65-75cm | 32 0-10cm | 32 20-30cm | 32 40-50cm | 32 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/91 | K6461/92 | K6461/93 | K6461/94 | K6461/95 | K6461/96 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.83 | 7.32 | 5.62 | 6.37 | 6.65 | 7.22 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.040 | 0.033 | 0.085 | 0.066 | 0.095 | 0.043 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 11 | 9.4 | 6.6 | 6.7 | 7.1 | 7.4 |
| | (kg/ha) | | 4,746 | 4,240 | 2,949 | 3,013 | 3,196 | 3,336 |
| | (mg/kg) | | 2,119 | 1,893 | 1,317 | 1,345 | 1,427 | 1,489 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.1 | 3.2 | 1.1 | 1.5 | 2.0 | 4.7 |
| | (kg/ha) | | 577 | 864 | 300 | 410 | 558 | 1,291 |
| | (mg/kg) | | 257 | 386 | 134 | 183 | 249 | 576 |
| Exchangeable Potassium | (cmol+/kg) | | 0.31 | 0.31 | 1.7 | 1.8 | 1.4 | 0.50 |
| | (kg/ha) | | 273 | 273 | 1,480 | 1,564 | 1,218 | 438 |
| | (mg/kg) | | 122 | 122 | 661 | 698 | 544 | 195 |
| Exchangeable Sodium | (cmol+/kg) | | 0.10 | 0.09 | <0.065 | <0.065 | 0.16 | 0.13 |
| | (kg/ha) | | 54 | 45 | <33 | <33 | 83 | 69 |
| | (mg/kg) | | 24 | 20 | <15 | <15 | 37 | 31 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | <0.01 | <0.01 | 0.06 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | 1.2 | 1.3 | 12 | 1.5 | 1.1 | 1.5 |
| | (mg/kg) | | <1 | <1 | 5.5 | <1 | <1 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.16 | 0.04 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 3.5 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 1.6 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 13 | 13 | 9.6 | 10 | 11 | 13 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 81 | 73 | 68 | 66 | 66 | 58 |
| Magnesium (%) | | | 16 | 24 | 11 | 15 | 19 | 37 |
| Potassium (%) | | | 2.4 | 2.4 | 18 | 18 | 13 | 3.9 |
| Sodium - ESP (%) | | | 0.80 | 0.67 | 0.54 | 0.51 | 1.5 | 1.0 |
| Aluminium (%) | | | 0.04 | 0.05 | 0.63 | 0.07 | 0.05 | 0.06 |
| Hydrogen (%) | | | 0.00 | 0.00 | 1.6 | 0.43 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 5.0 | 3.0 | 6.0 | 4.5 | 3.5 | 1.6 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10R 3/6 | 10R 3/6 | 5YR 3/3 | 10R 3/6 | 10R 3/6 | 10R 4/6 |
| | | | Dark red | Dark red | Dark reddish brown | Dark red | Dark red | Red |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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PO BOX 11034 TAMWORTH NSW 2340

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|---|---|---|---|---|---|---|---|
| | Sample ID: | 31 40-50cm | 31 65-75cm | 32 0-10cm | 32 20-30cm | 32 40-50cm | 32 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/91 | K6461/92 | K6461/93 | K6461/94 | K6461/95 | K6461/96 |

**Notes:**

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| | | | Sample 97 | Sample 98 | Sample 99 | Sample 100 | Sample 101 | Sample 102 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 33 0-10cm | 33 20-30cm | 33 40-50cm | 33 65-75cm | 34 0-10cm | 34 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/97** | **K6461/98** | **K6461/99** | **K6461/100** | **K6461/101** | **K6461/102** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.28 | 6.45 | 6.68 | 6.99 | 5.97 | 6.79 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.075 | 0.047 | 0.061 | 0.027 | 0.068 | 0.043 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.2 | 8.1 | 8.1 | 5.6 | 7.0 | 7.1 |
| | (kg/ha) | | 3,218 | 3,619 | 3,622 | 2,516 | 3,141 | 3,181 |
| | (mg/kg) | | 1,437 | 1,616 | 1,617 | 1,123 | 1,402 | 1,420 |
| Exchangeable Magnesium | (cmol+/kg) | | 1.3 | 3.5 | 4.9 | 7.3 | 2.0 | 1.9 |
| | (kg/ha) | | 367 | 959 | 1,325 | 1,977 | 545 | 525 |
| | (mg/kg) | | 164 | 428 | 592 | 883 | 243 | 234 |
| Exchangeable Potassium | (cmol+/kg) | | 0.78 | 0.53 | 0.31 | 0.26 | 1.7 | 1.3 |
| | (kg/ha) | | 683 | 467 | 273 | 228 | 1,497 | 1,171 |
| | (mg/kg) | | 305 | 208 | 122 | 102 | 668 | 523 |
| Exchangeable Sodium | (cmol+/kg) | | <0.065 | <0.065 | 0.10 | 0.15 | 0.08 | 0.09 |
| | (kg/ha) | | <33 | <33 | 50 | 76 | 43 | 46 |
| | (mg/kg) | | <15 | <15 | 22 | 34 | 19 | 20 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.19 | 0.01 | 0.02 | <0.01 | 0.01 | <0.01 |
| | (kg/ha) | | 37 | 2.5 | 3.0 | 1.1 | 2.8 | <1 |
| | (mg/kg) | | 17 | 1.1 | 1.4 | <1 | 1.2 | <1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.32 | 0.05 | <0.01 | <0.01 | 0.06 | <0.01 |
| | (kg/ha) | | 7.1 | 1.0 | <1 | <1 | 1.4 | <1 |
| | (mg/kg) | | 3.2 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 9.8 | 12 | 13 | 13 | 11 | 10 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 73 | 66 | 60 | 42 | 64 | 68 |
| Magnesium (%) | | | 14 | 29 | 36 | 55 | 18 | 18 |
| Potassium (%) | | | 7.9 | 4.4 | 2.3 | 2.0 | 16 | 13 |
| Sodium - ESP (%) | | | 0.38 | 0.51 | 0.73 | 1.1 | 0.76 | 0.85 |
| Aluminium (%) | | | 1.9 | 0.10 | 0.11 | 0.04 | 0.13 | 0.05 |
| Hydrogen (%) | | | 3.2 | 0.38 | 0.00 | 0.00 | 0.57 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 5.3 | 2.3 | 1.7 | 0.77 | 3.5 | 3.7 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/3 | 10R 4/8 | 2.5YR 4/8 | 2.5YR 6/8 | 7.5YR 3/4 | 7.5YR 3/4 |
| | | | Dark brown | Red | Red | Light red | Dark brown | Dark brown |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 97 | Sample 98 | Sample 99 | Sample 100 | Sample 101 | Sample 102 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 33 0-10cm | 33 20-30cm | 33 40-50cm | 33 65-75cm | 34 0-10cm | 34 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/97 | K6461/98 | K6461/99 | K6461/100 | K6461/101 | K6461/102 |

**Notes:**

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
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*Agricultural Co-Ordinator* KS

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| Parameter | Unit | Method reference | Sample 103 | Sample 104 | Sample 105 | Sample 106 | Sample 107 | Sample 108 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 34 40-50cm | 34 65-75cm | 36 0-10cm | 36 20-30cm | 36 40-50cm | 36 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/103** | **K6461/104** | **K6461/105** | **K6461/106** | **K6461/107** | **K6461/108** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.34 | 7.82 | 7.09 | 6.45 | 7.18 | 8.17 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.054 | 0.049 | 0.084 | 0.054 | 0.048 | 0.050 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 9.8 | 8.1 | 10 | 4.9 | 14 | 15 |
| | (kg/ha) | | 4,378 | 3,622 | 4,492 | 2,217 | 6,236 | 6,692 |
| | (mg/kg) | | 1,955 | 1,617 | 2,005 | 990 | 2,784 | 2,988 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 3.2 | 6.0 | 0.85 | 1.7 | 11 | 15 |
| | (kg/ha) | | 864 | 1,636 | 232 | 470 | 2,980 | 4,193 |
| | (mg/kg) | | 386 | 730 | 103 | 210 | 1,331 | 1,872 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 0.56 | 0.55 | 0.27 | 0.19 | 0.54 | 0.61 |
| | (kg/ha) | | 494 | 481 | 239 | 167 | 476 | 533 |
| | (mg/kg) | | 221 | 215 | 107 | 74 | 212 | 238 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.18 | 0.60 | 0.22 | 0.08 | 0.44 | 1.0 |
| | (kg/ha) | | 92 | 311 | 112 | 41 | 225 | 521 |
| | (mg/kg) | | 41 | 139 | 50 | 18 | 100 | 233 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | 1.1 | 1.1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | <0.01 | 0.04 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 14 | 15 | 11 | 7.0 | 26 | 32 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 71 | 53 | 88 | 71 | 54 | 47 |
| Magnesium (%) | | | 23 | 39 | 7.5 | 25 | 42 | 48 |
| Potassium (%) | | | 4.1 | 3.6 | 2.4 | 2.7 | 2.1 | 1.9 |
| Sodium - ESP (%) | | | 1.3 | 4.0 | 1.9 | 1.1 | 1.7 | 3.2 |
| Aluminium (%) | | | 0.04 | 0.04 | 0.02 | 0.05 | 0.01 | 0.01 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.00 | 0.55 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 3.1 | 1.3 | 12 | 2.9 | 1.3 | 0.97 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 3/3 | 10YR 4/3 | 2.5Y 3/2 | 2.5Y 4/3 | 10YR 4/1 | 5Y 4/3 |
| | | | Dark brown | Brown | Very dark greyish brown | Olive brown | Dark grey | Olive |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

CRICOS Provider: 01241G

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 103 | Sample 104 | Sample 105 | Sample 106 | Sample 107 | Sample 108 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 34 40-50cm | 34 65-75cm | 36 0-10cm | 36 20-30cm | 36 40-50cm | 36 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/103 | K6461/104 | K6461/105 | K6461/106 | K6461/107 | K6461/108 |

**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: Collingwo
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 res
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.
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 sc
17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

KS

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# AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 109 | Sample 110 | Sample 111 | Sample 112 | Sample 113 | Sample 114 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 37 0-10cm | 37 20-30cm | 37 40-50cm | 37 65-75cm | 39 0-10cm | 39 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/109 | K6461/110 | K6461/111 | K6461/112 | K6461/113 | K6461/114 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 4.94 | 6.67 | 7.32 | 7.54 | 8.02 | 6.87 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.094 | 0.015 | 0.079 | 0.045 | 0.078 | 0.031 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 3.9 | 3.75 | 9.5 | 9.70 | 12.51 | 9.13 |
| | (kg/ha) | | 1,759 | 1684 | 4,268 | 4354 | 5615 | 4100 |
| | (mg/kg) | | 785 | 752 | 1,905 | 1944 | 2507 | 1830 |
| Exchangeable Magnesium | (cmol+/kg) | | 0.87 | 0.50 | 10 | 10.69 | 15.68 | 3.71 |
| | (kg/ha) | | 238 | 135 | 2,845 | 2911 | 4269 | 1011 |
| | (mg/kg) | | 106 | 60 | 1,270 | 1300 | 1906 | 451 |
| Exchangeable Potassium | (cmol+/kg) | | 0.45 | 0.14 | 0.39 | 0.40 | 0.46 | 0.64 |
| | (kg/ha) | | 394 | 127 | 345 | 349 | 399 | 563 |
| | (mg/kg) | | 176 | 57 | 154 | 156 | 178 | 251 |
| Exchangeable Sodium | (cmol+/kg) | | 0.16 | 0.08 | 0.69 | 0.69 | 1.35 | 0.10 |
| | (kg/ha) | | 83 | 43 | 353 | 356 | 693 | 54 |
| | (mg/kg) | | 37 | 19 | 158 | 159 | 310 | 24 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.48 | 0.04 | 0.07 | 0.07 | 0.06 | 0.04 |
| | (kg/ha) | | 97 | 9 | 15 | 13 | 13 | 8 |
| | (mg/kg) | | 43 | 4 | 6.7 | 6 | 6 | 4 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.64 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | 14 | <1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | 6.4 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 6.5 | 4.52 | 21 | 21.55 | 30.06 | 13.63 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 60 | 83.0 | 45 | 45.0 | 41.6 | 67.0 |
| Magnesium (%) | | | 13 | 11.0 | 50 | 49.6 | 52.2 | 27.2 |
| Potassium (%) | | | 6.9 | 3.2 | 1.9 | 1.9 | 1.5 | 4.7 |
| Sodium - ESP (%) | | | 2.5 | 1.8 | 3.2 | 3.2 | 4.5 | 0.8 |
| Aluminium (%) | | | 7.4 | 0.9 | 0.35 | 0.3 | 0.2 | 0.3 |
| Hydrogen (%) | | | 9.7 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 4.5 | 7.5 | 0.91 | 0.9 | 0.8 | 2.5 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 3/2 | 5Y 6/1 | 2.5Y 5/3 | 2.5Y 3/2 | 5YR 3/3 | 7.5YR 3/4 |
| | | | Vey dark greyish brown | Grey | Light olive brown | Very dark greyish brown | Dark reddish brown | Dark brown |
| Mottles Munsell Colour | | | .. | .. | 2.5YR 2.5/2 | .. | .. | .. |
| | | | .. | .. | Very dusky red | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | 5 | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 109 | Sample 110 | Sample 111 | Sample 112 | Sample 113 | Sample 114 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 37 0-10cm | 37 20-30cm | 37 40-50cm | 37 65-75cm | 39 0-10cm | 39 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/109 | K6461/110 | K6461/111 | K6461/112 | K6461/113 | K6461/114 |

**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: Collingwo
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 res
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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 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 115 | Sample 116 | Sample 117 | Sample 118 | Sample 119 | Sample 120 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 39 40-50cm | 39 65-75cm | 40 0-10cm | 40 20-30cm | 40 40-50cm | 40 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/115** | **K6461/116** | **K6461/117** | **K6461/118** | **K6461/119** | **K6461/120** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.72 | 8.23 | 5.87 | 7.09 | 7.89 | 8.33 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.045 | 0.056 | 0.080 | 0.046 | 0.060 | 0.112 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 15.77 | 17.24 | 15.76 | 20.41 | 20.52 | 22.76 |
| | (kg/ha) | | 7079 | 7739 | 7074 | 9163 | 9210 | 10218 |
| | (mg/kg) | | 3160 | 3455 | 3158 | 4091 | 4112 | 4562 |
| Exchangeable Magnesium | (cmol+/kg) | | 8.66 | 11.19 | 7.41 | 11.62 | 13.36 | 15.67 |
| | (kg/ha) | | 2358 | 3047 | 2016 | 3163 | 3638 | 4267 |
| | (mg/kg) | | 1053 | 1360 | 900 | 1412 | 1624 | 1905 |
| Exchangeable Potassium | (cmol+/kg) | | 0.67 | 0.72 | 1.16 | 0.55 | 0.50 | 0.53 |
| | (kg/ha) | | 586 | 627 | 1017 | 486 | 436 | 462 |
| | (mg/kg) | | 262 | 280 | 454 | 217 | 195 | 206 |
| Exchangeable Sodium | (cmol+/kg) | | 0.36 | 0.63 | 0.21 | 0.46 | 0.83 | 1.37 |
| | (kg/ha) | | 184 | 325 | 110 | 235 | 427 | 704 |
| | (mg/kg) | | 82 | 145 | 49 | 105 | 190 | 314 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.09 | 0.10 | 0.08 | 0.11 | 0.09 | 0.09 |
| | (kg/ha) | | 17 | 21 | 17 | 22 | 19 | 17 |
| | (mg/kg) | | 8 | 9 | 8 | 10 | 8 | 8 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.49 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 11 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 5 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 25.54 | 29.88 | 25.11 | 33.15 | 35.30 | 40.42 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 61.7 | 57.7 | 62.8 | 61.6 | 58.1 | 56.3 |
| Magnesium (%) | | | 33.9 | 37.5 | 29.5 | 35.0 | 37.9 | 38.8 |
| Potassium (%) | | | 2.6 | 2.4 | 4.6 | 1.7 | 1.4 | 1.3 |
| Sodium - ESP (%) | | | 1.4 | 2.1 | 0.8 | 1.4 | 2.3 | 3.4 |
| Aluminium (%) | | | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 |
| Hydrogen (%) | | | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.8 | 1.5 | 2.1 | 1.8 | 1.5 | 1.5 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5YR 3/4 | 10YR 3/6 | 7.5YR 2.5/3 | 7.5YR 2.5/1 | 10YR 2/2 | 5Y 2.5/2 |
| | | | Dark reddish brown | Dark yellowish brown | Very dark brown | Black | Very dark brown | Black |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 115 | Sample 116 | Sample 117 | Sample 118 | Sample 119 | Sample 120 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 39 40-50cm | 39 65-75cm | 40 0-10cm | 40 20-30cm | 40 40-50cm | 40 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/115 | K6461/116 | K6461/117 | K6461/118 | K6461/119 | K6461/120 |

**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: Collingwo
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.
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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.
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12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimat
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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| | | | Sample 121 | Sample 122 | Sample 123 | Sample 124 | Sample 125 | Sample 126 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 41 0-10cm | 41 10-20cm | 41 30-40cm | 41 65-75cm | 42 0-10cm | 42 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | K6461/121 | K6461/122 | K6461/123 | K6461/124 | K6461/125 | K6461/126 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.00 | 5.60 | 7.28 | 8.78 | 5.97 | 6.58 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.075 | 0.023 | 0.049 | 0.088 | 0.091 | 0.070 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 3.62 | 2.44 | 10.65 | 10.06 | 13.03 | 14.62 |
| | (kg/ha) | | 1626 | 1093 | 4782 | 4514 | 5849 | 6564 |
| | (mg/kg) | | 726 | 488 | 2135 | 2015 | 2611 | 2930 |
| Exchangeable Magnesium | (cmol+/kg) | | 0.83 | 0.76 | 16.32 | 19.71 | 3.21 | 11.17 |
| | (kg/ha) | | 226 | 207 | 4441 | 5365 | 875 | 3042 |
| | (mg/kg) | | 101 | 92 | 1983 | 2395 | 391 | 1358 |
| Exchangeable Potassium | (cmol+/kg) | | 0.17 | <0.12 | 0.42 | 0.42 | 1.14 | 0.72 |
| | (kg/ha) | | 152 | <112 | 367 | 364 | 997 | 629 |
| | (mg/kg) | | 68 | <50 | 164 | 162 | 445 | 281 |
| Exchangeable Sodium | (cmol+/kg) | | 0.23 | 0.11 | 1.09 | 2.10 | 0.38 | 0.36 |
| | (kg/ha) | | 118 | 56 | 561 | 1081 | 196 | 187 |
| | (mg/kg) | | 53 | 25 | 250 | 483 | 87 | 84 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.74 | 0.11 | 0.08 | 0.09 | 0.12 | 0.12 |
| | (kg/ha) | | 150 | 23 | 17 | 17 | 23 | 24 |
| | (mg/kg) | | 67 | 10 | 8 | 8 | 10 | 11 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 1.50 | 0.66 | <0.01 | <0.01 | 0.30 | <0.01 |
| | (kg/ha) | | 34 | 15 | <1 | <1 | 7 | <1 |
| | (mg/kg) | | 15 | 7 | <1 | <1 | 3 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 7.10 | 4.14 | 28.56 | 32.37 | 18.17 | 27.00 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 51.0 | 58.8 | 37.3 | 31.1 | 71.7 | 54.2 |
| Magnesium (%) | | | 11.7 | 18.3 | 57.1 | 60.9 | 17.7 | 41.4 |
| Potassium (%) | | | 2.4 | 1.7 | 1.5 | 1.3 | 6.3 | 2.7 |
| Sodium - ESP (%) | | | 3.2 | 2.6 | 3.8 | 6.5 | 2.1 | 1.3 |
| Aluminium (%) | | | 10.5 | 2.8 | 0.3 | 0.3 | 0.6 | 0.4 |
| Hydrogen (%) | | | 21.1 | 15.9 | 0.0 | 0.0 | 1.6 | 0.0 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 4.4 | 3.2 | 0.7 | 0.5 | 4.1 | 1.3 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 2.5/3 | 5Y 7/1 | 2.5Y 4/3 | 2.5Y 5/3 | 10YR 3/1 | 7.5YR 3/2 |
| | | | Very dark brown | Light grey | Olive brown | Light olive brown | Very dark grey | Dark brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 121 | Sample 122 | Sample 123 | Sample 124 | Sample 125 | Sample 126 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 41 0-10cm | 41 10-20cm | 41 30-40cm | 41 65-75cm | 42 0-10cm | 42 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | K6461/121 | K6461/122 | K6461/123 | K6461/124 | K6461/125 | K6461/126 |

**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: Collingwo
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 res
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.
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.
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17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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## AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 127 | Sample 128 | Sample 129 | Sample 130 | Sample 131 | Sample 132 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 42 40-50cm | 42 65-75cm | 43 0-10cm | 43 20-30cm | 43 40-50cm | 43 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/127 | K6461/128 | K6461/129 | K6461/130 | K6461/131 | K6461/132 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.41 | 8.21 | 6.24 | 6.27 | 6.97 | 8.14 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.068 | 0.089 | 0.107 | 0.040 | 0.125 | 0.143 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 14.86 | 15.09 | 8.46 | 5.1 | 11 | 12 |
| | (kg/ha) | | 6672 | 6773 | 3797 | 2,307 | 4,989 | 5,307 |
| | (mg/kg) | | 2979 | 3024 | 1695 | 1,030 | 2,227 | 2,369 |
| Exchangeable Magnesium | (cmol+/kg) | | 13.72 | 16.93 | 0.89 | 1.1 | 12 | 19 |
| | (kg/ha) | | 3734 | 4609 | 241 | 304 | 3,207 | 5,146 |
| | (mg/kg) | | 1667 | 2058 | 108 | 136 | 1,432 | 2,297 |
| Exchangeable Potassium | (cmol+/kg) | | 0.64 | 0.60 | 0.22 | 0.17 | 0.44 | 0.50 |
| | (kg/ha) | | 562 | 522 | 193 | 147 | 386 | 441 |
| | (mg/kg) | | 251 | 233 | 86 | 66 | 172 | 197 |
| Exchangeable Sodium | (cmol+/kg) | | 0.74 | 1.48 | 0.19 | 0.16 | 1.7 | 3.8 |
| | (kg/ha) | | 383 | 764 | 97 | 82 | 853 | 1,979 |
| | (mg/kg) | | 171 | 341 | 43 | 37 | 381 | 884 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.12 | 0.12 | 0.06 | 0.14 | 0.15 | 0.14 |
| | (kg/ha) | | 24 | 24 | 12 | 27 | 31 | 28 |
| | (mg/kg) | | 11 | 11 | 6 | 12 | 14 | 12 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.14 | 0.10 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 3 | 2.2 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 30.08 | 34.22 | 9.95 | 6.8 | 25 | 35 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 49.4 | 44.1 | 85.0 | 75 | 44 | 34 |
| Magnesium (%) | | | 45.6 | 49.5 | 8.9 | 16 | 47 | 54 |
| Potassium (%) | | | 2.1 | 1.7 | 2.2 | 2.5 | 1.8 | 1.4 |
| Sodium - ESP (%) | | | 2.5 | 4.3 | 1.9 | 2.3 | 6.6 | 11 |
| Aluminium (%) | | | 0.4 | 0.3 | 0.6 | 2.0 | 0.61 | 0.39 |
| Hydrogen (%) | | | 0.0 | 0.0 | 1.4 | 1.5 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.1 | 0.9 | 9.5 | 4.6 | 0.94 | 0.63 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5Y 4/2 | 2.5Y 4/2 | 2.5Y 4/2 | 5Y 5/1 | 7.5YR 4/2 | 2.5Y 5/3 |
| | | | Olive grey | Dark greyish brown | Dark greyish brown | Grey | Brown | Light olive brown |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

CRICOS Provider: 01241G

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## AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 127 | Sample 128 | Sample 129 | Sample 130 | Sample 131 | Sample 132 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 42 40-50cm | 42 65-75cm | 43 0-10cm | 43 20-30cm | 43 40-50cm | 43 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | K6461/127 | K6461/128 | K6461/129 | K6461/130 | K6461/131 | K6461/132 |

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: Collingwo
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,
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11. Conversions to kg/ha = mg/kg x 2.24
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
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| | | | Sample 133 | Sample 134 | Sample 135 | Sample 136 | Sample 137 | Sample 138 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 46 0-10cm | 46 20-30cm | 46 40-50cm | 46 65-75cm | 47 0-10cm | 47 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/133** | **K6461/134** | **K6461/135** | **K6461/136** | **K6461/137** | **K6461/138** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.59 | 6.74 | 7.08 | 8.09 | 5.43 | 6.62 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.109 | 0.041 | 0.086 | 0.052 | 0.050 | 0.028 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.9 | 6.6 | 9.8 | 15 | 9.1 | 16 |
| | (kg/ha) | | 3,541 | 2,976 | 4,396 | 6,756 | 4,088 | 7,015 |
| | (mg/kg) | | 1,581 | 1,329 | 1,962 | 3,016 | 1,825 | 3,132 |
| Exchangeable Magnesium | (cmol+/kg) | | 1.2 | 2.4 | 6.7 | 13 | 3.2 | 6.9 |
| | (kg/ha) | | 322 | 648 | 1,821 | 3,540 | 861 | 1,872 |
| | (mg/kg) | | 144 | 289 | 813 | 1,580 | 384 | 836 |
| Exchangeable Potassium | (cmol+/kg) | | 0.91 | 0.55 | 0.38 | 0.51 | 1.2 | 0.49 |
| | (kg/ha) | | 799 | 482 | 333 | 447 | 1,036 | 427 |
| | (mg/kg) | | 357 | 215 | 149 | 200 | 463 | 191 |
| Exchangeable Sodium | (cmol+/kg) | | 0.13 | 0.11 | 0.34 | 0.75 | 0.14 | 0.27 |
| | (kg/ha) | | 65 | 57 | 177 | 387 | 74 | 141 |
| | (mg/kg) | | 29 | 25 | 79 | 173 | 33 | 63 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.16 | 0.11 | 0.12 | 0.15 | 0.32 | 0.16 |
| | (kg/ha) | | 33 | 22 | 23 | 30 | 65 | 33 |
| | (mg/kg) | | 15 | 9.7 | 10 | 13 | 29 | 15 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.48 | <0.01 | <0.01 | <0.01 | 0.88 | <0.01 |
| | (kg/ha) | | 11 | <1 | <1 | <1 | 20 | <1 |
| | (mg/kg) | | 4.8 | <1 | <1 | <1 | 8.8 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 11 | 9.8 | 17 | 29 | 15 | 23 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 73 | 68 | 57 | 51 | 62 | 67 |
| Magnesium (%) | | | 11 | 24 | 39 | 44 | 21 | 29 |
| Potassium (%) | | | 8.5 | 5.6 | 2.2 | 1.7 | 8.0 | 2.1 |
| Sodium - ESP (%) | | | 1.2 | 1.1 | 2.0 | 2.6 | 0.97 | 1.2 |
| Aluminium (%) | | | 1.5 | 1.1 | 0.67 | 0.50 | 2.2 | 0.69 |
| Hydrogen (%) | | | 4.5 | 0.00 | 0.00 | 0.00 | 6.0 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 6.7 | 2.8 | 1.5 | 1.2 | 2.9 | 2.3 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 4/2 Dark reddish grey | 2.5YR 4/4 Reddish brown | 2.5YR 4/4 Reddish brown | 2.5Y 4/3 Olive brown | 2.5YR 2.5/2 Very dusky red | 2.5YR 2.5/3 Dark reddish brown |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 133 | Sample 134 | Sample 135 | Sample 136 | Sample 137 | Sample 138 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 46 0-10cm | 46 20-30cm | 46 40-50cm | 46 65-75cm | 47 0-10cm | 47 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/133 | K6461/134 | K6461/135 | K6461/136 | K6461/137 | K6461/138 |

**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: Collingwo
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
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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,
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9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil res
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 139 | Sample 140 | Sample 141 | Sample 142 | Sample 143 | Sample 144 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 47 40-50cm | 47 65-75cm | 49 0-10cm | 49 20-30cm | 49 40-50cm | 49 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/139 | K6461/140 | K6461/141 | K6461/142 | K6461/143 | K6461/144 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.19 | 7.48 | 5.20 | 6.37 | 7.24 | 7.96 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.025 | 0.032 | 0.086 | 0.035 | 0.037 | 0.057 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 14 | 16 | 6.5 | 10 | 39 | 16 |
| | (kg/ha) | | 6,096 | 7,084 | 2,900 | 4,664 | 17,337 | 7,207 |
| | (mg/kg) | | 2,721 | 3,162 | 1,295 | 2,082 | 7,740 | 3,217 |
| Exchangeable Magnesium | (cmol+/kg) | | 7.3 | 11 | 3.1 | 8.5 | 44 | 20 |
| | (kg/ha) | | 1,990 | 2,914 | 839 | 2,321 | 11,858 | 5,523 |
| | (mg/kg) | | 888 | 1,301 | 375 | 1,036 | 5,294 | 2,466 |
| Exchangeable Potassium | (cmol+/kg) | | 0.30 | 0.39 | 0.48 | 0.48 | 1.4 | 0.44 |
| | (kg/ha) | | 261 | 339 | 421 | 419 | 1,186 | 384 |
| | (mg/kg) | | 116 | 151 | 188 | 187 | 529 | 171 |
| Exchangeable Sodium | (cmol+/kg) | | 0.23 | 0.52 | 0.11 | 0.27 | 1.4 | 1.0 |
| | (kg/ha) | | 118 | 270 | 58 | 138 | 746 | 530 |
| | (mg/kg) | | 53 | 120 | 26 | 62 | 333 | 237 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.17 | 0.16 | 0.25 | 0.12 | 0.12 | 0.12 |
| | (kg/ha) | | 34 | 33 | 51 | 24 | 25 | 23 |
| | (mg/kg) | | 15 | 15 | 23 | 11 | 11 | 10 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 1.1 | 0.49 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 25 | 11 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 11 | 4.9 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 22 | 28 | 11 | 20 | 85 | 38 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 63 | 57 | 56 | 51 | 45 | 42 |
| Magnesium (%) | | | 34 | 39 | 27 | 42 | 51 | 53 |
| Potassium (%) | | | 1.4 | 1.4 | 4.2 | 2.4 | 1.6 | 1.2 |
| Sodium - ESP (%) | | | 1.1 | 1.9 | 0.98 | 1.3 | 1.7 | 2.7 |
| Aluminium (%) | | | 0.79 | 0.59 | 2.2 | 0.58 | 0.15 | 0.30 |
| Hydrogen (%) | | | 0.00 | 0.00 | 9.6 | 2.4 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.9 | 1.5 | 2.1 | 1.2 | 0.89 | 0.79 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 3/4 Dark reddish brown | 10R 3/2 Dusky red | 2.5YR 3/1 Dark reddish grey | 2.5YR 4/3 Reddish brown | 7.5YR 5/3 Brown | 2.5Y 5/3 Light olive brown |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 139 | Sample 140 | Sample 141 | Sample 142 | Sample 143 | Sample 144 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 47 40-50cm | 47 65-75cm | 49 0-10cm | 49 20-30cm | 49 40-50cm | 49 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/139 | K6461/140 | K6461/141 | K6461/142 | K6461/143 | K6461/144 |

**Notes:**

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2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwo
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7. Total Acid Extractable Nutrients indicate a store of nutrients.
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| | | | Sample 145 | Sample 146 | Sample 147 | Sample 148 | Sample 149 | Sample 150 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 50 0-10cm | 50 20-30cm | 50 40-50cm | 50 65-75cm | 51 0-10cm | 51 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/145** | **K6461/146** | **K6461/147** | **K6461/148** | **K6461/149** | **K6461/150** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.21 | 7.07 | 7.76 | 8.38 | 5.40 | 6.39 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.064 | 0.051 | 0.072 | 0.059 | 0.126 | 0.013 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 10 | 11 | 14 | 16 | 3.7 | 2.0 |
| | (kg/ha) | | 4,519 | 4,896 | 6,253 | 6,995 | 1,652 | 913 |
| | (mg/kg) | | 2,017 | 2,186 | 2,792 | 3,123 | 737 | 407 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 2.2 | 5.2 | 8.7 | 12 | 0.62 | 0.58 |
| | (kg/ha) | | 608 | 1,402 | 2,371 | 3,347 | 168 | 157 |
| | (mg/kg) | | 271 | 626 | 1,059 | 1,494 | 75 | 70 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 1.9 | 0.56 | 0.65 | 0.67 | 0.18 | <0.12 |
| | (kg/ha) | | 1,631 | 486 | 566 | 585 | 156 | <112 |
| | (mg/kg) | | 728 | 217 | 253 | 261 | 70 | <50 |
| Exchangeable Sodium | (cmol$_+$/kg) | | <0.065 | 0.15 | 0.36 | 0.91 | 0.13 | 0.07 |
| | (kg/ha) | | <33 | 79 | 187 | 466 | 65 | 36 |
| | (mg/kg) | | <15 | 35 | 83 | 208 | 29 | 16 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | 0.17 | 0.17 | 0.17 | 0.15 | 0.16 | 0.04 |
| | (kg/ha) | | 35 | 35 | 34 | 31 | 32 | 8.9 |
| | (mg/kg) | | 16 | 16 | 15 | 14 | 14 | 4.0 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.18 | <0.01 | <0.01 | <0.01 | 0.60 | 0.15 |
| | (kg/ha) | | 4.0 | <1 | <1 | <1 | 13 | 3.3 |
| | (mg/kg) | | 1.8 | <1 | <1 | <1 | 6.0 | 1.5 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 15 | 17 | 24 | 30 | 5.4 | 3.0 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 69 | 64 | 58 | 53 | 69 | 69 |
| Magnesium (%) | | | 15 | 30 | 37 | 42 | 11 | 19 |
| Potassium (%) | | | 13 | 3.3 | 2.7 | 2.3 | 3.3 | 3.0 |
| Sodium - ESP (%) | | | 0.42 | 0.90 | 1.5 | 3.1 | 2.4 | 2.4 |
| Aluminium (%) | | | 1.2 | 1.0 | 0.71 | 0.51 | 3.0 | 1.5 |
| Hydrogen (%) | | | 1.2 | 0.00 | 0.00 | 0.00 | 11 | 5.0 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 4.5 | 2.1 | 1.6 | 1.3 | 6.0 | 3.5 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5Y 3/2 | 10YR 3/2 | 10YR 4/6 | 10YR 5/4 | 5Y 4/1 | 5Y 6/1 |
| | | | Very dark greyish brown | Very dark greyish brown | Dark yellowish brown | Yellowish brown | Dark grey | Grey |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 145 | Sample 146 | Sample 147 | Sample 148 | Sample 149 | Sample 150 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 50 0-10cm | 50 20-30cm | 50 40-50cm | 50 65-75cm | 51 0-10cm | 51 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/145 | K6461/146 | K6461/147 | K6461/148 | K6461/149 | K6461/150 |

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: Collingwo
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 res
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.
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 sc
17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
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CRICOS Provider: 01241G

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# AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 151 | Sample 152 | Sample 153 | Sample 154 | Sample 155 | Sample 156 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 51 40-50cm | 51 65-75cm | 52 0-10cm | 52 20-30cm | 52 40-50cm | 52 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/151 | K6461/152 | K6461/153 | K6461/154 | K6461/155 | K6461/156 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.71 | 8.28 | 5.54 | 6.50 | 7.24 | 8.00 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.038 | 0.088 | 0.076 | 0.080 | 0.065 | 0.049 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 6.2 | 9.4 | 10 | 17 | 18 | 18 |
| | (kg/ha) | | 2,769 | 4,223 | 4,652 | 7,562 | 7,951 | 7,959 |
| | (mg/kg) | | 1,236 | 1,885 | 2,077 | 3,376 | 3,550 | 3,553 |
| Exchangeable Magnesium | (cmol+/kg) | | 7.7 | 16 | 3.0 | 9.4 | 12 | 13 |
| | (kg/ha) | | 2,088 | 4,417 | 830 | 2,554 | 3,195 | 3,545 |
| | (mg/kg) | | 932 | 1,972 | 371 | 1,140 | 1,426 | 1,582 |
| Exchangeable Potassium | (cmol+/kg) | | 0.27 | 0.43 | 1.5 | 1.2 | 0.92 | 0.60 |
| | (kg/ha) | | 239 | 373 | 1,286 | 1,045 | 807 | 524 |
| | (mg/kg) | | 107 | 166 | 574 | 467 | 360 | 234 |
| Exchangeable Sodium | (cmol+/kg) | | 1.3 | 3.1 | 0.13 | 0.23 | 0.43 | 0.63 |
| | (kg/ha) | | 673 | 1,612 | 68 | 116 | 224 | 327 |
| | (mg/kg) | | 300 | 720 | 30 | 52 | 100 | 146 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.07 | 0.07 | 0.11 | 0.08 | 0.06 | 0.08 |
| | (kg/ha) | | 14 | 15 | 22 | 16 | 13 | 15 |
| | (mg/kg) | | 6.4 | 6.5 | 10.0 | 7.0 | 5.6 | 6.9 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.70 | 0.12 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 16 | 2.6 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 7.0 | 1.2 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 15 | 29 | 16 | 28 | 31 | 32 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 40 | 32 | 66 | 61 | 57 | 55 |
| Magnesium (%) | | | 50 | 55 | 19 | 34 | 38 | 41 |
| Potassium (%) | | | 1.8 | 1.5 | 9.3 | 4.3 | 3.0 | 1.9 |
| Sodium - ESP (%) | | | 8.4 | 11 | 0.84 | 0.81 | 1.4 | 2.0 |
| Aluminium (%) | | | 0.46 | 0.25 | 0.70 | 0.28 | 0.20 | 0.24 |
| Hydrogen (%) | | | 0.00 | 0.00 | 4.4 | 0.42 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 0.80 | 0.58 | 3.4 | 1.8 | 1.5 | 1.4 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5Y 5/1 | 2.5Y 6/2 | 7.5YR 2.5/3 | 2.5Y 6/6 | 10YR 4/2 | 10YR 5/4 |
| | | | Grey | Light brownish grey | Very dark brown | Olive yellow | Dark greyish brown | Yellowish brown |
| Mottles Munsell Colour | | | 2.5Y 7/6 | 2.5Y 7/8 | .. | .. | .. | .. |
| | | | Yellow | Yellow | .. | .. | .. | .. |
| Degree of Mottling (%) | | | 10 | 25 | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 151 | Sample 152 | Sample 153 | Sample 154 | Sample 155 | Sample 156 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 51 40-50cm | 51 65-75cm | 52 0-10cm | 52 20-30cm | 52 40-50cm | 52 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/151 | K6461/152 | K6461/153 | K6461/154 | K6461/155 | K6461/156 |

**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: Collingwo
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 res
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
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17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
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PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 157 | Sample 158 | Sample 159 | Sample 160 | Sample 161 | Sample 162 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 53 0-10cm | 53 20-30cm | 53 40-50cm | 53 65-75cm | 54 0-10cm | 54 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/157** | **K6461/158** | **K6461/159** | **K6461/160** | **K6461/161** | **K6461/162** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.51 | 6.82 | 6.81 | 7.44 | 5.15 | 6.17 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.128 | 0.027 | 0.029 | 0.040 | 0.084 | 0.027 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.5 | 5.6 | 5.4 | 14 | 5.4 | 7.8 |
| | (kg/ha) | | 3,373 | 2,493 | 2,411 | 6,359 | 2,408 | 3,514 |
| | (mg/kg) | | 1,506 | 1,113 | 1,077 | 2,839 | 1,075 | 1,569 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 1.9 | 1.3 | 1.3 | 11 | 1.2 | 3.7 |
| | (kg/ha) | | 505 | 358 | 361 | 2,948 | 327 | 1,005 |
| | (mg/kg) | | 225 | 160 | 161 | 1,316 | 146 | 449 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 0.26 | 0.14 | 0.13 | 0.40 | 0.22 | 0.22 |
| | (kg/ha) | | 228 | 120 | 114 | 353 | 195 | 191 |
| | (mg/kg) | | 102 | 54 | 51 | 158 | 87 | 85 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.17 | 0.14 | 0.15 | 0.50 | 0.19 | 0.12 |
| | (kg/ha) | | 85 | 73 | 77 | 257 | 96 | 61 |
| | (mg/kg) | | 38 | 32 | 34 | 115 | 43 | 27 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | 0.08 | 0.04 | 0.04 | 0.06 | 0.16 | 0.08 |
| | (kg/ha) | | 16 | 7.3 | 8.6 | 11 | 31 | 16 |
| | (mg/kg) | | 7.1 | 3.2 | 3.9 | 5.1 | 14 | 7.0 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.59 | <0.01 | <0.01 | <0.01 | 1.1 | 0.28 |
| | (kg/ha) | | 13 | <1 | <1 | <1 | 24 | 6.2 |
| | (mg/kg) | | 5.9 | <1 | <1 | <1 | 11 | 2.8 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 10 | 7.2 | 7.0 | 26 | 8.2 | 12 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 72 | 77 | 76 | 55 | 66 | 64 |
| Magnesium (%) | | | 18 | 18 | 19 | 42 | 15 | 30 |
| Potassium (%) | | | 2.5 | 1.9 | 1.9 | 1.6 | 2.7 | 1.8 |
| Sodium - ESP (%) | | | 1.6 | 2.0 | 2.1 | 1.9 | 2.3 | 0.97 |
| Aluminium (%) | | | 0.76 | 0.50 | 0.61 | 0.22 | 1.9 | 0.64 |
| Hydrogen (%) | | | 5.7 | 0.00 | 0.00 | 0.00 | 13 | 2.3 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 4.1 | 4.2 | 4.0 | 1.3 | 4.5 | 2.1 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5Y 4/3 | 10YR 3/3 | 2.5Y 5/6 | 2.5Y 5/4 | 7.5YR 3/1 | 2.5YR 4/4 |
| | | | Olive brown | Dark brown | Light olive brown | Light olive brown | Very dark grey | Reddish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 157 | Sample 158 | Sample 159 | Sample 160 | Sample 161 | Sample 162 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 53 0-10cm | 53 20-30cm | 53 40-50cm | 53 65-75cm | 54 0-10cm | 54 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | **K6461/157** | **K6461/158** | **K6461/159** | **K6461/160** | **K6461/161** | **K6461/162** |

**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: Collingwo
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,
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9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil res
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
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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
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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| | | | Sample 163 | Sample 164 | Sample 165 | Sample 166 | Sample 167 | Sample 168 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 54 40-50cm | 54 65-75cm | 55 0-10cm | 55 20-30cm | 55 40-50cm | 55 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | | Method reference | K6461/163 | K6461/164 | K6461/165 | K6461/166 | K6461/167 | K6461/168 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.80 | 7.28 | 4.95 | 5.94 | 7.13 | 7.84 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.065 | 0.047 | 0.117 | 0.041 | 0.028 | 0.035 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 12 | 12 | 5.1 | 5.1 | 7.4 | 15 |
| | (kg/ha) | | 5,517 | 5,307 | 2,302 | 2,280 | 3,344 | 6,603 |
| | (mg/kg) | | 2,463 | 2,369 | 1,028 | 1,018 | 1,493 | 2,948 |
| Exchangeable Magnesium | (cmol+/kg) | | 12 | 14 | 1.2 | 1.6 | 3.6 | 13 |
| | (kg/ha) | | 3,365 | 3,929 | 336 | 432 | 972 | 3,439 |
| | (mg/kg) | | 1,502 | 1,754 | 150 | 193 | 434 | 1,535 |
| Exchangeable Potassium | (cmol+/kg) | | 0.37 | 0.42 | 1.3 | 0.94 | 0.76 | 0.59 |
| | (kg/ha) | | 327 | 366 | 1,150 | 825 | 668 | 518 |
| | (mg/kg) | | 146 | 163 | 514 | 369 | 298 | 231 |
| Exchangeable Sodium | (cmol+/kg) | | 0.65 | 1.1 | 0.13 | 0.10 | 0.17 | 0.62 |
| | (kg/ha) | | 332 | 573 | 69 | 50 | 86 | 317 |
| | (mg/kg) | | 148 | 256 | 31 | 22 | 39 | 142 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.08 | 0.08 | 0.33 | 0.08 | 0.07 | 0.07 |
| | (kg/ha) | | 15 | 16 | 66 | 16 | 13 | 15 |
| | (mg/kg) | | 6.8 | 7.3 | 29 | 7.1 | 5.9 | 6.5 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 1.3 | 0.42 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 28 | 9.3 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 13 | 4.2 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 26 | 28 | 9.4 | 8.2 | 12 | 29 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 48 | 42 | 55 | 62 | 62 | 51 |
| Magnesium (%) | | | 48 | 52 | 13 | 19 | 30 | 44 |
| Potassium (%) | | | 1.4 | 1.5 | 14 | 11 | 6.3 | 2.1 |
| Sodium - ESP (%) | | | 2.5 | 4.0 | 1.4 | 1.2 | 1.4 | 2.2 |
| Aluminium (%) | | | 0.29 | 0.29 | 3.5 | 0.96 | 0.55 | 0.25 |
| Hydrogen (%) | | | 0.00 | 0.00 | 13 | 5.1 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 0.99 | 0.82 | 4.1 | 3.2 | 2.1 | 1.2 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 6/8 | 5YR 5/6 | 7.5YR 4/3 | 5YR 5/6 | 5YR 4/4 | 2.5Y 6/6 |
| | | | Brownish yellow | Yellowish red | Brown | Yellowish red | Reddish brown | Olive yellow |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

CRICOS Provider: 01241G

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 163 | Sample 164 | Sample 165 | Sample 166 | Sample 167 | Sample 168 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 54 40-50cm | 54 65-75cm | 55 0-10cm | 55 20-30cm | 55 40-50cm | 55 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/163 | K6461/164 | K6461/165 | K6461/166 | K6461/167 | K6461/168 |

**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: Collingwo
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 res
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.
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 sc
17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
KS

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 169 | Sample 170 | Sample 171 | Sample 172 | Sample 173 | Sample 174 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 59 0-10cm | 59 20-30cm | 59 40-50cm | 59 65-75cm | 60 0-10cm | 60 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | K6461/169 | K6461/170 | K6461/171 | K6461/172 | K6461/173 | K6461/174 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.98 | 6.67 | 7.15 | 7.36 | 5.87 | 6.88 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.062 | 0.051 | 0.030 | 0.027 | 0.050 | 0.025 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 10 | 21 | 24 | 24 | 12 | 12 |
| | (kg/ha) | | 4,677 | 9,565 | 10,593 | 10,642 | 5,448 | 5,564 |
| | (mg/kg) | | 2,088 | 4,270 | 4,729 | 4,751 | 2,432 | 2,484 |
| Exchangeable Magnesium | (cmol+/kg) | | 3.4 | 14 | 17 | 16 | 3.3 | 4.2 |
| | (kg/ha) | | 935 | 3,941 | 4,752 | 4,230 | 905 | 1,155 |
| | (mg/kg) | | 417 | 1,760 | 2,121 | 1,888 | 404 | 516 |
| Exchangeable Potassium | (cmol+/kg) | | 0.85 | 0.61 | 0.46 | 0.20 | 0.70 | 0.69 |
| | (kg/ha) | | 744 | 536 | 406 | 179 | 616 | 608 |
| | (mg/kg) | | 332 | 239 | 181 | 80 | 275 | 272 |
| Exchangeable Sodium | (cmol+/kg) | | 0.09 | 0.28 | 0.48 | 0.65 | 0.09 | 0.12 |
| | (kg/ha) | | 45 | 147 | 245 | 337 | 47 | 64 |
| | (mg/kg) | | 20 | 65 | 109 | 150 | 21 | 29 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.06 | 0.06 | 0.06 | 0.09 | 0.05 | 0.05 |
| | (kg/ha) | | 12 | 13 | 12 | 19 | 11 | 11 |
| | (mg/kg) | | 5.5 | 5.8 | 5.4 | 8.3 | 4.7 | 4.8 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.53 | <0.01 | <0.01 | <0.01 | 0.42 | <0.01 |
| | (kg/ha) | | 12 | <1 | <1 | <1 | 9.4 | <1 |
| | (mg/kg) | | 5.3 | <1 | <1 | <1 | 4.2 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 15 | 37 | 42 | 40 | 17 | 18 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 68 | 58 | 56 | 59 | 73 | 71 |
| Magnesium (%) | | | 22 | 39 | 42 | 39 | 20 | 24 |
| Potassium (%) | | | 5.5 | 1.7 | 1.1 | 0.51 | 4.2 | 4.0 |
| Sodium - ESP (%) | | | 0.57 | 0.77 | 1.1 | 1.6 | 0.55 | 0.71 |
| Aluminium (%) | | | 0.40 | 0.17 | 0.14 | 0.23 | 0.31 | 0.30 |
| Hydrogen (%) | | | 3.4 | 0.00 | 0.00 | 0.00 | 2.5 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.0 | 1.5 | 1.4 | 1.5 | 3.6 | 2.9 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/3 | 2.5YR 3/4 | 10YR 4/6 | 10YR 5/6 | 7.5YR 2.5/3 | 5YR 2.5/2 |
| | | | Dark brown | Dark reddish brown | Dark yellowish brown | Yellowish brown | Very dark brown | Dark reddish brown |
| Mottles Munsell Colour | | | .. | .. | .. | 5YR 2.5/1 | .. | .. |
| | | | .. | .. | .. | Black | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | 5 | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 169 | Sample 170 | Sample 171 | Sample 172 | Sample 173 | Sample 174 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 59 0-10cm | 59 20-30cm | 59 40-50cm | 59 65-75cm | 60 0-10cm | 60 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | K6461/169 | K6461/170 | K6461/171 | K6461/172 | K6461/173 | K6461/174 |

**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: Collingwo
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 res
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
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

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CRICOS Provider: 01241G

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| | | | Sample 175 | Sample 176 | Sample 177 | Sample 178 | Sample 179 | Sample 180 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 60 40-50cm | 60 65-75cm | 61 0-10cm | 61 20-30cm | 61 40-50cm | 61 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | | Method reference | K6461/175 | K6461/176 | K6461/177 | K6461/178 | K6461/179 | K6461/180 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.72 | 8.17 | 5.68 | 6.84 | 7.25 | 7.71 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.035 | 0.051 | 0.108 | 0.024 | 0.025 | 0.030 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 20 | 22 | 11 | 20 | 19 | 18 |
| | (kg/ha) | | 8,900 | 9,686 | 5,093 | 8,774 | 8,501 | 8,215 |
| | (mg/kg) | | 3,973 | 4,324 | 2,274 | 3,917 | 3,795 | 3,667 |
| Exchangeable Magnesium | (cmol+/kg) | | 11 | 13 | 4.4 | 15 | 17 | 17 |
| | (kg/ha) | | 2,968 | 3,550 | 1,185 | 4,156 | 4,614 | 4,685 |
| | (mg/kg) | | 1,325 | 1,585 | 529 | 1,855 | 2,060 | 2,092 |
| Exchangeable Potassium | (cmol+/kg) | | 1.0 | 0.95 | 2.1 | 0.43 | 0.40 | 0.31 |
| | (kg/ha) | | 904 | 830 | 1,860 | 378 | 354 | 268 |
| | (mg/kg) | | 403 | 370 | 831 | 169 | 158 | 120 |
| Exchangeable Sodium | (cmol+/kg) | | 0.51 | 1.0 | 0.11 | 0.24 | 0.29 | 0.42 |
| | (kg/ha) | | 264 | 519 | 55 | 123 | 148 | 218 |
| | (mg/kg) | | 118 | 232 | 25 | 55 | 66 | 97 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.05 | 0.05 | 0.10 | 0.06 | 0.06 | 0.05 |
| | (kg/ha) | | 9.4 | 10 | 20 | 11 | 11 | 9.2 |
| | (mg/kg) | | 4.2 | 4.5 | 8.8 | 5.0 | 5.0 | 4.1 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.70 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 16 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 7.0 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 32 | 37 | 19 | 36 | 37 | 36 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 61 | 59 | 61 | 55 | 52 | 50 |
| Magnesium (%) | | | 34 | 36 | 23 | 43 | 46 | 47 |
| Potassium (%) | | | 3.2 | 2.6 | 11 | 1.2 | 1.1 | 0.84 |
| Sodium - ESP (%) | | | 1.6 | 2.8 | 0.57 | 0.67 | 0.78 | 1.2 |
| Aluminium (%) | | | 0.14 | 0.14 | 0.52 | 0.16 | 0.15 | 0.13 |
| Hydrogen (%) | | | 0.00 | 0.00 | 3.7 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.8 | 1.7 | 2.6 | 1.3 | 1.1 | 1.1 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10 YR 3/2 | 2.5Y 4/3 | 7.5YR 3/2 | 2.5YR 4/3 | 5Y 6/4 | 5Y 4/4 |
| | | | Very dark greyish brown | Olive brown | Dark brown | Reddish brown | Pale olive | Olive |
| Mottles Munsell Colour | | | 10YR 2/1 | .. | .. | .. | .. | .. |
| | | | Black | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | 3 | .. | .. | .. | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 175 | Sample 176 | Sample 177 | Sample 178 | Sample 179 | Sample 180 |
|---|---|---|---|---|---|---|---|
| | **Sample ID:** | 60 40-50cm | 60 65-75cm | 61 0-10cm | 61 20-30cm | 61 40-50cm | 61 65-75cm |
| | **Crop:** | Soil | Soil | Soil | Soil | Soil | Soil |
| | **Client:** | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/175 | K6461/176 | K6461/177 | K6461/178 | K6461/179 | K6461/180 |

**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: Collingwo
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 res
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
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11. Conversions to kg/ha = mg/kg x 2.24
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 181 | Sample 182 | Sample 183 | Sample 184 | Sample 185 | Sample 186 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 62 0-10cm | 62 20-30cm | 62 40-50cm | 62 65-75cm | 63 0-10cm | 63 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | | Method reference | K6461/181 | K6461/182 | K6461/183 | K6461/184 | K6461/185 | K6461/186 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.63 | 6.75 | 7.65 | 8.21 | 5.57 | 6.93 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.057 | 0.050 | 0.053 | 0.056 | 0.092 | 0.030 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 9.6 | 16 | 18 | 17 | 14 | 19 |
| | (kg/ha) | | 4,302 | 7,067 | 8,040 | 7,471 | 6,251 | 8,648 |
| | (mg/kg) | | 1,921 | 3,155 | 3,589 | 3,335 | 2,791 | 3,861 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.3 | 9.6 | 15 | 17 | 5.1 | 13 |
| | (kg/ha) | | 629 | 2,613 | 4,089 | 4,528 | 1,395 | 3,554 |
| | (mg/kg) | | 281 | 1,167 | 1,826 | 2,021 | 623 | 1,587 |
| Exchangeable Potassium | (cmol+/kg) | | 0.84 | 0.69 | 0.87 | 0.82 | 1.6 | 0.68 |
| | (kg/ha) | | 739 | 606 | 765 | 720 | 1,427 | 599 |
| | (mg/kg) | | 330 | 271 | 341 | 322 | 637 | 268 |
| Exchangeable Sodium | (cmol+/kg) | | <0.065 | 0.17 | 0.48 | 0.82 | 0.10 | 0.27 |
| | (kg/ha) | | <33 | 85 | 247 | 425 | 49 | 137 |
| | (mg/kg) | | <15 | 38 | 110 | 190 | 22 | 61 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.05 | 0.06 | 0.06 | 0.06 | 0.12 | 0.07 |
| | (kg/ha) | | 9.7 | 12 | 12 | 11 | 24 | 15 |
| | (mg/kg) | | 4.3 | 5.2 | 5.3 | 5.1 | 11 | 6.5 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.52 | <0.01 | <0.01 | <0.01 | 0.71 | <0.01 |
| | (kg/ha) | | 12 | <1 | <1 | <1 | 16 | <1 |
| | (mg/kg) | | 5.2 | <1 | <1 | <1 | 7.1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 13 | 26 | 34 | 35 | 22 | 33 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 72 | 60 | 52 | 48 | 64 | 58 |
| Magnesium (%) | | | 17 | 37 | 44 | 48 | 24 | 39 |
| Potassium (%) | | | 6.3 | 2.6 | 2.5 | 2.4 | 7.5 | 2.1 |
| Sodium - ESP (%) | | | 0.42 | 0.63 | 1.4 | 2.4 | 0.44 | 0.80 |
| Aluminium (%) | | | 0.36 | 0.22 | 0.17 | 0.16 | 0.54 | 0.22 |
| Hydrogen (%) | | | 3.9 | 0.00 | 0.00 | 0.00 | 3.3 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 4.1 | 1.6 | 1.2 | 1.0 | 2.7 | 1.5 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 3/2 | 7.5YR 3/2 | 10YR 3/2 | 5Y 4/4 | 5YR 3/1 | 2.5YR 3/4 |
| | | | Dark reddish brown | Dark brown | Very dark greyish brown | Olive | Very dark grey | Dark reddish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 181 | Sample 182 | Sample 183 | Sample 184 | Sample 185 | Sample 186 |
|---|---|---|---|---|---|---|---|---|
| | | **Sample ID:** | 62 0-10cm | 62 20-30cm | 62 40-50cm | 62 65-75cm | 63 0-10cm | 63 20-30cm |
| | | **Crop:** | Soil | Soil | Soil | Soil | Soil | Soil |
| | | **Client:** | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | **Parameter** | **Method reference** | K6461/181 | K6461/182 | K6461/183 | K6461/184 | K6461/185 | K6461/186 |

**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: Collingwo
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.
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7. Total Acid Extractable Nutrients indicate a store of nutrients.
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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| Parameter | | Method reference | Sample 187 | Sample 188 | Sample 189 | Sample 190 | Sample 191 | Sample 192 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 63 40-50cm | 63 65-75cm | 64 0-10cm | 64 20-30cm | 64 40-50cm | 64 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/187 | K6461/188 | K6461/189 | K6461/190 | K6461/191 | K6461/192 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.31 | 7.57 | 6.53 | 6.59 | 7.12 | 7.61 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.032 | 0.038 | 0.046 | 0.035 | 0.029 | 0.030 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 19 | 23 | 14 | 17 | 18 | 23 |
| | (kg/ha) | | 8,742 | 10,415 | 6,460 | 7,458 | 8,143 | 10,181 |
| | (mg/kg) | | 3,903 | 4,650 | 2,884 | 3,330 | 3,635 | 4,545 |
| Exchangeable Magnesium | (cmol+/kg) | | 15 | 18 | 4.3 | 9.8 | 12 | 14 |
| | (kg/ha) | | 4,023 | 4,804 | 1,167 | 2,662 | 3,333 | 3,917 |
| | (mg/kg) | | 1,796 | 2,145 | 521 | 1,189 | 1,488 | 1,749 |
| Exchangeable Potassium | (cmol+/kg) | | 0.51 | 0.42 | 1.0 | 0.64 | 0.68 | 0.66 |
| | (kg/ha) | | 445 | 369 | 912 | 558 | 597 | 577 |
| | (mg/kg) | | 199 | 165 | 407 | 249 | 266 | 257 |
| Exchangeable Sodium | (cmol+/kg) | | 0.46 | 0.75 | 0.09 | 0.15 | 0.18 | 0.26 |
| | (kg/ha) | | 235 | 387 | 45 | 77 | 93 | 136 |
| | (mg/kg) | | 105 | 173 | 20 | 35 | 41 | 61 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.06 | 0.07 | 0.08 | 0.06 | 0.06 | 0.05 |
| | (kg/ha) | | 11 | 13 | 15 | 12 | 12 | 11 |
| | (mg/kg) | | 5.1 | 6.0 | 6.8 | 5.5 | 5.5 | 4.9 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | <1 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | <1 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 35 | 42 | 20 | 27 | 31 | 38 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 55 | 55 | 72 | 61 | 58 | 60 |
| Magnesium (%) | | | 42 | 42 | 22 | 36 | 39 | 38 |
| Potassium (%) | | | 1.4 | 1.0 | 5.2 | 2.3 | 2.2 | 1.7 |
| Sodium - ESP (%) | | | 1.3 | 1.8 | 0.44 | 0.55 | 0.57 | 0.69 |
| Aluminium (%) | | | 0.16 | 0.16 | 0.38 | 0.22 | 0.20 | 0.14 |
| Hydrogen (%) | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.3 | 1.3 | 3.4 | 1.7 | 1.5 | 1.6 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5Y 4/3 | 5YR 4/2 | 2.5YR 3/1 | 2.5YR 3/3 | 7.5YR 3/2 | 10YR 4/6 |
| | | | Reddish brown | Dark reddish grey | Dark reddish grey | Dusky red | Dark brown | Dark yellowish brown |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 187 | Sample 188 | Sample 189 | Sample 190 | Sample 191 | Sample 192 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 63 40-50cm | 63 65-75cm | 64 0-10cm | 64 20-30cm | 64 40-50cm | 64 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/187 | K6461/188 | K6461/189 | K6461/190 | K6461/191 | K6461/192 |

**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: Collingwo
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 res
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.
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 sc
17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
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# AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 193 | Sample 194 | Sample 195 | Sample 196 | Sample 197 | Sample 198 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 66 0-10cm | 66 20-30cm | 66 40-50cm | 66 65-75cm | 67 0-10cm | 67 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/193 | K6461/194 | K6461/195 | K6461/196 | K6461/197 | K6461/198 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.86 | 6.72 | 7.84 | 8.41 | 5.36 | 6.25 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.089 | 0.078 | 0.054 | 0.077 | 0.059 | 0.022 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 12 | 17 | 20 | 20 | 7.0 | 7.0 |
| | (kg/ha) | | 5,263 | 7,449 | 8,769 | 8,865 | 3,144 | 3,134 |
| | (mg/kg) | | 2,350 | 3,325 | 3,915 | 3,958 | 1,404 | 1,399 |
| Exchangeable Magnesium | (cmol+/kg) | | 3.4 | 7.7 | 12 | 15 | 1.7 | 2.2 |
| | (kg/ha) | | 937 | 2,094 | 3,367 | 4,097 | 456 | 603 |
| | (mg/kg) | | 418 | 935 | 1,503 | 1,829 | 204 | 269 |
| Exchangeable Potassium | (cmol+/kg) | | 2.7 | 0.97 | 0.66 | 0.62 | 0.56 | 0.28 |
| | (kg/ha) | | 2,332 | 845 | 574 | 544 | 493 | 244 |
| | (mg/kg) | | 1,041 | 377 | 256 | 243 | 220 | 109 |
| Exchangeable Sodium | (cmol+/kg) | | 0.23 | 0.25 | 0.65 | 1.4 | 0.08 | 0.11 |
| | (kg/ha) | | 120 | 131 | 334 | 700 | 43 | 58 |
| | (mg/kg) | | 54 | 58 | 149 | 313 | 19 | 26 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.08 | 0.06 | 0.06 | 0.05 | 0.18 | 0.06 |
| | (kg/ha) | | 16 | 13 | 12 | 10 | 36 | 12 |
| | (mg/kg) | | 7.0 | 5.8 | 5.1 | 4.6 | 16 | 5.4 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.58 | <0.01 | <0.01 | <0.01 | 0.87 | 0.28 |
| | (kg/ha) | | 13 | <1 | <1 | <1 | 19 | 6.2 |
| | (mg/kg) | | 5.8 | <1 | <1 | <1 | 8.7 | 2.8 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 19 | 26 | 33 | 37 | 10 | 9.9 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 63 | 65 | 59 | 54 | 68 | 70 |
| Magnesium (%) | | | 18 | 30 | 37 | 41 | 16 | 22 |
| Potassium (%) | | | 14 | 3.8 | 2.0 | 1.7 | 5.4 | 2.8 |
| Sodium - ESP (%) | | | 1.2 | 0.99 | 1.9 | 3.7 | 0.80 | 1.1 |
| Aluminium (%) | | | 0.42 | 0.25 | 0.17 | 0.14 | 1.7 | 0.60 |
| Hydrogen (%) | | | 3.1 | 0.00 | 0.00 | 0.00 | 8.4 | 2.8 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.4 | 2.2 | 1.6 | 1.3 | 4.2 | 3.2 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 3/1 | 10YR 2/2 | 10YR 3/2 | 5Y 3/2 | 2.5YR 2.5/2 | 2.5YR 3/3 |
| | | | Very dark grey | Very dark brown | Very dark greyish brown | Dark olive grey | Very dusky red | Dark reddish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 193 | Sample 194 | Sample 195 | Sample 196 | Sample 197 | Sample 198 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 66 0-10cm | 66 20-30cm | 66 40-50cm | 66 65-75cm | 67 0-10cm | 67 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/193 | K6461/194 | K6461/195 | K6461/196 | K6461/197 | K6461/198 |

**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: Collingwo
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 res
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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15. This report is not to be reproduced except in full. Results only relate to the item tested.
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17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

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## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 199 | Sample 200 | Sample 201 | Sample 202 | Sample 203 | Sample 204 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 67 40-50cm | 67 65-75cm | 68 0-10cm | 68 20-30cm | 68 40-50cm | 68 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/199 | K6461/200 | K6461/201 | K6461/202 | K6461/203 | K6461/204 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.84 | 7.17 | 5.54 | 6.72 | 7.16 | 8.36 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.012 | 0.022 | 0.045 | 0.032 | 0.039 | 0.074 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.7 | 9.4 | 7.0 | 13 | 15 | 19 |
| | (kg/ha) | | 3,442 | 4,218 | 3,134 | 6,017 | 6,534 | 8,653 |
| | (mg/kg) | | 1,537 | 1,883 | 1,399 | 2,686 | 2,917 | 3,863 |
| Exchangeable Magnesium | (cmol+/kg) | | 4.2 | 5.7 | 1.9 | 8.6 | 12 | 18 |
| | (kg/ha) | | 1,155 | 1,565 | 518 | 2,354 | 3,286 | 4,816 |
| | (mg/kg) | | 515 | 698 | 231 | 1,051 | 1,467 | 2,150 |
| Exchangeable Potassium | (cmol+/kg) | | 0.26 | 0.25 | 0.47 | 0.58 | 0.55 | 0.46 |
| | (kg/ha) | | 229 | 216 | 410 | 504 | 483 | 399 |
| | (mg/kg) | | 102 | 96 | 183 | 225 | 216 | 178 |
| Exchangeable Sodium | (cmol+/kg) | | 0.25 | 1.1 | 0.12 | 0.33 | 0.66 | 2.0 |
| | (kg/ha) | | 129 | 586 | 64 | 169 | 341 | 1,055 |
| | (mg/kg) | | 57 | 261 | 28 | 75 | 152 | 471 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.06 | 0.04 | 0.11 | 0.06 | 0.06 | 0.06 |
| | (kg/ha) | | 11 | 9.0 | 23 | 12 | 12 | 12 |
| | (mg/kg) | | 5.0 | 4.0 | 10 | 5.4 | 5.4 | 5.3 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.75 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 17 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 7.5 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 12 | 17 | 10 | 23 | 28 | 40 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 61 | 57 | 68 | 58 | 52 | 49 |
| Magnesium (%) | | | 34 | 35 | 18 | 38 | 43 | 45 |
| Potassium (%) | | | 2.1 | 1.5 | 4.5 | 2.5 | 2.0 | 1.2 |
| Sodium - ESP (%) | | | 2.0 | 6.9 | 1.2 | 1.4 | 2.4 | 5.2 |
| Aluminium (%) | | | 0.45 | 0.27 | 1.1 | 0.26 | 0.22 | 0.15 |
| Hydrogen (%) | | | 0.00 | 0.00 | 7.3 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.8 | 1.6 | 3.7 | 1.6 | 1.2 | 1.1 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 3/4 Dark reddish brown | 10YR 3/2 Very dark greyish brown | 10YR 3/1 Very dark grey | 2.5Y 3/2 Very dark greyish brown | 2.5Y 3/1 Very dark grey | 5Y 4/3 Olive |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 199 | Sample 200 | Sample 201 | Sample 202 | Sample 203 | Sample 204 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 67 40-50cm | 67 65-75cm | 68 0-10cm | 68 20-30cm | 68 40-50cm | 68 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K6461/199 | K6461/200 | K6461/201 | K6461/202 | K6461/203 | K6461/204 |

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: Collingwo
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,
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    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
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
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| | | | Sample 205 | Sample 206 | Sample 207 | Sample 208 | Sample 209 | Sample 210 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 69 0-10cm | 69 20-30cm | 69 40-50cm | 69 65-75cm | 70 0-10cm | 70 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | K6461/205 | K6461/206 | K6461/207 | K6461/208 | K6461/209 | K6461/210 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.79 | 6.56 | 7.07 | 7.58 | 5.84 | 6.73 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.066 | 0.052 | 0.046 | 0.056 | 0.104 | 0.043 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 8.0 | 7.4 | 15 | 19 | 9.0 | 7.0 |
| | (kg/ha) | | 3,573 | 3,344 | 6,611 | 8,405 | 4,021 | 3,129 |
| | (mg/kg) | | 1,595 | 1,493 | 2,951 | 3,752 | 1,795 | 1,397 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.3 | 3.8 | 11 | 16 | 3.2 | 4.5 |
| | (kg/ha) | | 633 | 1,032 | 3,007 | 4,370 | 875 | 1,215 |
| | (mg/kg) | | 282 | 461 | 1,343 | 1,951 | 391 | 543 |
| Exchangeable Potassium | (cmol+/kg) | | 1.4 | 0.86 | 0.81 | 0.57 | 1.1 | 0.59 |
| | (kg/ha) | | 1,185 | 752 | 706 | 495 | 932 | 518 |
| | (mg/kg) | | 529 | 336 | 315 | 221 | 416 | 231 |
| Exchangeable Sodium | (cmol+/kg) | | 0.08 | 0.15 | 0.44 | 0.97 | 0.16 | 0.22 |
| | (kg/ha) | | 43 | 79 | 225 | 500 | 82 | 112 |
| | (mg/kg) | | 19 | 35 | 101 | 223 | 36 | 50 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.07 | 0.04 | 0.07 | 0.05 | 0.06 | 0.06 |
| | (kg/ha) | | 14 | 7.6 | 14 | 9.9 | 13 | 12 |
| | (mg/kg) | | 6.1 | 3.4 | 6.1 | 4.4 | 5.7 | 5.2 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.70 | <0.01 | <0.01 | <0.01 | 0.51 | <0.01 |
| | (kg/ha) | | 16 | <1 | <1 | <1 | 11 | <1 |
| | (mg/kg) | | 7.0 | <1 | <1 | <1 | 5.1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 12 | 12 | 27 | 36 | 14 | 12 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 64 | 61 | 54 | 51 | 64 | 57 |
| Magnesium (%) | | | 19 | 31 | 41 | 44 | 23 | 36 |
| Potassium (%) | | | 11 | 7.0 | 3.0 | 1.6 | 7.6 | 4.8 |
| Sodium - ESP (%) | | | 0.66 | 1.3 | 1.6 | 2.7 | 1.1 | 1.8 |
| Aluminium (%) | | | 0.55 | 0.31 | 0.25 | 0.13 | 0.45 | 0.47 |
| Hydrogen (%) | | | 5.6 | 0.00 | 0.00 | 0.00 | 3.6 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.4 | 2.0 | 1.3 | 1.2 | 2.8 | 1.6 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/2 | 10YR 3/2 | 5YR 3/2 | 5Y 4/2 | 7.5YR 3/3 | 2.5YR 3/6 |
| | | | Dark brown | Very dark greyish brown | Dark reddish brown | Olive grey | Dark brown | Dark red |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 205 | Sample 206 | Sample 207 | Sample 208 | Sample 209 | Sample 210 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 69 0-10cm | 69 20-30cm | 69 40-50cm | 69 65-75cm | 70 0-10cm | 70 20-30cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/205 | K6461/206 | K6461/207 | K6461/208 | K6461/209 | K6461/210 |

**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: Collingwo
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 res
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 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
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CRICOS Provider: 01241G

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ABN: 41 995 651 524

# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 211 | Sample 212 | Sample 213 | Sample 214 | Sample 215 | Sample 216 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 70 40-50cm | 70 65-75cm | 71 0-10cm | 71 20-30cm | 71 40-50cm | 71 65-75cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K6461/211** | **K6461/212** | **K6461/213** | **K6461/214** | **K6461/215** | **K6461/216** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.57 | 8.02 | 5.88 | 6.82 | 6.92 | 7.18 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.036 | 0.057 | 0.064 | 0.033 | 0.056 | 0.041 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 13 | 12 | 13 | 11 | 14 | 14 |
| | (kg/ha) | | 5,758 | 5,586 | 5,830 | 5,105 | 6,290 | 6,468 |
| | (mg/kg) | | 2,571 | 2,494 | 2,603 | 2,279 | 2,808 | 2,887 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 14 | 18 | 3.1 | 4.8 | 13 | 16 |
| | (kg/ha) | | 3,941 | 4,767 | 854 | 1,307 | 3,473 | 4,363 |
| | (mg/kg) | | 1,760 | 2,128 | 381 | 583 | 1,551 | 1,948 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 0.59 | 0.45 | 1.7 | 0.47 | 0.53 | 0.60 |
| | (kg/ha) | | 517 | 390 | 1,490 | 411 | 466 | 522 |
| | (mg/kg) | | 231 | 174 | 665 | 184 | 208 | 233 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.77 | 1.6 | 0.07 | 0.10 | 0.24 | 0.42 |
| | (kg/ha) | | 395 | 814 | 34 | 52 | 126 | 219 |
| | (mg/kg) | | 176 | 363 | 15 | 23 | 56 | 98 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | 0.06 | 0.06 | 0.06 | 0.05 | 0.06 | 0.07 |
| | (kg/ha) | | 12 | 12 | 12 | 9.8 | 13 | 14 |
| | (mg/kg) | | 5.2 | 5.4 | 5.5 | 4.4 | 5.6 | 6.1 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.55 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 12 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 5.5 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 29 | 32 | 19 | 17 | 28 | 32 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 45 | 39 | 70 | 68 | 51 | 46 |
| Magnesium (%) | | | 50 | 55 | 17 | 29 | 46 | 51 |
| Potassium (%) | | | 2.1 | 1.4 | 9.2 | 2.8 | 1.9 | 1.9 |
| Sodium - ESP (%) | | | 2.7 | 4.9 | 0.36 | 0.60 | 0.88 | 1.3 |
| Aluminium (%) | | | 0.20 | 0.19 | 0.33 | 0.29 | 0.22 | 0.21 |
| Hydrogen (%) | | | 0.00 | 0.00 | 3.0 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 0.89 | 0.71 | 4.1 | 2.4 | 1.1 | 0.90 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5YR 4/8 | 2.5YR 3/4 | 10YR 2/2 | 5YR 2.5/2 | 2.5YR 3/4 | 2.5Y 4/4 |
| | | | Red | Dark reddish brown | Very dark brown | Dark reddish brown | Dark reddish brown | Olive brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 211 | Sample 212 | Sample 213 | Sample 214 | Sample 215 | Sample 216 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 70 40-50cm | 70 65-75cm | 71 0-10cm | 71 20-30cm | 71 40-50cm | 71 65-75cm |
| | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K6461/211 | K6461/212 | K6461/213 | K6461/214 | K6461/215 | K6461/216 |

**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: Collingwo
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 res
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
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17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 217 | Sample 218 | Sample 219 | Sample 220 | Sample 221 | Sample 222 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 72 0-10cm | 72 20-30cm | 72 40-50cm | 72 65-75cm | 73 0-10cm | 73 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K6461/217 | K6461/218 | K6461/219 | K6461/220 | K6461/221 | K6461/222 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 4.97 | 6.26 | 6.79 | 7.02 | 5.98 | 6.96 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.058 | 0.014 | 0.013 | 0.013 | 0.050 | 0.031 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 2.5 | 4.5 | 6.7 | 5.3 | 9.7 | 15 |
| | (kg/ha) | | 1,143 | 2,003 | 2,999 | 2,397 | 4,349 | 6,739 |
| | (mg/kg) | | 510 | 894 | 1,339 | 1,070 | 1,941 | 3,008 |
| Exchangeable Magnesium | (cmol+/kg) | | 0.81 | 1.1 | 3.4 | 3.9 | 4.4 | 14 |
| | (kg/ha) | | 220 | 303 | 915 | 1,062 | 1,207 | 3,729 |
| | (mg/kg) | | 98 | 135 | 409 | 474 | 539 | 1,665 |
| Exchangeable Potassium | (cmol+/kg) | | 0.33 | 0.16 | 0.28 | 0.28 | 1.3 | 0.63 |
| | (kg/ha) | | 285 | 142 | 246 | 243 | 1,151 | 552 |
| | (mg/kg) | | 127 | 64 | 110 | 109 | 514 | 246 |
| Exchangeable Sodium | (cmol+/kg) | | 0.08 | 0.08 | 0.07 | 0.07 | 0.09 | 0.21 |
| | (kg/ha) | | 40 | 41 | 35 | 38 | 46 | 109 |
| | (mg/kg) | | 18 | 18 | 16 | 17 | 20 | 49 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.56 | 0.07 | 0.07 | 0.06 | 0.07 | 0.06 |
| | (kg/ha) | | 113 | 14 | 15 | 13 | 13 | 13 |
| | (mg/kg) | | 50 | 6.3 | 6.7 | 5.6 | 5.9 | 5.7 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 1.4 | 0.37 | <0.01 | <0.01 | 0.54 | <0.01 |
| | (kg/ha) | | 32 | 8.2 | <1 | <1 | 12 | <1 |
| | (mg/kg) | | 14 | 3.7 | <1 | <1 | 5.4 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 5.8 | 6.3 | 10 | 9.7 | 16 | 30 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 44 | 71 | 64 | 55 | 60 | 51 |
| Magnesium (%) | | | 14 | 18 | 32 | 40 | 27 | 46 |
| Potassium (%) | | | 5.7 | 2.6 | 2.7 | 2.9 | 8.1 | 2.1 |
| Sodium - ESP (%) | | | 1.4 | 1.3 | 0.65 | 0.77 | 0.55 | 0.71 |
| Aluminium (%) | | | 9.7 | 1.1 | 0.71 | 0.64 | 0.40 | 0.22 |
| Hydrogen (%) | | | 25 | 5.9 | 0.00 | 0.00 | 3.3 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.2 | 4.0 | 2.0 | 1.4 | 2.2 | 1.1 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 3/3 | 10R 3/4 | 2.5YR 4/8 | 2.5YR 4/8 | 7.5YR 2.5/2 | 7.5YR 3/2 |
| | | | Dark brown | Dusky red | Red | Red | Very dark brown | Dark brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 217 | Sample 218 | Sample 219 | Sample 220 | Sample 221 | Sample 222 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 72 0-10cm | 72 20-30cm | 72 40-50cm | 72 65-75cm | 73 0-10cm | 73 20-30cm |
| | | Crop: | Soil | Soil | Soil | Soil | Soil | Soil |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | K6461/217 | K6461/218 | K6461/219 | K6461/220 | K6461/221 | K6461/222 |

**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: Collingwo
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 res
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
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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# AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 223 | Sample 224 | Heavy Soil | Medium Soil | Light Soil | Sandy Soil |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 73 40-50cm | 73 65-75cm | | | | |
| | | Crop: | Soil | Soil | | | | |
| | | Client: | Umwelt | Umwelt | Clay | Clay Loam | Loam | Loamy Sand |
| Parameter | | Method reference | K6461/223 | K6461/224 | Indicative guidelines - refer to Notes 6 and 8 | | | |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.42 | 7.76 | 6.5 | 6.5 | 6.3 | 6.3 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.033 | 0.041 | 0.200 | 0.150 | 0.120 | 0.100 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 18 | 18 | 15.6 | 10.8 | 5.0 | 1.9 |
| | (kg/ha) | | 8,146 | 7,904 | 7000 | 4816 | 2240 | 840 |
| | (mg/kg) | | 3,637 | 3,529 | 3125 | 2150 | 1000 | 375 |
| Exchangeable Magnesium | (cmol+/kg) | | 21 | 23 | 2.4 | 1.7 | 1.2 | 0.60 |
| | (kg/ha) | | 5,701 | 6,309 | 650 | 448 | 325 | 168 |
| | (mg/kg) | | 2,545 | 2,817 | 290 | 200 | 145 | 75 |
| Exchangeable Potassium | (cmol+/kg) | | 0.43 | 0.37 | 0.60 | 0.50 | 0.40 | 0.30 |
| | (kg/ha) | | 380 | 320 | 526 | 426 | 336 | 224 |
| | (mg/kg) | | 170 | 143 | 235 | 190 | 150 | 100 |
| Exchangeable Sodium | (cmol+/kg) | | 0.27 | 0.46 | 0.3 | 0.26 | 0.22 | 0.11 |
| | (kg/ha) | | 140 | 235 | 155 | 134 | 113 | 57 |
| | (mg/kg) | | 62 | 105 | 69 | 60 | 51 | 25 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.04 | 0.06 | 0.6 | 0.5 | 0.4 | 0.2 |
| | (kg/ha) | | 9.0 | 12 | 121 | 101 | 73 | 30 |
| | (mg/kg) | | 4.0 | 5.3 | 54 | 45 | 32 | 14 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.6 | 0.5 | 0.4 | 0.2 |
| | (kg/ha) | | <1 | <1 | 13 | 11 | 8 | 3 |
| | (mg/kg) | | <1 | <1 | 6 | 5 | 4 | 2 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 40 | 42 | 20.1 | 14.3 | 7.8 | 3.3 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 46 | 42 | 77.6 | 75.7 | 65.6 | 57.4 |
| Magnesium (%) | | | 53 | 56 | 11.9 | 11.9 | 15.7 | 18.1 |
| Potassium (%) | | | 1.1 | 0.88 | 3.0 | 3.5 | 5.2 | 9.1 |
| Sodium - ESP (%) | | | 0.68 | 1.1 | 1.5 | 1.8 | 2.9 | 3.3 |
| Aluminium (%) | | | 0.11 | 0.14 | 6.0 | 7.1 | 10.5 | 12.1 |
| Hydrogen (%) | | | 0.00 | 0.00 | | | | |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 0.87 | 0.76 | 6.5 | 6.4 | 4.2 | 3.2 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 4/6 | 5Y 5/4 | .. | | | |
| | | | Dark yellowish brown | Olive | .. | | | |
| Mottles Munsell Colour | | | .. | .. | .. | | | |
| | | | .. | .. | .. | | | |
| Degree of Mottling (%) | | | .. | .. | .. | | | |

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# AGRICULTURAL SOIL ANALYSIS REPORT

224 samples supplied by Minesoils Pty. Ltd. on 3/05/2021 . Lab Job No.K6461
Analysis requested by Clayton Richards. Your Job: MS-051 BSAL
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 223 | Sample 224 | *Heavy Soil* | *Medium Soil* | *Light Soil* | *Sandy Soil* |
|---|---|---|---|---|---|---|---|
| Sample ID: | | 73 40-50cm | 73 65-75cm | | | | |
| Crop: | | Soil | Soil | | | | |
| Client: | | Umwelt | Umwelt | *Clay* | *Clay Loam* | *Loam* | *Loamy Sand* |
| **Parameter** | **Method reference** | **K6461/223** | **K6461/224** | **Indicative guidelines - refer to Notes 6 and 8** | | | |

**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: Collingwo
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 res
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12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimat
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17. This report was issued on 09/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*
KS

## GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

48 soil samples supplied by Minesoils Pty Ltd on 12 July, 2021 - Lab Job No. K9074.
Analysis requested by Clayton Richards. Client reference: MS-051-BSAL Stage2.
PO Box 11034 TAMWORTH NSW 2340

| SAMPLE ID | Lab Code | MOIST MUNSELL COLOUR | | MOISTURE CONTENT (% of water in air-dry 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 ISSS (% of total oven-dry equivalent) | CLAY < 2 µm (% of total oven-dry equivalent) | Total soil fractions (incl. Gravel) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1 0-10** | K9074/1 | 2.5YR 3/3 | dark reddish brown | 22.2% | 2.2% | 0.0% | 2.2% | 12.1% | 48.7% | 18.0% | 19.0% | 100.0% |
| **1 20-30** | K9074/2 | 2.5YR 3/4 | dark reddish brown | 18.4% | 12.1% | 4.5% | 7.6% | 7.2% | 37.4% | 15.1% | 28.3% | 100.0% |
| **1 40-50** | K9074/3 | 2.5Y 5/6 | light olive brown | 22.0% | 1.5% | 0.0% | 1.5% | 4.8% | 22.2% | 16.4% | 55.1% | 100.0% |
| **1 65-75** | K9074/4 | 5Y 4/3 | olive | 17.4% | 2.9% | 2.1% | 0.8% | 5.3% | 21.2% | 12.4% | 58.2% | 100.0% |
| **5 0-10** | K9074/5 | 7.5YR 2.5/3 | very dark brown | 25.2% | 6.2% | 1.8% | 4.4% | 40.4% | 23.8% | 19.8% | 9.8% | 100.0% |
| **5 20-30** | K9074/6 | 5YR 3/2 | dark reddish brown | 14.4% | 5.1% | 0.1% | 5.0% | 39.5% | 15.1% | 24.7% | 15.7% | 100.0% |
| **5 40-50** | K9074/7 | 5YR 3/4 | dark reddish brown | 8.9% | 8.5% | 0.5% | 8.1% | 40.7% | 14.6% | 23.2% | 13.0% | 100.0% |
| **5 65-75** | K9074/8 | 2.5YR 4/8 | red | 7.8% | 7.3% | 0.4% | 6.9% | 45.8% | 11.9% | 19.8% | 15.3% | 100.0% |
| **6 0-10** | K9074/9 | 7.5YR 2.5/3 | very dark brown | 18.5% | 3.7% | 0.0% | 3.7% | 25.6% | 28.8% | 26.6% | 15.3% | 100.0% |
| **6 20-30** | K9074/10 | 10YR 2/2 | very dark brown | 17.2% | 4.3% | 0.0% | 4.3% | 21.3% | 29.6% | 27.1% | 17.7% | 100.0% |
| **6 40-50** | K9074/11 | 5YR 3/4 | dark reddish brown | 14.2% | 11.9% | 0.9% | 11.0% | 25.6% | 26.4% | 20.1% | 16.0% | 100.0% |
| **6 65-75** | K9074/12 | 10YR 3/6 | dark yellowish brown | 11.6% | 7.0% | 1.3% | 5.7% | 21.5% | 31.3% | 22.6% | 17.6% | 100.0% |
| **8 0-10** | K9074/13 | 10YR 2/2 | very dark brown | 17.6% | 1.7% | 0.0% | 1.7% | 6.4% | 48.9% | 21.7% | 21.2% | 100.0% |
| **8 20-30** | K9074/14 | 5YR 3/4 | dark reddish brown | 20.2% | 0.3% | 0.0% | 0.3% | 4.0% | 30.0% | 14.7% | 51.0% | 100.0% |
| **8 40-50** | K9074/15 | 7.5YR 3/2 | dark brown | 23.8% | 0.2% | 0.0% | 0.2% | 2.3% | 20.5% | 14.5% | 62.5% | 100.0% |
| **8 65-75** | K9074/16 | 2.5Y 5/6 | light olive brown | 17.4% | 0.6% | 0.0% | 0.6% | 3.5% | 23.9% | 16.4% | 55.6% | 100.0% |
| **9 0-10** | K9074/17 | 7.5YR 2.5/3 | very dark brown | 20.4% | 3.1% | 0.5% | 2.6% | 8.2% | 40.7% | 24.2% | 23.7% | 100.0% |
| **9 20-30** | K9074/18 | 2.5YR 3/3 | dark reddish brown | 22.2% | 10.4% | 3.4% | 7.0% | 6.9% | 20.9% | 14.4% | 47.3% | 100.0% |
| **9 40-50** | K9074/19 | 5Y 5/6 | olive | 23.2% | 1.1% | 0.0% | 1.1% | 3.9% | 15.6% | 13.1% | 66.3% | 100.0% |
| **9 65-75** | K9074/20 | 2.5Y 4/3 | olive brown | 19.0% | 0.2% | 0.0% | 0.2% | 3.0% | 14.7% | 11.3% | 70.7% | 100.0% |
| **10 0-10** | K9074/21 | 10YR 2/2 | very dark brown | 16.8% | 0.7% | 0.0% | 0.7% | 21.0% | 41.0% | 24.6% | 12.7% | 100.0% |
| **10 20-30** | K9074/22 | 5YR 4/4 | reddish brown | 14.9% | 1.3% | 0.2% | 1.1% | 25.9% | 38.0% | 18.6% | 16.2% | 100.0% |
| **10 40-50** | K9074/23 | 2.5YR 3/3 | dark reddish brown | 15.0% | 2.4% | 0.2% | 2.2% | 21.2% | 38.9% | 15.4% | 22.0% | 100.0% |
| **10 65-75** | K9074/24 | 10YR 2/2 | very dark brown | 16.0% | 0.1% | 0.0% | 0.1% | 15.2% | 39.0% | 16.1% | 29.5% | 100.0% |
| **11 0-10** | K9074/25 | 7.5YR 2.5/2 | very dark brown | 16.1% | 4.8% | 1.9% | 2.8% | 9.3% | 55.6% | 20.3% | 10.0% | 100.0% |
| **11 20-30** | K9074/26 | 5YR 4/4 | reddish brown | 14.1% | 4.8% | 1.8% | 3.0% | 9.3% | 55.0% | 21.8% | 9.1% | 100.0% |
| **11 40-50** | K9074/27 | 10R 4/8 | red | 13.5% | 3.7% | 1.6% | 2.1% | 7.4% | 47.1% | 19.6% | 22.3% | 100.0% |
| **11 65-75** | K9074/28 | 10R 4/8 | red | 16.6% | 5.1% | 1.6% | 3.5% | 5.6% | 33.3% | 15.1% | 40.8% | 100.0% |
| **12 0-10** | K9074/29 | 7.5YR 3/4 | dark brown | 37.4% | 0.1% | 0.0% | 0.1% | 3.8% | 24.2% | 33.6% | 38.4% | 100.0% |
| **12 20-30** | K9074/30 | 2.5YR 4/8 | red | 24.9% | 0.0% | 0.0% | 0.0% | 1.5% | 7.9% | 20.4% | 70.1% | 100.0% |
| **12 40-50** | K9074/31 | 5YR 6/8 | reddish yellow | 21.3% | 0.0% | 0.0% | 0.0% | 1.6% | 11.8% | 25.7% | 60.9% | 100.0% |
| **12 65-75** | K9074/32 | 5YR 5/8 | yellowish red | 22.5% | 0.0% | 0.0% | 0.0% | 1.7% | 6.2% | 25.6% | 66.5% | 100.0% |
| **17 0-10** | K9074/33 | 7.5YR 2.5/2 | very dark brown | 20.8% | 7.1% | 1.7% | 5.3% | 11.4% | 43.6% | 26.1% | 11.8% | 100.0% |
| **17 20-30** | K9074/34 | 10YR 5/8 | yellowish brown | 16.9% | 4.2% | 1.6% | 2.6% | 10.4% | 35.7% | 17.7% | 32.0% | 100.0% |
| **17 40-50** | K9074/35 | 5YR 5/8 | yellowish red | 20.0% | 0.7% | 0.0% | 0.7% | 2.9% | 11.6% | 11.3% | 73.6% | 100.0% |
| **17 65-75** | K9074/36 | 2.5Y 5/6 | light olive brown | 18.4% | 2.8% | 0.7% | 2.1% | 3.1% | 13.1% | 16.5% | 64.5% | 100.0% |
| **18 0-10** | K9074/37 | 10YR 2/2 | very dark brown | 25.9% | 0.8% | 0.0% | 0.8% | 4.4% | 39.3% | 22.1% | 33.5% | 100.0% |
| **18 20-30** | K9074/38 | 10YR 3/2 | very dark greyish browr | 25.9% | 0.5% | 0.0% | 0.5% | 2.6% | 23.3% | 15.3% | 58.4% | 100.0% |
| **18 40-50** | K9074/39 | 5Y 3/2 | dark olive grey | 24.5% | 0.2% | 0.0% | 0.2% | 3.1% | 23.2% | 12.4% | 61.1% | 100.0% |
| **18 65-75** | K9074/40 | 5Y 3/2 | dark olive grey | 22.8% | 0.5% | 0.0% | 0.5% | 3.3% | 25.1% | 11.0% | 60.1% | 100.0% |
| **19 0-10** | K9074/41 | 7.5YR 4/1 | dark grey | 18.2% | 0.7% | 0.0% | 0.7% | 1.5% | 60.2% | 27.9% | 9.7% | 100.0% |
| **19 20-30** | K9074/42 | 2.5Y 4/4 | olive brown | 12.6% | 0.0% | 0.0% | 0.0% | 0.9% | 64.4% | 24.1% | 10.6% | 100.0% |
| **19 40-50** | K9074/43 | 10R 4/8 | red | 21.3% | 0.0% | 0.0% | 0.0% | 0.3% | 28.4% | 10.9% | 60.3% | 100.0% |
| **19 65-75** | K9074/44 | 10R 3/6 | dark red | 19.5% | 0.3% | 0.0% | 0.3% | 0.5% | 33.8% | 15.1% | 50.3% | 100.0% |
| **20 0-10** | K9074/45 | 5YR 4/6 | yellowish red | 17.5% | 0.2% | 0.0% | 0.2% | 2.6% | 62.7% | 19.8% | 14.8% | 100.0% |
| **20 20-30** | K9074/46 | 10R 4/8 | red | 16.0% | 0.0% | 0.0% | 0.0% | 3.0% | 48.6% | 21.1% | 27.2% | 100.0% |
| **20 40-50** | K9074/47 | 10R 3/6 | dark red | 14.4% | 0.1% | 0.0% | 0.1% | 1.3% | 38.0% | 16.9% | 43.7% | 100.0% |
| **20 65-75** | K9074/48 | 10R 4/8 | red | 16.9% | 0.0% | 0.0% | 0.0% | 0.6% | 29.4% | 13.6% | 56.4% | 100.0% |

**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.

4. This report is not to be reproduced except in full. Results only relate to the item tested.

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 30/08/2021

checked: ...............
Graham Lancaster (Nata signatory)
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# AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 12/07/2021. Lab Job No.K9074
Analysis requested by Clayton Richards. Your Job: MS-051-BSAL Stage2
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 1 0-10 | 1 20-30 | 1 40-50 | 1 65-75 | 5 0-10 | 5 20-30 |
| | | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | K9074/1 | K9074/2 | K9074/3 | K9074/4 | K9074/5 | K9074/6 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.35 | 6.65 | 8.03 | 8.53 | 6.50 | 7.01 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.089 | 0.046 | 0.068 | 0.205 | 0.126 | 0.056 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 6.7 | 9.9 | 15 | 25 | 16 | 9.8 |
| | (kg/ha) | | 3,011 | 4,456 | 6,725 | 11,108 | 7,081 | 4,418 |
| | (mg/kg) | | 1,344 | 1,989 | 3,002 | 4,959 | 3,161 | 1,972 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 2.1 | 4.0 | 11 | 16 | 3.3 | 2.0 |
| | (kg/ha) | | 559 | 1,085 | 3,056 | 4,256 | 910 | 557 |
| | (mg/kg) | | 250 | 484 | 1,364 | 1,900 | 406 | 248 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 1.8 | 0.67 | 0.42 | 0.41 | 2.2 | 0.54 |
| | (kg/ha) | | 1,620 | 584 | 364 | 360 | 1,958 | 472 |
| | (mg/kg) | | 723 | 261 | 163 | 161 | 874 | 211 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.11 | 0.14 | 0.72 | 1.1 | 0.13 | 0.22 |
| | (kg/ha) | | 59 | 73 | 371 | 591 | 65 | 114 |
| | (mg/kg) | | 26 | 32 | 166 | 264 | 29 | 51 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | 0.11 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 |
| | (kg/ha) | | 21 | 4.8 | 3.9 | 3.7 | 6.0 | 4.3 |
| | (mg/kg) | | 9.5 | 2.1 | 1.7 | 1.6 | 2.7 | 1.9 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 1.5 | <0.01 | <0.01 | <0.01 | 0.32 | <0.01 |
| | (kg/ha) | | 33 | <1 | <1 | <1 | 7.2 | <1 |
| | (mg/kg) | | 15 | <1 | <1 | <1 | 3.2 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 12 | 15 | 27 | 42 | 22 | 13 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 55 | 67 | 55 | 59 | 72 | 78 |
| Magnesium (%) | | | 17 | 27 | 41 | 37 | 15 | 16 |
| Potassium (%) | | | 15 | 4.5 | 1.5 | 0.98 | 10 | 4.3 |
| Sodium - ESP (%) | | | 0.93 | 0.96 | 2.6 | 2.7 | 0.58 | 1.7 |
| Aluminium (%) | | | 0.86 | 0.16 | 0.07 | 0.04 | 0.14 | 0.17 |
| Hydrogen (%) | | | 12 | 0.00 | 0.00 | 0.00 | 1.5 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 3.3 | 2.5 | 1.3 | 1.6 | 4.7 | 4.8 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 2.5YR 3/3 dark reddish brown | 2.5YR 3/4 dark reddish brown | 2.5Y 5/6 light olive brown | 5Y 4/3 olive | 7.5YR 2.5/3 very dark brown | 5YR 3/2 dark reddish brown |
| | | | .. | .. | .. | .. | .. | .. |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 12/07/2021. Lab Job No.K9074
Analysis requested by Clayton Richards. Your Job: MS-051-BSAL Stage2
PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 1 0-10 | 1 20-30 | 1 40-50 | 1 65-75 | 5 0-10 | 5 20-30 |
| | | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | Parameter | Method reference | K9074/1 | K9074/2 | K9074/3 | K9074/4 | K9074/5 | K9074/6 |

**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 30/07/2021.

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

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

KS

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# AGRICULTURAL SOIL ANALYSIS REPORT

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PO BOX 11034 TAMWORTH NSW 2340

| | | | Sample 7 | Sample 8 | Sample 9 | Sample 10 | Sample 11 | Sample 12 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 5 40-50 | 5 65-75 | 6 0-10 | 6 20-30 | 6 40-50 | 6 65-75 |
| | | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K9074/7** | **K9074/8** | **K9074/9** | **K9074/10** | **K9074/11** | **K9074/12** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.88 | 6.96 | 6.11 | 6.88 | 7.17 | 7.15 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.060 | 0.026 | 0.048 | 0.024 | 0.019 | 0.022 |
| Exchangeable Calcium | (cmol$_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 8.3 | 8.4 | 8.2 | 7.7 | 6.6 | 7.0 |
| | (kg/ha) | | 3,741 | 3,793 | 3,678 | 3,443 | 2,979 | 3,156 |
| | (mg/kg) | | 1,670 | 1,693 | 1,642 | 1,537 | 1,330 | 1,409 |
| Exchangeable Magnesium | (cmol$_+$/kg) | | 2.1 | 2.4 | 1.8 | 2.4 | 3.2 | 3.8 |
| | (kg/ha) | | 581 | 645 | 499 | 663 | 868 | 1,036 |
| | (mg/kg) | | 259 | 288 | 223 | 296 | 388 | 463 |
| Exchangeable Potassium | (cmol$_+$/kg) | | 0.41 | 0.23 | 0.70 | 0.22 | 0.20 | 0.20 |
| | (kg/ha) | | 359 | 203 | 617 | 195 | 177 | 176 |
| | (mg/kg) | | 160 | 90 | 275 | 87 | 79 | 78 |
| Exchangeable Sodium | (cmol$_+$/kg) | | 0.20 | 0.34 | 0.28 | 0.14 | 0.17 | 0.19 |
| | (kg/ha) | | 104 | 176 | 142 | 70 | 89 | 99 |
| | (mg/kg) | | 47 | 79 | 63 | 31 | 40 | 44 |
| Exchangeable Aluminium | (cmol$_+$/kg) | **Inhouse S37 (KCl) | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | (kg/ha) | | 4.5 | 3.8 | 3.6 | 3.4 | 3.4 | 3.6 |
| | (mg/kg) | | 2.0 | 1.7 | 1.6 | 1.5 | 1.5 | 1.6 |
| Exchangeable Hydrogen | (cmol$_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.25 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 5.5 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 2.5 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg) | 11 | 11 | 11 | 10 | 10 | 11 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100 | 75 | 74 | 73 | 73 | 65 | 63 |
| Magnesium (%) | | | 19 | 21 | 16 | 23 | 31 | 34 |
| Potassium (%) | | | 3.7 | 2.0 | 6.2 | 2.1 | 2.0 | 1.8 |
| Sodium - ESP (%) | | | 1.8 | 3.0 | 2.4 | 1.3 | 1.7 | 1.7 |
| Aluminium (%) | | | 0.20 | 0.17 | 0.16 | 0.16 | 0.16 | 0.16 |
| Hydrogen (%) | | | 0.00 | 0.00 | 2.2 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol$_+$/kg) | 3.9 | 3.6 | 4.5 | 3.2 | 2.1 | 1.8 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 3/4 dark reddish brown | 2.5YR 4/8 red | 7.5YR 2.5/3 very dark brown | 10YR 2/2 very dark brown | 5YR 3/4 dark reddish brown | 10YR 3/6 dark yellowish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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# AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Clayton Richards. Your Job: MS-051-BSAL Stage2
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 7 | Sample 8 | Sample 9 | Sample 10 | Sample 11 | Sample 12 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 5 40-50 | 5 65-75 | 6 0-10 | 6 20-30 | 6 40-50 | 6 65-75 |
| | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K9074/7 | K9074/8 | K9074/9 | K9074/10 | K9074/11 | K9074/12 |

**Notes:**

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2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwo
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
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6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
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17. This report was issued on 30/07/2021.

*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

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# AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 12/07/2021. Lab Job No.K9074
Analysis requested by Clayton Richards. Your Job: MS-051-BSAL Stage2
PO BOX 11034 TAMWORTH NSW 2340

| Parameter | | Method reference | Sample 13 | Sample 14 | Sample 15 | Sample 16 | Sample 17 | Sample 18 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 8 0-10 | 8 20-30 | 8 40-50 | 8 65-75 | 9 0-10 | 9 20-30 |
| | | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K9074/13 | K9074/14 | K9074/15 | K9074/16 | K9074/17 | K9074/18 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.99 | 6.82 | 7.30 | 7.66 | 5.66 | 7.18 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.039 | 0.023 | 0.048 | 0.055 | 0.047 | 0.048 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 7.2 | 14 | 16 | 14 | 8.7 | 13 |
| | (kg/ha) | | 3,215 | 6,411 | 7,072 | 6,458 | 3,926 | 5,978 |
| | (mg/kg) | | 1,435 | 2,862 | 3,157 | 2,883 | 1,753 | 2,669 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.6 | 6.9 | 9.5 | 11 | 2.9 | 6.1 |
| | (kg/ha) | | 694 | 1,873 | 2,594 | 2,867 | 791 | 1,668 |
| | (mg/kg) | | 310 | 836 | 1,158 | 1,280 | 353 | 744 |
| Exchangeable Potassium | (cmol+/kg) | | 0.24 | 0.34 | 0.39 | 0.39 | 1.1 | 0.95 |
| | (kg/ha) | | 209 | 298 | 339 | 340 | 940 | 831 |
| | (mg/kg) | | 94 | 133 | 151 | 152 | 420 | 371 |
| Exchangeable Sodium | (cmol+/kg) | | 0.19 | 0.22 | 0.31 | 0.54 | 0.16 | 0.25 |
| | (kg/ha) | | 96 | 116 | 158 | 278 | 82 | 131 |
| | (mg/kg) | | 43 | 52 | 70 | 124 | 37 | 59 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.03 | 0.02 | 0.02 | 0.02 | 0.04 | 0.03 |
| | (kg/ha) | | 5.3 | 4.2 | 3.7 | 3.8 | 8.6 | 5.7 |
| | (mg/kg) | | 2.4 | 1.9 | 1.7 | 1.7 | 3.8 | 2.6 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.43 | <0.01 | <0.01 | <0.01 | 0.90 | <0.01 |
| | (kg/ha) | | 9.7 | <1 | <1 | <1 | 20 | <1 |
| | (mg/kg) | | 4.3 | <1 | <1 | <1 | 9.0 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 11 | 22 | 26 | 26 | 14 | 21 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 68 | 66 | 61 | 56 | 63 | 64 |
| Magnesium (%) | | | 24 | 32 | 37 | 41 | 21 | 30 |
| Potassium (%) | | | 2.3 | 1.6 | 1.5 | 1.5 | 7.8 | 4.6 |
| Sodium - ESP (%) | | | 1.8 | 1.0 | 1.2 | 2.1 | 1.1 | 1.2 |
| Aluminium (%) | | | 0.25 | 0.10 | 0.07 | 0.07 | 0.31 | 0.14 |
| Hydrogen (%) | | | 4.1 | 0.00 | 0.00 | 0.00 | 6.5 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 2.8 | 2.1 | 1.7 | 1.4 | 3.0 | 2.2 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 2/2 | 5YR 3/4 | 7.5YR 3/2 | 2.5Y 5/6 | 7.5YR 2.5/3 | 2.5YR 3/3 |
| | | | very dark brown | dark reddish brown | dark brown | light olive brown | very dark brown | dark reddish brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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| | | Sample 13 | Sample 14 | Sample 15 | Sample 16 | Sample 17 | Sample 18 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 8 0-10 | 8 20-30 | 8 40-50 | 8 65-75 | 9 0-10 | 9 20-30 |
| | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K9074/13 | K9074/14 | K9074/15 | K9074/16 | K9074/17 | K9074/18 |

**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: Collingwo
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 res
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
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| | | | Sample 19 | Sample 20 | Sample 21 | Sample 22 | Sample 23 | Sample 24 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 9 40-50 | 9 65-75 | 10 0-10 | 10 20-30 | 10 40-50 | 10 65-75 |
| | | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | | **Method reference** | **K9074/19** | **K9074/20** | **K9074/21** | **K9074/22** | **K9074/23** | **K9074/24** |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 7.94 | 8.43 | 5.97 | 6.62 | 6.90 | 7.13 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.057 | 0.094 | 0.037 | 0.055 | 0.041 | 0.026 |
| Exchangeable Calcium | ($cmol_+$/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 16 | 17 | 6.5 | 7.0 | 9.4 | 12 |
| | (kg/ha) | | 7,228 | 7,776 | 2,916 | 3,151 | 4,228 | 5,270 |
| | (mg/kg) | | 3,227 | 3,472 | 1,302 | 1,407 | 1,888 | 2,353 |
| Exchangeable Magnesium | ($cmol_+$/kg) | | 10 | 13 | 1.3 | 1.1 | 1.8 | 2.5 |
| | (kg/ha) | | 2,754 | 3,587 | 350 | 313 | 483 | 690 |
| | (mg/kg) | | 1,229 | 1,601 | 156 | 140 | 216 | 308 |
| Exchangeable Potassium | ($cmol_+$/kg) | | 0.49 | 0.48 | 0.60 | 0.37 | 0.38 | 0.41 |
| | (kg/ha) | | 426 | 421 | 521 | 321 | 332 | 357 |
| | (mg/kg) | | 190 | 188 | 233 | 143 | 148 | 159 |
| Exchangeable Sodium | ($cmol_+$/kg) | | 0.45 | 0.83 | 0.11 | 0.11 | 0.12 | 0.15 |
| | (kg/ha) | | 231 | 427 | 55 | 57 | 60 | 79 |
| | (mg/kg) | | 103 | 191 | 25 | 26 | 27 | 35 |
| Exchangeable Aluminium | ($cmol_+$/kg) | **Inhouse S37 (KCl) | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 |
| | (kg/ha) | | 5.8 | 5.4 | 5.2 | 5.5 | 6.0 | 8.7 |
| | (mg/kg) | | 2.6 | 2.4 | 2.3 | 2.5 | 2.7 | 3.9 |
| Exchangeable Hydrogen | ($cmol_+$/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.57 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 13 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 5.7 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) ($cmol_+$/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H ($cmol_+$/kg) | 27 | 32 | 9.1 | 8.7 | 12 | 15 |
| Calcium (%) | | **Base Saturation Calculations - Cation $cmol_+$/kg / ECEC x 100 | 59 | 54 | 72 | 81 | 80 | 79 |
| Magnesium (%) | | | 37 | 41 | 14 | 13 | 15 | 17 |
| Potassium (%) | | | 1.8 | 1.5 | 6.6 | 4.2 | 3.2 | 2.7 |
| Sodium - ESP (%) | | | 1.6 | 2.6 | 1.2 | 1.3 | 1.0 | 1.0 |
| Aluminium (%) | | | 0.11 | 0.08 | 0.28 | 0.31 | 0.25 | 0.29 |
| Hydrogen (%) | | | 0.00 | 0.00 | 6.2 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium ($cmol_+$/kg) | 1.6 | 1.3 | 5.1 | 6.1 | 5.3 | 4.6 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5Y 5/6 | 2.5Y 4/3 | 10YR 2/2 | 5YR 4/4 | 2.5YR 3/3 | 10YR 2/2 |
| | | | olive | olive brown | very dark brown | reddish brown | dark reddish brown | very dark brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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| | | Sample 19 | Sample 20 | Sample 21 | Sample 22 | Sample 23 | Sample 24 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 9 40-50 | 9 65-75 | 10 0-10 | 10 20-30 | 10 40-50 | 10 65-75 |
| | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K9074/19 | K9074/20 | K9074/21 | K9074/22 | K9074/23 | K9074/24 |

**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: Collingwo
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| Parameter | | Method reference | Sample 25 | Sample 26 | Sample 27 | Sample 28 | Sample 29 | Sample 30 |
|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | 11 0-10 | 11 20-30 | 11 40-50 | 11 65-75 | 12 0-10 | 12 20-30 |
| Crop: | | | N/G | N/G | N/G | N/G | N/G | N/G |
| Client: | | | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K9074/25 | K9074/26 | K9074/27 | K9074/28 | K9074/29 | K9074/30 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 4.77 | 5.18 | 5.65 | 5.74 | 5.95 | 6.41 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.033 | 0.017 | 0.017 | 0.017 | 0.084 | 0.049 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 1.2 | 1.5 | 2.1 | 2.9 | 17 | 24 |
| | (kg/ha) | | 554 | 660 | 964 | 1,291 | 7,696 | 10,975 |
| | (mg/kg) | | 247 | 295 | 431 | 576 | 3,436 | 4,900 |
| Exchangeable Magnesium | (cmol+/kg) | | 0.44 | 0.44 | 1.7 | 3.7 | 7.6 | 11 |
| | (kg/ha) | | 120 | 120 | 476 | 1,007 | 2,078 | 2,944 |
| | (mg/kg) | | 54 | 54 | 212 | 449 | 928 | 1,314 |
| Exchangeable Potassium | (cmol+/kg) | | 0.34 | 0.18 | 0.18 | 0.25 | 1.8 | 0.73 |
| | (kg/ha) | | 296 | 155 | 155 | 217 | 1,541 | 639 |
| | (mg/kg) | | 132 | 69 | 69 | 97 | 688 | 285 |
| Exchangeable Sodium | (cmol+/kg) | | <0.065 | <0.065 | 0.08 | 0.19 | 0.27 | 0.36 |
| | (kg/ha) | | <33 | <33 | 43 | 96 | 139 | 186 |
| | (mg/kg) | | <15 | <15 | 19 | 43 | 62 | 83 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.92 | 0.35 | 0.13 | 0.18 | 0.05 | 0.05 |
| | (kg/ha) | | 185 | 70 | 27 | 37 | 9.5 | 11 |
| | (mg/kg) | | 83 | 31 | 12 | 16 | 4.3 | 4.8 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 3.4 | 1.7 | 0.96 | 1.1 | 0.82 | 0.63 |
| | (kg/ha) | | 77 | 39 | 22 | 25 | 18 | 14 |
| | (mg/kg) | | 34 | 17 | 9.6 | 11 | 8.2 | 6.3 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 6.4 | 4.2 | 5.3 | 8.3 | 28 | 37 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 19 | 35 | 41 | 35 | 62 | 66 |
| Magnesium (%) | | | 6.9 | 11 | 33 | 45 | 28 | 29 |
| Potassium (%) | | | 5.3 | 4.2 | 3.4 | 3.0 | 6.4 | 2.0 |
| Sodium - ESP (%) | | | 0.26 | 0.68 | 1.6 | 2.2 | 0.98 | 0.97 |
| Aluminium (%) | | | 14 | 8.2 | 2.5 | 2.2 | 0.17 | 0.14 |
| Hydrogen (%) | | | 54 | 41 | 18 | 13 | 3.0 | 1.7 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 2.8 | 3.3 | 1.2 | 0.78 | 2.2 | 2.3 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 7.5YR 2.5/2 | 5YR 4/4 | 10R 4/8 | 10R 4/8 | 7.5YR 3/4 | 2.5YR 4/8 |
| | | | very dark brown | reddish brown | red | red | dark brown | red |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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| | | Sample 25 | Sample 26 | Sample 27 | Sample 28 | Sample 29 | Sample 30 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 11 0-10 | 11 20-30 | 11 40-50 | 11 65-75 | 12 0-10 | 12 20-30 |
| | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K9074/25 | K9074/26 | K9074/27 | K9074/28 | K9074/29 | K9074/30 |

**Notes:**

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| | | | Sample 31 | Sample 32 | Sample 33 | Sample 34 | Sample 35 | Sample 36 |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID: | 12 40-50 | 12 65-75 | 17 0-10 | 17 20-30 | 17 40-50 | 17 65-75 |
| | | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | | Method reference | K9074/31 | K9074/32 | K9074/33 | K9074/34 | K9074/35 | K9074/36 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.69 | 6.73 | 5.67 | 7.37 | 8.05 | 8.21 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.053 | 0.057 | 0.057 | 0.067 | 0.060 | 0.074 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 24 | 25 | 7.9 | 10 | 18 | 17 |
| | (kg/ha) | | 10,610 | 11,121 | 3,527 | 4,611 | 8,245 | 7,669 |
| | (mg/kg) | | 4,737 | 4,965 | 1,575 | 2,059 | 3,681 | 3,424 |
| Exchangeable Magnesium | (cmol+/kg) | | 11 | 12 | 1.2 | 3.2 | 11 | 13 |
| | (kg/ha) | | 3,128 | 3,309 | 329 | 870 | 2,877 | 3,589 |
| | (mg/kg) | | 1,396 | 1,477 | 147 | 388 | 1,284 | 1,602 |
| Exchangeable Potassium | (cmol+/kg) | | 0.31 | 0.24 | 0.81 | 0.25 | 0.48 | 0.36 |
| | (kg/ha) | | 268 | 211 | 710 | 221 | 422 | 316 |
| | (mg/kg) | | 120 | 94 | 317 | 99 | 188 | 141 |
| Exchangeable Sodium | (cmol+/kg) | | 0.53 | 0.59 | 0.13 | 0.10 | 0.31 | 0.52 |
| | (kg/ha) | | 274 | 304 | 66 | 51 | 158 | 269 |
| | (mg/kg) | | 122 | 136 | 30 | 23 | 70 | 120 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.06 | 0.06 | 0.04 | 0.03 | 0.03 | 0.03 |
| | (kg/ha) | | 11 | 11 | 8.5 | 6.3 | 6.4 | 6.3 |
| | (mg/kg) | | 5.0 | 5.0 | 3.8 | 2.8 | 2.8 | 2.8 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | <0.01 | <0.01 | 0.87 | <0.01 | <0.01 | <0.01 |
| | (kg/ha) | | <1 | <1 | 19 | <1 | <1 | <1 |
| | (mg/kg) | | <1 | <1 | 8.7 | <1 | <1 | <1 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 36 | 38 | 11 | 14 | 30 | 31 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 66 | 66 | 72 | 74 | 62 | 55 |
| Magnesium (%) | | | 32 | 32 | 11 | 23 | 36 | 42 |
| Potassium (%) | | | 0.85 | 0.64 | 7.4 | 1.8 | 1.6 | 1.2 |
| Sodium - ESP (%) | | | 1.5 | 1.6 | 1.2 | 0.71 | 1.0 | 1.7 |
| Aluminium (%) | | | 0.15 | 0.15 | 0.39 | 0.23 | 0.11 | 0.10 |
| Hydrogen (%) | | | 0.00 | 0.00 | 7.9 | 0.00 | 0.00 | 0.00 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 2.1 | 2.0 | 6.5 | 3.2 | 1.7 | 1.3 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 5YR 6/8 | 5YR 5/8 | 7.5YR 2.5/2 | 10YR 5/8 | 5YR 5/8 | 2.5Y 5/6 |
| | | | reddish yellow | yellowish red | very dark brown | yellowish brown | yellowish red | light olive brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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## AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 12/07/2021. Lab Job No.K9074
Analysis requested by Clayton Richards. Your Job: MS-051-BSAL Stage2
PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 31 | Sample 32 | Sample 33 | Sample 34 | Sample 35 | Sample 36 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 12 40-50 | 12 65-75 | 17 0-10 | 17 20-30 | 17 40-50 | 17 65-75 |
| | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K9074/31 | K9074/32 | K9074/33 | K9074/34 | K9074/35 | K9074/36 |

**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: Collingwo
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,
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*Agricultural Co-Ordinator* KS

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| Parameter | Unit | Method reference | Sample 37 | Sample 38 | Sample 39 | Sample 40 | Sample 41 | Sample 42 |
|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | 18 0-10 | 18 20-30 | 18 40-50 | 18 65-75 | 19 0-10 | 19 20-30 |
| Crop: | | | N/G | N/G | N/G | N/G | N/G | N/G |
| Client: | | | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K9074/37 | K9074/38 | K9074/39 | K9074/40 | K9074/41 | K9074/42 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.14 | 7.16 | 8.38 | 8.46 | 6.00 | 6.02 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.055 | 0.039 | 0.074 | 0.089 | 0.035 | 0.016 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 17 | 22 | 24 | 22 | 2.3 | 0.80 |
| | (kg/ha) | | 7,530 | 9,972 | 10,865 | 10,039 | 1,046 | 358 |
| | (mg/kg) | | 3,362 | 4,452 | 4,851 | 4,482 | 467 | 160 |
| Exchangeable Magnesium | (cmol+/kg) | | 5.3 | 7.4 | 12 | 14 | 0.76 | 0.39 |
| | (kg/ha) | | 1,451 | 2,022 | 3,348 | 3,811 | 206 | 107 |
| | (mg/kg) | | 648 | 903 | 1,494 | 1,701 | 92 | 48 |
| Exchangeable Potassium | (cmol+/kg) | | 0.52 | 0.48 | 0.44 | 0.42 | 0.55 | 0.35 |
| | (kg/ha) | | 456 | 423 | 384 | 364 | 480 | 311 |
| | (mg/kg) | | 204 | 189 | 172 | 163 | 215 | 139 |
| Exchangeable Sodium | (cmol+/kg) | | 0.36 | 0.20 | 0.44 | 0.76 | <0.065 | <0.065 |
| | (kg/ha) | | 183 | 102 | 225 | 393 | <33 | <33 |
| | (mg/kg) | | 82 | 46 | 100 | 176 | <15 | <15 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.04 | 0.03 | 0.03 | 0.03 | 0.05 | 0.05 |
| | (kg/ha) | | 7.8 | 6.8 | 6.6 | 6.7 | 9.2 | 11 |
| | (mg/kg) | | 3.5 | 3.0 | 3.0 | 3.0 | 4.1 | 4.9 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.47 | <0.01 | <0.01 | <0.01 | 0.59 | 0.38 |
| | (kg/ha) | | 11 | <1 | <1 | <1 | 13 | 8.5 |
| | (mg/kg) | | 4.7 | <1 | <1 | <1 | 5.9 | 3.8 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 23 | 30 | 37 | 38 | 4.3 | 2.0 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 71 | 73 | 65 | 60 | 54 | 40 |
| Magnesium (%) | | | 23 | 24 | 33 | 37 | 17 | 20 |
| Potassium (%) | | | 2.2 | 1.6 | 1.2 | 1.1 | 13 | 18 |
| Sodium - ESP (%) | | | 1.5 | 0.65 | 1.2 | 2.0 | 1.1 | 1.3 |
| Aluminium (%) | | | 0.17 | 0.11 | 0.09 | 0.09 | 1.1 | 2.7 |
| Hydrogen (%) | | | 2.0 | 0.00 | 0.00 | 0.00 | 14 | 19 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 3.1 | 3.0 | 2.0 | 1.6 | 3.1 | 2.0 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10YR 2/2 | 10YR 3/2 | 5Y 3/2 | 5Y 3/2 | 7.5YR 4/1 | 2.5Y 4/4 |
| | | | very dark brown | very dark greyish brown | dark olive grey | dark olive grey | dark grey | olive brown |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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PO BOX 11034 TAMWORTH NSW 2340

| | | Sample 37 | Sample 38 | Sample 39 | Sample 40 | Sample 41 | Sample 42 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 18 0-10 | 18 20-30 | 18 40-50 | 18 65-75 | 19 0-10 | 19 20-30 |
| | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| **Parameter** | **Method reference** | K9074/37 | K9074/38 | K9074/39 | K9074/40 | K9074/41 | K9074/42 |

**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: Collingwo
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,
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9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil res
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
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| Parameter | Unit | Method reference | Sample 43 | Sample 44 | Sample 45 | Sample 46 | Sample 47 | Sample 48 |
|---|---|---|---|---|---|---|---|---|
| Sample ID: | | | 19 40-50 | 19 65-75 | 20 0-10 | 20 20-30 | 20 40-50 | 20 65-75 |
| Crop: | | | N/G | N/G | N/G | N/G | N/G | N/G |
| Client: | | | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| | | | K9074/43 | K9074/44 | K9074/45 | K9074/46 | K9074/47 | K9074/48 |
| pH | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 5.77 | 5.88 | 5.30 | 5.86 | 5.96 | 6.05 |
| Electrical Conductivity (dS/m) | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.021 | 0.009 | 0.049 | 0.023 | 0.023 | 0.013 |
| Exchangeable Calcium | (cmol+/kg) | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 4.4 | 3.9 | 2.2 | 4.4 | 5.8 | 5.7 |
| | (kg/ha) | | 1,978 | 1,755 | 978 | 1,993 | 2,613 | 2,577 |
| | (mg/kg) | | 883 | 783 | 437 | 890 | 1,167 | 1,151 |
| Exchangeable Magnesium | (cmol+/kg) | | 2.3 | 2.9 | 0.84 | 0.92 | 1.8 | 3.2 |
| | (kg/ha) | | 625 | 793 | 230 | 249 | 493 | 871 |
| | (mg/kg) | | 279 | 354 | 103 | 111 | 220 | 389 |
| Exchangeable Potassium | (cmol+/kg) | | 1.7 | 0.85 | 0.59 | 0.34 | 0.32 | 0.47 |
| | (kg/ha) | | 1,456 | 742 | 513 | 301 | 276 | 408 |
| | (mg/kg) | | 650 | 331 | 229 | 134 | 123 | 182 |
| Exchangeable Sodium | (cmol+/kg) | | 0.07 | <0.065 | <0.065 | <0.065 | 0.10 | 0.09 |
| | (kg/ha) | | 35 | <33 | <33 | <33 | 49 | 45 |
| | (mg/kg) | | 16 | <15 | <15 | <15 | 22 | 20 |
| Exchangeable Aluminium | (cmol+/kg) | **Inhouse S37 (KCl) | 0.07 | 0.05 | 0.18 | 0.05 | 0.05 | 0.05 |
| | (kg/ha) | | 15 | 9.8 | 36 | 11 | 11 | 11 |
| | (mg/kg) | | 6.5 | 4.4 | 16 | 4.9 | 4.8 | 4.8 |
| Exchangeable Hydrogen | (cmol+/kg) | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.34 | 0.18 | 1.4 | 0.53 | 0.22 | 0.14 |
| | (kg/ha) | | 7.7 | 4.1 | 32 | 12 | 4.9 | 3.1 |
| | (mg/kg) | | 3.4 | 1.8 | 14 | 5.3 | 2.2 | 1.4 |
| Effective Cation Exchange Capacity (ECEC) (cmol+/kg) | | **Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg) | 8.8 | 8.0 | 5.2 | 6.3 | 8.3 | 9.7 |
| Calcium (%) | | **Base Saturation Calculations - Cation cmol+/kg / ECEC x 100 | 50 | 49 | 42 | 70 | 70 | 59 |
| Magnesium (%) | | | 26 | 37 | 16 | 14 | 22 | 33 |
| Potassium (%) | | | 19 | 11 | 11 | 5.4 | 3.8 | 4.8 |
| Sodium - ESP (%) | | | 0.77 | 0.78 | 0.83 | 0.85 | 1.2 | 0.91 |
| Aluminium (%) | | | 0.81 | 0.61 | 3.4 | 0.87 | 0.64 | 0.56 |
| Hydrogen (%) | | | 3.9 | 2.3 | 27 | 8.3 | 2.6 | 1.5 |
| Calcium/Magnesium Ratio | | **Calculation: Calcium / Magnesium (cmol+/kg) | 1.9 | 1.3 | 2.6 | 4.8 | 3.2 | 1.8 |
| Moist Munsell Colour | | **Inhouse Munsell Soil Colour Classification | 10R 4/8 | 10R 3/6 | 5YR 4/6 | 10R 4/8 | 10R 3/6 | 10R 4/8 |
| | | | red | dark red | yellowish red | red | dark red | red |
| Mottles Munsell Colour | | | .. | .. | .. | .. | .. | .. |
| | | | .. | .. | .. | .. | .. | .. |
| Degree of Mottling (%) | | | .. | .. | .. | .. | .. | .. |

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| | | Sample 43 | Sample 44 | Sample 45 | Sample 46 | Sample 47 | Sample 48 |
|---|---|---|---|---|---|---|---|
| | Sample ID: | 19 40-50 | 19 65-75 | 20 0-10 | 20 20-30 | 20 40-50 | 20 65-75 |
| | Crop: | N/G | N/G | N/G | N/G | N/G | N/G |
| | Client: | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt | Umwelt |
| Parameter | Method reference | K9074/43 | K9074/44 | K9074/45 | K9074/46 | K9074/47 | K9074/48 |

**Notes:**

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
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5. Guidelines for phosphorus have been reduced for Australian soils.
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7. Total Acid Extractable Nutrients indicate a store of nutrients.
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator*

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| | | | Heavy Soil | Medium Soil | Light Soil | Sandy Soil |
|---|---|---|---|---|---|---|
| | | Sample ID: | | | | |
| | | Crop: | | | | |
| | | Client: | Clay | Clay Loam | Loam | Loamy Sand |
| **Parameter** | | **Method reference** | **Indicative guidelines - refer to Notes 6 and 8** | | | |
| **pH** | | Rayment & Lyons 2011 - 4A1 (1:5 Water) | 6.5 | 6.5 | 6.3 | 6.3 |
| **Electrical Conductivity (dS/m)** | | Rayment & Lyons 2011 - 3A1 (1:5 Water) | 0.200 | 0.150 | 0.120 | 0.100 |
| **Exchangeable Calcium** | **($cmol_+/kg$)** | Rayment & Lyons 2011 - 15D3 (Ammonium Acetate) | 15.6 | 10.8 | 5.0 | 1.9 |
| | **(kg/ha)** | | 7000 | 4816 | 2240 | 840 |
| | **(mg/kg)** | | 3125 | 2150 | 1000 | 375 |
| **Exchangeable Magnesium** | **($cmol_+/kg$)** | | 2.4 | 1.7 | 1.2 | 0.60 |
| | **(kg/ha)** | | 650 | 448 | 325 | 168 |
| | **(mg/kg)** | | 290 | 200 | 145 | 75 |
| **Exchangeable Potassium** | **($cmol_+/kg$)** | | 0.60 | 0.50 | 0.40 | 0.30 |
| | **(kg/ha)** | | 526 | 426 | 336 | 224 |
| | **(mg/kg)** | | 235 | 190 | 150 | 100 |
| **Exchangeable Sodium** | **($cmol_+/kg$)** | | 0.3 | 0.26 | 0.22 | 0.11 |
| | **(kg/ha)** | | 155 | 134 | 113 | 57 |
| | **(mg/kg)** | | 69 | 60 | 51 | 25 |
| **Exchangeable Aluminium** | **($cmol_+/kg$)** | **Inhouse S37 (KCl) | 0.6 | 0.5 | 0.4 | 0.2 |
| | **(kg/ha)** | | 121 | 101 | 73 | 30 |
| | **(mg/kg)** | | 54 | 45 | 32 | 14 |
| **Exchangeable Hydrogen** | **($cmol_+/kg$)** | **Rayment & Lyons 2011 - 15G1 (Acidity Titration) | 0.6 | 0.5 | 0.4 | 0.2 |
| | **(kg/ha)** | | 13 | 11 | 8 | 3 |
| | **(mg/kg)** | | 6 | 5 | 4 | 2 |
| **Effective Cation Exchange Capacity (ECEC) ($cmol_+/kg$)** | | **Calculation: Sum of Ca,Mg,K,Na,Al,H ($cmol_+/kg$) | 20.1 | 14.3 | 7.8 | 3.3 |
| **Calcium (%)** | | **Base Saturation Calculations - Cation $cmol_+/kg$ / ECEC x 100 | 77.6 | 75.7 | 65.6 | 57.4 |
| **Magnesium (%)** | | | 11.9 | 11.9 | 15.7 | 18.1 |
| **Potassium (%)** | | | 3.0 | 3.5 | 5.2 | 9.1 |
| **Sodium - ESP (%)** | | | 1.5 | 1.8 | 2.9 | 3.3 |
| **Aluminium (%)**<br>**Hydrogen (%)** | | | 6.0 | 7.1 | 10.5 | 12.1 |
| **Calcium/Magnesium Ratio** | | **Calculation: Calcium / Magnesium ($cmol_+/kg$) | 6.5 | 6.4 | 4.2 | 3.2 |
| **Moist Munsell Colour** | | **Inhouse Munsell Soil Colour Classification | .. | | | |
| | | | .. | | | |
| **Mottles Munsell Colour** | | | .. | | | |
| | | | .. | | | |
| **Degree of Mottling (%)** | | | .. | | | |

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PO BOX 11034 TAMWORTH NSW 2340

| | | | Heavy Soil | Medium Soil | Light Soil | Sandy Soil |
|---|---|---|---|---|---|---|
| | | Sample ID: | | | | |
| | | Crop: | | | | |
| | | Client: | Clay | Clay Loam | Loam | Loamy Sand |
| | Parameter | Method reference | Indicative guidelines - refer to Notes 6 and 8 | | | |

**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: Collingwo
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.
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*Quality Checked: Kris Saville*
*Agricultural Co-Ordinator* KS

# Appendix 4
Land and Soil Capability Assessment Ratings

## Table 5: LSC Parameters and overall Class

| | Hazard Criteria | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Overall |
| | Water erosion | Wind erosion | Structure | Acidity | Salinity | Water-logging | Soil depth | Movement | Class |
| **C1** | 3 | 3 | 4 | 4 | 1 | 2 | 1 | 1 | **4** |
| **C2** | 3 | 4 | 4 | 3 | 1 | 1 | 1 | 1 | **4** |
| **C3** | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | **4** |
| **C4** | 3 | 3 | 4 | 4 | 1 | 1 | 1 | 1 | **4** |
| **C5** | 3 | 3 | 4 | 4 | 1 | 2 | 1 | 1 | **4** |
| **C6** | 3 | 3 | 4 | 4 | 1 | 2 | 1 | 1 | **4** |
| **C7** | 3 | 4 | 4 | 3 | 1 | 1 | 1 | 1 | **4** |
| **C8** | 3 | 4 | 3 | 3 | 1 | 1 | 6 | 1 | **6** |
| **C9** | 2 | 4 | 3 | 3 | 1 | 2 | 4 | 1 | **4** |
| **C10** | 2 | 4 | 4 | 4 | 1 | 1 | 1 | 1 | **4** |
| **C11** | 3 | 3 | 4 | 4 | 1 | 2 | 1 | 1 | **4** |
| **C12** | 3 | 3 | 4 | 4 | 1 | 1 | 1 | 1 | **4** |
| **C13** | 3 | 3 | 4 | 4 | 1 | 1 | 1 | 1 | **4** |
| **C14** | 4 | 3 | 3 | 3 | 1 | 4 | 4 | 1 | **4** |
| **C15** | - | - | - | - | - | - | - | - | **-** |
| **C16** | 4 | 3 | 3 | 3 | 1 | 4 | 1 | 1 | **4** |
| **C22** | 3 | 3 | 4 | 4 | 1 | 2 | 1 | 1 | **4** |
| **C23** | 3 | 3 | 3 | 3 | 1 | 1 | 4 | 1 | **4** |
| **C24** | 3 | 4 | 4 | 3 | 1 | 1 | 1 | 1 | **4** |
| **C25** | 2 | 3 | 3 | 4 | 1 | 4 | 1 | 1 | **4** |
| **C26** | 3 | 3 | 4 | 4 | 1 | 2 | 1 | 1 | **4** |
| **C28** | 1 | 2 | 4 | 4 | 1 | 4 | 1 | 1 | **4** |
| **C29** | 3 | 3 | 4 | 5 | 1 | 2 | 1 | 1 | **5** |
| **C30** | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | **3** |
| **C31** | 3 | 3 | 4 | 4 | 1 | 1 | 1 | 1 | **4** |
| **C32** | 2 | 4 | 4 | 3 | 1 | 1 | 1 | 1 | **4** |
| **C33** | 3 | 3 | 4 | 4 | 1 | 2 | 1 | 1 | **4** |
| **C34** | 3 | 4 | 4 | 3 | 1 | 2 | 1 | 1 | **4** |
| **C35** | 3 | 3 | 3 | 3 | 1 | 2 | 4 | 1 | **4** |
| **C36** | 3 | 3 | 4 | 3 | 1 | 4 | 1 | 1 | **4** |
| **C37** | 3 | 4 | 1 | 4 | 1 | 4 | 1 | 1 | **4** |
| **C38** | 3 | 4 | 3 | 3 | 1 | 1 | 7 | 1 | **7** |

| | Hazard Criteria | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Overall |
| | Water erosion | Wind erosion | Structure | Acidity | Salinity | Water-logging | Soil depth | Movement | Class |
| C39 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C40 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 3 |
| C41 | 3 | 3 | 4 | 5 | 1 | 2 | 1 | 1 | 5 |
| C42 | 3 | 4 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C43 | 3 | 3 | 1 | 5 | 1 | 4 | 1 | 1 | 5 |
| C44 | 3 | 3 | 3 | 3 | 1 | 2 | 7 | 1 | 7 |
| C45 | 3 | 4 | 3 | 3 | 1 | 1 | 4 | 1 | 4 |
| C46 | 2 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C47 | 3 | 4 | 4 | 4 | 1 | 2 | 1 | 1 | 4 |
| C48 | 3 | 3 | 3 | 3 | 1 | 1 | 4 | 1 | 4 |
| C49 | 3 | 2 | 4 | 4 | 1 | 2 | 1 | 1 | 4 |
| C50 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C51 | 2 | 3 | 4 | 4 | 1 | 4 | 1 | 1 | 4 |
| C52 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C53 | 2 | 5 | 4 | 5 | 1 | 4 | 1 | 1 | 5 |
| C54 | 3 | 3 | 4 | 4 | 1 | 3 | 1 | 1 | 4 |
| C55 | 3 | 4 | 3 | 4 | 1 | 4 | 1 | 1 | 4 |
| C56 | 3 | 4 | 3 | 3 | 1 | 1 | 7 | 1 | 7 |
| C57 | 3 | 4 | 3 | 3 | 1 | 1 | 4 | 1 | 4 |
| C58 | 3 | 4 | 3 | 3 | 1 | 2 | 7 | 1 | 7 |
| C59 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C60 | 3 | 2 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C61 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C62 | 3 | 2 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C63 | 3 | 4 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C64 | 3 | 4 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C65 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 3 |
| C66 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C67 | 1 | 2 | 4 | 4 | 1 | 2 | 1 | 1 | 4 |
| C68 | 2 | 2 | 4 | 4 | 1 | 2 | 1 | 1 | 4 |
| C69 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| C70 | 2 | 4 | 4 | 3 | 1 | 1 | 1 | 1 | 4 |
| C71 | 4 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |

| | Hazard Criteria | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Overall |
| | Water erosion | Wind erosion | Structure | Acidity | Salinity | Water-logging | Soil depth | Movement | Class |
| C72 | 4 | 4 | 1 | 5 | 1 | 1 | 1 | 1 | 5 |
| C73 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 3 |
| D1 | 3 | 4 | 4 | 4 | 2 | 1 | 1 | 1 | 4 |
| D2 | 3 | 4 | 3 | 3 | 1 | 2 | 4 | 1 | 4 |
| D3 | 3 | 3 | 3 | 3 | 1 | 2 | 4 | 1 | 4 |
| D4 | 3 | 2 | 3 | 3 | 1 | 2 | 7 | 1 | 7 |
| D5 | 2 | 5 | 1 | 5 | 2 | 1 | 1 | 1 | 5 |
| D6 | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 3 |
| D10 | 1 | 2 | 4 | 3 | 2 | 2 | 1 | 1 | 4 |
| D11 | 3 | 6 | 4 | 5 | 2 | 1 | 6 | 1 | 7 |
| D13 | 3 | 4 | 3 | 3 | 1 | 2 | 4 | 1 | 4 |
| D14 | 3 | 4 | 3 | 3 | 1 | 2 | 7 | 1 | 7 |
| D18 | 3 | 4 | 4 | 3 | 2 | 2 | 1 | 1 | 4 |
| D19 | 1 | 4 | 4 | 3 | 2 | 1 | 1 | 1 | 4 |
| M1 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 3 |
| M2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 3 |
| M3 | 3 | 3 | 4 | 4 | 2 | 4 | 1 | 1 | 4 |
| M4 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 3 |
| M5 | 3 | 3 | 4 | 3 | 2 | 2 | 1 | 1 | 4 |
| M6 | 3 | 3 | 4 | 3 | 1 | 2 | 6 | 1 | 6 |
| M7 | 3 | 3 | 4 | 3 | 1 | 2 | 4 | 1 | 4 |
| M8 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 3 |
| M9 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 3 |
| M10 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| M11 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 3 |
| M12 | 2 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| M13 | 3 | 3 | 4 | 3 | 1 | 2 | 1 | 1 | 4 |
| 12 | 2 | 2 | 4 | 3 | 2 | 1 | 1 | 1 | 4 |
| 13 | 6 | 5 | 1 | 4 | 1 | 2 | 1 | 1 | 6 |
| 14 | 6 | 3 | 3 | 3 | 1 | 1 | 4 | 1 | 6 |
| 15 | 6 | 3 | 3 | 3 | 1 | 1 | 7 | 6 | 7 |
| 16 | 6 | 4 | 3 | 3 | 1 | 2 | 6 | 6 | 6 |
| 17 | 3 | 4 | 3 | 3 | 1 | 3 | 1 | 1 | 4 |

| | Hazard Criteria | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Overall |
| | Water erosion | Wind erosion | Structure | Acidity | Salinity | Water-logging | Soil depth | Movement | Class |
| **18** | 4 | 3 | 3 | 3 | 1 | 1 | 4 | 1 | **4** |
| **19** | 4 | 3 | 3 | 3 | 1 | 1 | 6 | 1 | **6** |

# Appendix 5
## Site and Technology Selection Report

Design
for a better
*future* /

Newcrest Mining Limited

# Southern Tailings Storage Facility Site and Technology Selection Process

Cadia Continued Operations Project

August 2023

# Question today
# *Imagine tomorrow*
# Create for the future

## Southern Tailings Storage Facility Site and Technology Selection Process
## Cadia Continued Operations Project

Newcrest Mining Limited

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NML Doc Number: 730-17062-FS-REP-0059

| Rev | Date | Details |
|---|---|---|
| 0 | 29 August 2023 | Issued as final |

| | Name | Date | Signature |
|---|---|---|---|
| Prepared by: | Ana dos Santos | 29 August 2023 | [redacted] |
| | Felicity Richards | | [redacted] |
| Reviewed by: | Brad Tiver | 29 August 2023 | [redacted] |

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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# Abbreviations

| | |
|---|---|
| CAPEX | Capital expenditure |
| CCC | Community Consultative Committee |
| CCOP | Cadia Continued Operations Project |
| CUO | Cadia Underground Operations |
| CS | Concept Study |
| CVO | Cadia Valley Operations |
| DPE | Department of Planning and Environment (NSW) |
| EIS | Environmental Impact Statement |
| FS | Feasibility Study |
| GFICC | Geotechnical failure impact consequence catastrophic |
| GISTM | Global Industry Standard on Tailings Management |
| LGA | Local Government Area |
| LOM | Life of Mine |
| MCA | Multi-criteria analysis |
| NML | Newcrest Mining Limited |
| NTSF | Northern Tailings Storage Facility |
| OPEX | Operating expenditure |
| PAR | Population at risk |
| PFS | Pre-Feasibility Study |
| PTSF | In-pit tailings storage facility |
| RL | Reduced level |
| SIA | Social Impact Assessment |
| SISR | Social Impact Scoping Report |
| STSF | Southern Tailings Storage Facility |
| STSFX | Southern Tailings Storage Facility Extension |
| TSF | Tailings Storage Facility |
| WRD | Waste rock dump |
| WSD | Water storage dam |
| w/w | Weight of solids divided by total weight of slurry/paste |

# Executive Summary

This report has been prepared by WSP on behalf of Newcrest Mining Limited (NML)-owned Cadia Valley Operations (CVO). The intent of this report is to provide a singular summary that documents the history of technical studies that have been undertaken to define the most appropriate location and technology for an additional tailings storage facility that balances long term stability, environmental and community impacts and cost of operation.

Specifically, this report presents:

- An assessment of the TSF studies conducted to date to assess the most appropriate site(s) and the most suitable tailings disposal technology.
- A summary of the technical, environmental and community impacts considered during the selection process.

CVO is a large underground block-caving gold and copper mining operation, with current approval for production of 32 Mtpa and modification to that approval to allow up to 35 Mtpa to be processed is undergoing assessment by regulatory bodies. Those approvals allow CVO to operate until 2031 with tailings deposition into the Pit Tailings Storage Facility (PTSF), Northern Tailings Storage Facility (NTSF) and the Southern Tailings Storage Facility (STSF). Full utilisation of the existing reserves would extend the life of operation beyond 2050.

In 2018, a failure occurred in one section of the southern embankment of the NTSF and deposition ceased in this facility, along with the STSF which was put on care and maintenance to allow for engineering review and limited buttressing. The STSF was subsequently returned to operation with deposition in Stage 6 completed and subsequently the STSF was placed into care and maintenance. At that time Cadia commenced the use of the PTSF whilst the NTSF and STSF underwent engineering review and execution of currently ongoing buttressing works. Engineering studies for the NTSF have identified the required works to repair the failed section of embankment. However, the studies have thus far failed to identify a safe and certain method for re-commissioning the facility for further deposition, and this is unlikely to be identified in the short to medium term. Therefore, the existing PTSF, NTSF and the STSF are likely only sufficient to provide storage capacity until the early 2030s.

Site and technology selection studies for an additional TSF commenced in 2005, with CVO commissioning engineering firm URS to carry out a study to locate and quantify potential TSF sites that could provide the additional tailings storage capacity required to meet the Life of Mine (LOM) requirements, as understood at that time. Further studies were commissioned with Golder in 2012 and in 2016 to 2018, with the intent to search for potential sites and in consideration of different tailings disposal methods. CVO continued progressing such studies with Hatch and Golder, up until 2021, in preparation for the Cadia Continuous Operations Project (CCOP) announcement (refer Community Engagement section below). These studies are further detailed in the following sections.

### *Community Engagement*

In 2020 Umwelt commenced engagement activities with key stakeholders for the purpose of preparing a socio-economic study into existing operations at CVO at that time and gaining stakeholders' perceptions of the company more broadly. In October 2021 the CCOP was announced to the community with the aim of informing and engaging the community on the future of the Cadia operations leading to the submission of an application to extend the license to operate beyond 2031. Whilst detailed internal studies and limited community based discussion for the new TSF had been undertaken since 2005, October 2021 was the first time that detailed and targeted engagement with the community was held on tailings site selection and technology.

Following the announcement of CCOP in October 2021, Cadia held 23 personal meetings with a total of 43 proximal landholders. Cadia engaged with the NSW Government across six project briefings. Briefings were attended by the Department of Planning and Environment (DPE) representatives from the Water and Biodiversity, Conservation and Science divisions. Briefings were also held with Department of Regional NSW representatives from the Resources Regulator, the Mining Exploration and Geoscience division, and the Mine Development Panel of the Mining Concierge.

The NSW Environmental Protection Agency (EPA) and the Natural Resources Access Regulator (NRAR) were also briefed on the project. The Blayney, Cabonne and Orange City Councils were briefed and invited to provide feedback on CCOP concepts, including the proposed construction of a new TSF.

The Cadia community is well-informed, interested and engaged with the existing and future operations of CVO. They have historically been present and actively participated in a range of information sessions and individual meetings with Cadia in relation to CCOP, inclusive of discussions on the site and technology selection for an additional TSF. The primary concern raised by the community relates to dust management of any new TSF at Cadia.

### *Site selection*

The TSF site selection process is based on technical, social and environmental design requirements, as follows:

*Technical requirements:*

1. Capacity for tailings storage to meet the remaining Life of Mine (LOM);
2. Selection of a suitable site(s), both topographically and geotechnically;
3. Suitable TSF construction methods;
4. Appropriate technical risks associated with these construction methods, execution and long term stability; and
5. Consideration of the capital and operating costs of the TSF construction methods.

*Social and environmental requirements:*

1. Minimisation of the disturbance areas and biodiversity impacts;
2. Minimisation of noise and dust emissions associated with operation of the TSF;
3. Minimisation of impacts on existing water bodies – both quality and quantity.
4. Minimisation of impacts to the visual amenity of neighbouring landholders.

Several studies have been undertaken to assess suitable locations of the new TSF, since 2005 until 2019. Up to 10 potential TSF sites were initially identified by Golder in 2012 (building on from URS 2005 studies) as candidate locations for the new TSF, as follows (these specific site locations are presented in Figure 3.4 in the main body of the report, and Figure ES.1 provides a general overview of the sites considered in the studies.

1. Ridgeway void and underground
2. Copper Gully
3. Cadia creek (Cadiangullong)
4. Cadia pit
5. Rodd's Creek dam
6. Cadia East
7. Waste rock dump
8. Bundella Valley (Swallow Creek)
9. Far south Rodds creek
10. NTSF & STSF (i.e. using the existing TSFs).

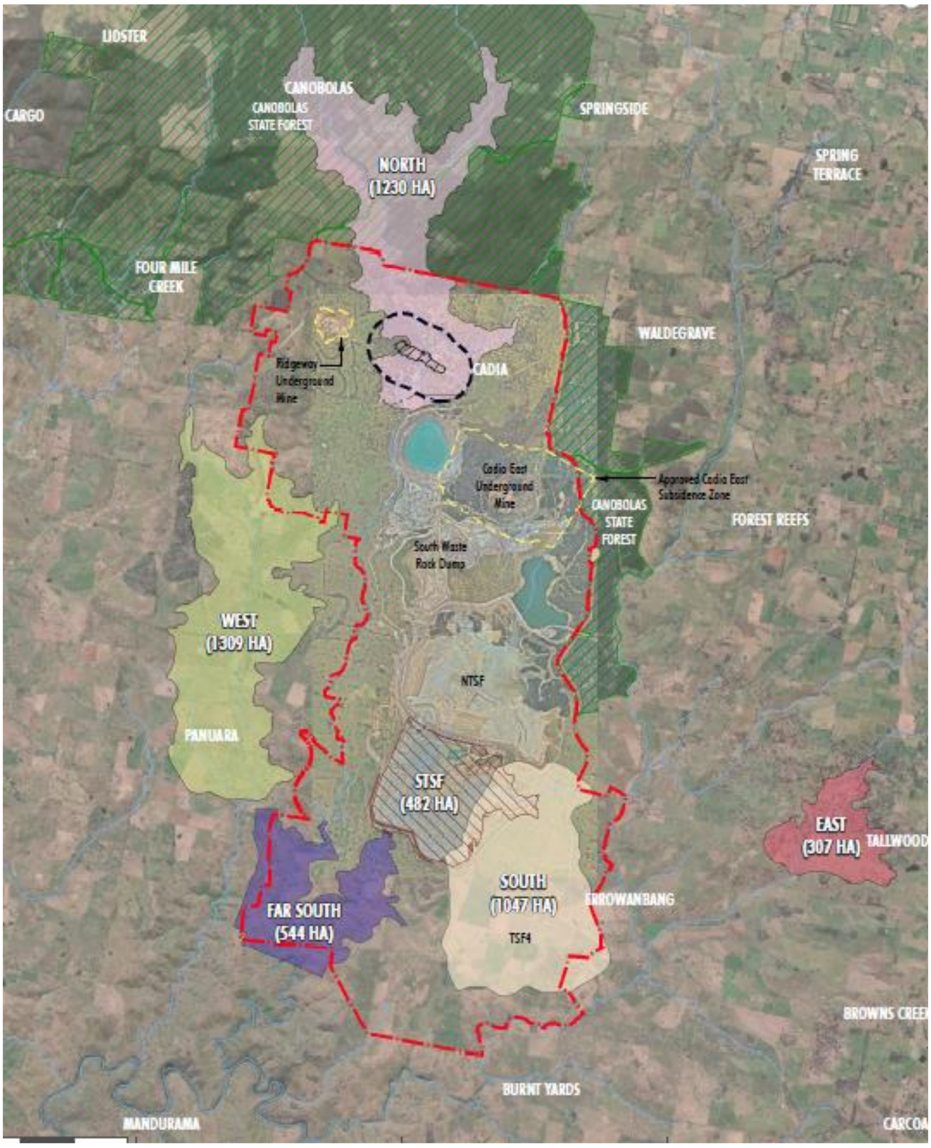


Figure ES.1 TSF sites studied since 2005 (Newcrest Mining Limited, 2023)

In 2017, Golder considered five additional locations, but none were viable:

- TSF1: Swallow Creek, north end
- TSF2: Swallow Creek, middle
- TSF3: Swallow Creek, south
- TSF4: South Rodd's Creek
- TSF5: Gooleys Creek.

In addition to the above studies, wider site searches were undertaken to a 40 km radius around the mine with no credible alternatives identified.

In 2018, Golder examined additional sites, with limitations/issues associated with each site as follows:

- Cadiangullong (located in new catchments unaffected by mining activities), also considered by Golder in 2012.
- Lower Cadiangullong Creek (located in new catchments unaffected by mining activities).

- Belubula River (not credible, unacceptable impact on Belubula and Lachlan River catchment communities and environment).
- Errowanbang (located outside of the mine lease).

Most of the sites considered in the 2005-2018 studies had a limited storage capacity, so a combination of two or more TSFs would have to be operated simultaneously to meet the expected tailings output. In addition, these TSFs had a very limited tailings tonnage they could accept in their early years, due to the narrow valley topography.

Following the above findings, CVO narrowed the site options to the Cadiangullong creek (North site) and the STSF Errowanbang (South site) and assessed different tailings disposal methods for these options. Golder assessed the pros and cons associated with the North and South sites from 2018 to 2019, as follows.

The main advantages associated with the Cadiangullong creek (North site) are:

- The narrow valley results in reduced construction quantities for embankment.
- The site is within 5 km of the process plant.
- The site is located relatively further from neighbouring properties, compared to the South site.

The main disadvantages associated with the Cadiangullong creek (North site) are:

- The land is forested area to the north of the site, implementing the TSF at this location would result in significant impacts to biodiversity and plant community species as well as fauna.
- The Four Mile Creek road would need to be relocated.
- High capital cost associated with sediment and runoff control infrastructure.
- Cadiangullong Dam would need to be replaced and a site identified which would increase potential environmental impacts.
- The embankment would be founded on loosely backfilled mine waste over the Cadia north pit and would be extremely technically challenging.
- A major diversion channel and drop-structure would be needed to carry runoff from the 90 km² catchment located upstream of the TSF, divert runoff around the TSF and deliver it to the Cadiangullong diversion channel around the Cadia pit, which would:
    - Require a major excavation into the rock to form the diversion channel.
    - Result in significant environmental impacts.

The main advantages associated with the Errowanbang (South site) are:

- Most of the ground has a low slope of ±2.5%, falling from east to west.
- There is a very limited external catchment (it is within the current TSF catchment area and river system) and this runoff can be diverted relatively easily.
- There is a suitable location for a surface runoff sediment control dam in the lower Rodds Creek valley.
- Lower land disturbance, compared to the North site.
- Waterway impacts are negligible and no new catchment affected.

The main disadvantages associated with the Errowanbang (South site) are:

- All options would be visible, to some extent, to the landholders to the east, south and west.
- The footprint is adjacent to Flyers Creek.
- The Panuara and Meribah roads would need to be relocated.

- The site is about 6.5 km from the process plant.

These studies demonstrated that the Errowanbang (South site) was the most suitable site.

In 2019, Hatch, as part of a consolidated concept study report, prepared a high level Multi Criteria Assessment (MCA) and detailed risk and cost assessments of the TSF options identified in previous studies and associated tailings disposal methods, which confirmed that Errowanbang (South site) was the most suitable option.

The North site option significantly contradicted several of CVO's agreed technical (failure risk, loose embankment foundation, relocation of the water storage dam), environmental and community (relocation of public busy road, disturbance of forested area and impact to biodiversity, major diversion channel and drop structure to divert runoff from catchment area upstream, resulting in major environmental impacts) criteria and was discounted from further examination.

The South site TSF was therefore selected as the most suitable option (most of the ground has flat slope, it is within the current TSF catchment area and river system, it provides the ability to integrate with STSF, resulting in lower land disturbance area compared to the North site, waterway impacts are negligible with no new catchment affected, adequate foundation conditions may be achieved) and later was redesignated as the South TSF eXtension (STSFX).

### *Tailings deposition technology selection*

A range of potential tailings deposition technologies were considered across the identified TSF sites, until one technology was selected as being the most appropriate for the STSFX. The technologies initially considered were:

- Conventional (thickened) slurry – as currently used at Cadia;
- Central thickened discharge;
- Paste;
- Dry stack (filtered tailings);
- Co-disposal of coarse mine waste (cobbles and boulders) with slurry;
- Co-mingling (tailings and coarse waste rock are mixed together within a storage facility or as a single discharge stream); and
- Hydrocyclone sand wall embankment.

It was assessed that the hydrocyclone sand wall embankment tailings deposition system was most suitable to Cadia for the following reasons:

- Marginally lower land disturbance requirements compared to other options (in alignment with previously presented *Social and environmental requirement 1*);
- Significantly reduced quarry rock and borrow requirements (in alignment with previously presented *Social and environmental requirement 1*);
- Hydrocyclone sand wall embankment construction uses less energy than some other tailings technologies (paste, dry stack, rock placement) and is more amenable to Newcrest's zero carbon emissions goals (in alignment with previously presented *Social and environmental requirement 1* and *Technical requirement 5*).
- Noise levels similar to the current NTSF and STSF operations and lower than other options (in alignment with previously presented *Social and environmental requirement 2*);
- Similar dust levels to the dust generated by the NTSF and STSF when operating and lower than other options (in alignment with previously presented *Social and environmental requirement 2*);
- Lower technical risk due to increased embankment stability inherent in the technology (in alignment with previously presented *Technical requirement 4*);

- No increase in water recovery above current requirements (in alignment with previously presented *Technical requirement 5*);

In considering the community's primary concern about dust management (*Social and environmental requirement 2*), the advantages of this technology are as follows:

- It maintains the advantage conventional disposal has, namely the ability to keep the tailings beach wet, provided that tailings deposition is planned accordingly.
- The outer slope of the sand dam is compacted to minimise its propensity to liquefy under earthquake loading and this action assists to control dust generation from the outer slopes.
- To further reduce dust generation from the beach and the slopes, large area water cannons will be used, whilst early development of the final toe and slope of the embankment will allow implementing temporary vegetation and early rehabilitation, further reducing the propensity for dust.

### *Additional MCA to combine sites and tailings deposition technologies*

The MCA undertaken by Hatch in 2019 (refer "Site selection" Section of this Executive Summary) did not consider weighted criteria (it only included 'yes' or 'no' ratings, except for the cost assessment) and did not include hydrocyclone sand wall embankment as a disposal method for the South site.

Therefore, Newcrest and WSP undertook an additional MCA in 2023 with the intent to:

- Consider semi-quantitative criteria (including weightings) for the site and tailings disposal options considered, based on risk assessments completed by Hatch in 2019.
- Align with GISTM's[1] Requirement 3.2, "For new tailings facilities, the Operator shall use the knowledge base and undertake a multi-criteria alternatives analysis of all feasible sites, technologies and strategies for tailings management (…)".

The MCA indicated the following as the top three options, from the highest to the lowest ranking option:

1. Hydrocyclone sand wall embankment disposal method for the South site.
2. Paste tailings discharge with upstream raised embankments at the South site.
3. Slurry tailings discharge at the South site with downstream raised embankments.

### *Layout optimisation*

Once the site location and technology combination was chosen, nine layout options were presented for consideration during the Pre-Feasibility Study (PFS) and put through an MCA, to define the most suitable layout. The MCA determined a preferred option, Option 5A, which was displayed to the community for feedback.

When compared to Option 5A, the final design of STSFX completed during the Feasibility (FS) phase and presented to the DPE and community in May 2023 has taken into account the feedback from the community and has the benefits:

- Reduced footprint reducing disturbance and biodiversity impacts;
- Reduced impacts from dust and noise on local community stakeholders;
- Creates an integrated single facility with the existing STSFX and NTSFX reducing visual amenity for neighbouring landholders;

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[1] Global Industry Standard on Tailings Management

- Adjusts the facility to match the 25-year approval extension timeframes allowing all stakeholders to assess any future request for another facility at a time closer to the approval date. This includes the opportunity to utilise currently excluded locations (e.g.: Ridgeway and/or Cadia East subsidence zones) or currently underdeveloped technologies, to further reduce impacts.
- The potential for temporary or progressive closure and rehabilitation in areas where construction and tailings placement is complete.

The layout progression from before the MCA, up until Option 5A and the final STSFX design based on community feedback is illustrated in Figure ES.2 to Figure ES.4.

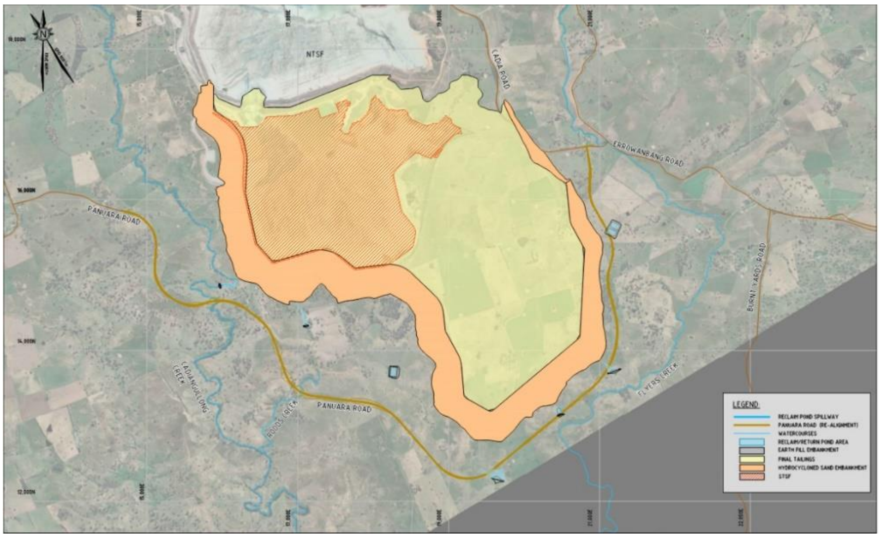


Figure ES.2 STSFX configuration prior to MCA

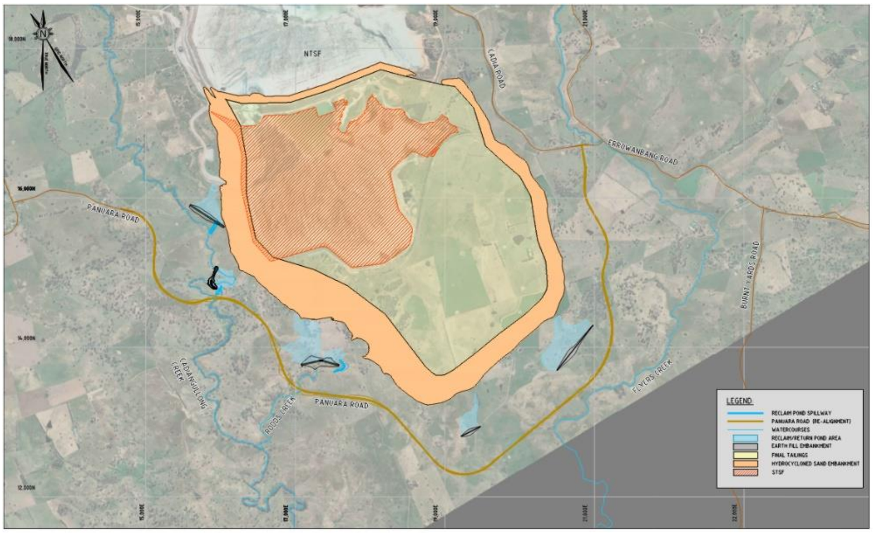


Figure ES.3 Option 5A selected as a result of the MCA

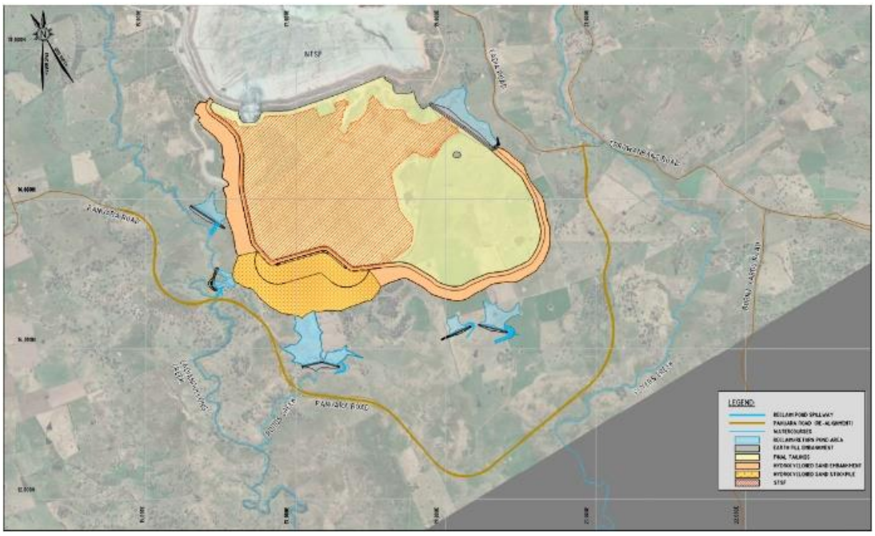


Figure ES.4 STSFX

# 1 Introduction

## 1.1 Overview

The Newcrest Mining Limited (NML) owned Cadia Valley Operations (CVO) is a large underground block-caving gold, copper and molybdenum mining operation. The mining operations result in the generation of saleable metal products (gold dore, gold rich copper concentrate and molybdenum concentrate), and mine waste which becomes tailings with no economic value. Mining tailings cannot be directly disposed into the environment, as they have a potential for pollution of ecosystems and negative impact to flora and fauna. Tailings are therefore disposed of and stored at tailings storage facilities (TSFs).

The CVO has an approved annual production of 32Mt with plans to process up to 35 Mt of ore once approval is granted by regulatory authorities. This ore is crushed and milled to allow the copper and gold, to be recovered in three process plants, with the resulting tailings being pumped as a thickened slurry.

The first TSF, the Northern TSF (NTSF), was designed to accommodate the tailings from the Cadia hill open pit and originally accommodated the tailings produced by Concentrator 1. The Southern Tailings Storage Facility (STSF) was originally designed to accommodate the tailings from the Ridgeway underground mine via Concentrator 2. The NTSF was designed in 1997 by engineering firm Knight Piesold as a conventional slurry tailings facility with a zoned earth rockfill containment embankment, with plans to raise the embankment over time using the upstream2 method, supported by a downstream buttress only. The STSF was developed in 2001 by engineering consulting firm URS, following the same design concept used for the NTSF. Later in the operational life the STSF was modified to accommodate concentrator 1 feed and the NTSF was modified to take previous feed to the STSF.

CVO is licensed to mine until 2031 and current storage facilities (NTSF, STSF and PTSF) have storage capacity that will exceed this timeframe however the known reserves at Cadia exceed the capacity of these facilities. CVO commissioned URS in 2005 (URS, 2005) to carry out a study to locate and quantify potential TSF sites that could provide the additional tailings storage capacity required to meet the Life of Mine (LOM) requirement. These studies were further developed in 2006 (URS, 2006) to Pre-Feasibility Study level (PFS). More studies were commissioned by CVO following the completion of the URS study in 2005/2006 and are discussed in more detail throughout this report.

More recently, the failure of the NTSF in 2018 has required Cadia to utilise the Cadia pit for tailings disposal (PTSF) until the NTSF is repaired and the STSF is lifted to its next stage, Stage 7. However, these TSFs provide limited storage capacity, and at this time it is likely that only the STSF will be recommissioned in the short to medium term. CVO therefore requires a new TSF to support continued operations for its known reserves. CVO has since undertaken studies to define the new TSF under the Cadia Continued Operations Project (CCOP).

Stakeholder and community engagement relevant to this work commenced in 2020 and has continued up until and following the announcement of CCOP in October 2021, discussed further in Section 2.1.2. Various engagement activities have been undertaken with a range of stakeholders including the NSW Government, local councils and landholders to seek feedback on CCOP concepts, including the proposed construction of a new TSF. The Cadia community is well-informed, interested and engaged with the existing and future operations of CVO. They have historically been present and actively participated in a range of information sessions and individual meetings with Cadia in relation to CCOP, inclusive of

2 Upstream construction method: embankment raises are constructed over the existing embankment crest and over tailings.

Downstream construction method: embankment raises are constructed over the existing embankment crest and over existing ground located outside of the TSF.

Centreline construction method: embankment raises are constructed over the existing embankment crest and partially over tailings, partially over existing ground located outside of the TSF.

discussions on the site and technology selection for an additional TSF. The primary concern raised by the community relates to dust management of any new TSF at Cadia.

This report summarises several studies that assessed multiple options for a suitable site against an agreed set of environmental, community and technical considerations.

## 1.2 Overview of Cadia Continued Operations Project

Cadia commenced the Cadia Continued Operations Project (CCOP) to secure the long-term mining future of Cadia, with direct and indirect employment of over 3,000 people and the economic benefit this brings to the Orange City, Cabonne and Blayney Shires, as well as the state of NSW and the Commonwealth.

The Cadia East mine has reserves in excess of 30 years of production and will be seeking approval from the NSW Department of Planning and Environment (DPE) for an extension to the current approvals of 25 years under the CCOP. During this period, CVO requires additional tailings storage capacity of approximately 600 Mt. Security of tailings storage for this time horizon is important to allow the continued development of the operation and to create the certainty required for future investments.

## 1.3 Future tailings disposal

### *1.3.1 Life of Mine Tailings Management Strategy*

During the proposal 25-year approval term under the CCOP. This LOM tailings strategy will include:

- An integrated tailings deposition plan for NTSF, STSF and PTSF.
- Closure plans for each of the NTSF and PTSF, both of which are likely to have their useful life exhausted by 2030.
- The development of the STSFX, which incorporates a new area to the east of the STSF and its integration with the STSF, to provide LOM tailings storage for the period 2028-2048.
- A closure plan for the STSFX, which incorporates the current STSF.

### *1.3.2 Study history and timeline*

Several tailings disposal site identification studies have been completed since 2005, as illustrated in Figure 1.1. Starting with a study carried out by URS in 2005 and finishing with the (Golder, 2018c) study that identified the STSFX site.

This report forms part of the CCOP and the LOM tailings Feasibility Study currently in preparation in 2023.

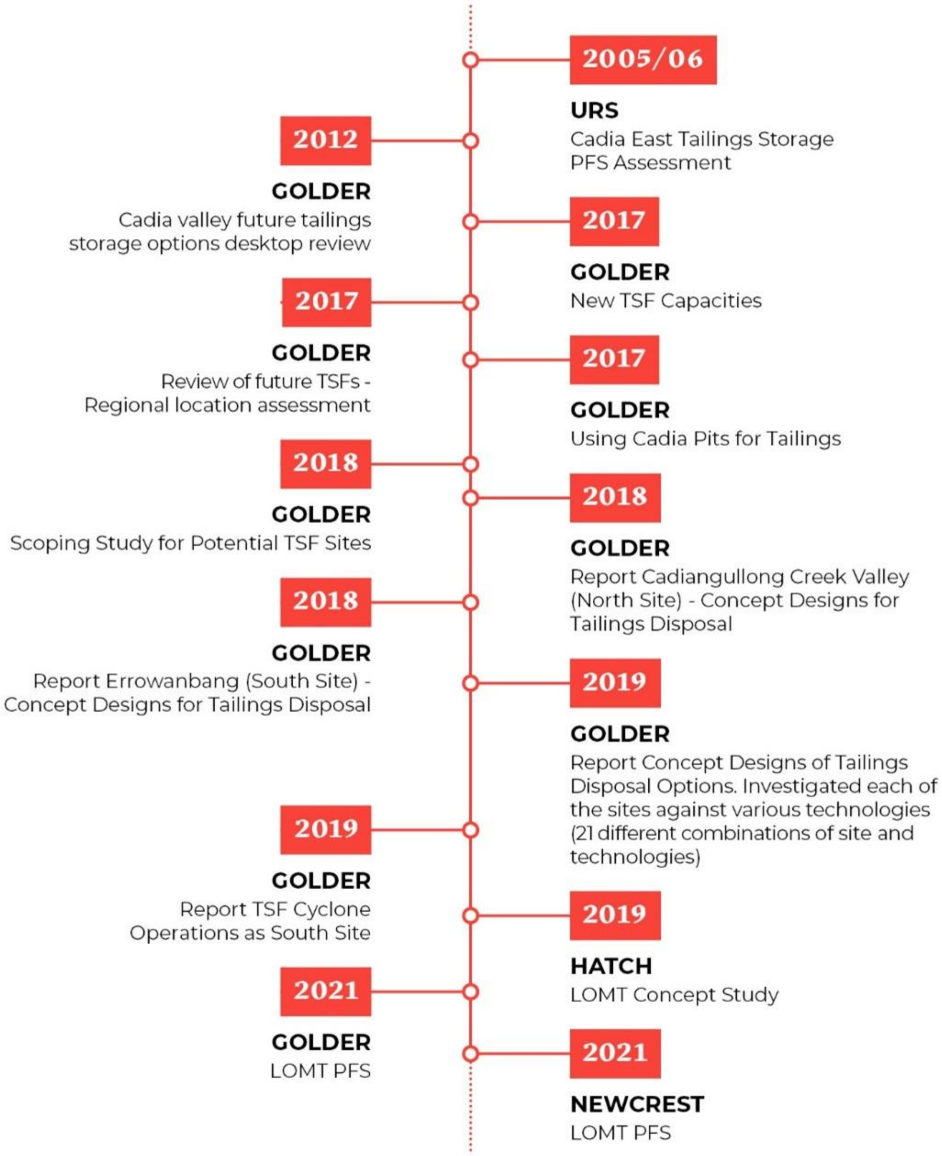


Figure 1.1 Study history and timeline

## 1.4 Purpose of this report

This report has been prepared by WSP on behalf of Newcrest to provide a singular summary that documents the history of technical studies that have been undertaken. Specifically, this report presents:

- An assessment of the TSF studies conducted to date to identify the most appropriate tailings deposition system and site.
- The site selection process undertaken progressively through the years and how it selected the STSFX site.
- Details on the justification for the selection of the STSFX site.
- A summary of the technical, environmental and community impacts considered during the selection process.

# 2 Engagement

## 2.1 Overview of engagement

Newcrest and CVO have engaged with stakeholders for CCOP (inclusive of TSF location and tailings deposition system assessments), and during the PFS, MCA and FS processes. Newcrest further captures community sentiment toward its activities via quarterly Community Consultative Committee (CCC) meetings and Cadia District Residents Meetings.

### *2.1.1 Preliminary stakeholder identification*

The following stakeholders have been identified for the CCOP as part of the Social Impact Scoping Report (SISR) being prepared by environmental and social consultancy Umwelt (Umwelt, 2022). The SISR forms part of the Social Impact Assessment (SIA), a formal requirement of the CCOP environmental impact statement (EIS). As Newcrest and CVO have been present in the region for a long time and have a long history of engagement with stakeholders, previous assessments and existing stakeholder databases were used in the identification process. Umwelt and Newcrest representatives then identified future stakeholders in CCOP and their engagement preferences. Thirteen separate stakeholder groups were identified, see Figure 2.1.


Figure 2.1 Preliminary stakeholder identification (Source: (Umwelt, 2022))

### 2.1.2 Historical engagement activities at Cadia

In 2020 Umwelt commenced engagement activities with key stakeholders for the purpose of preparing a socio-economic study into existing operations at CVO at that time and gaining stakeholders' perceptions of the company more broadly. This engagement program included consultation with over 500 community members and 37 key stakeholders and neighbouring landholders. While this consultation program engaged with over 1,000 people across five stakeholder groups, this engagement program was not specifically targeted at the site and technology selection for an additional TSF, rather the broader existing Cadia operations at the time (Umwelt, 2020).

Detailed studies for the new TSF had been undertaken since 2005, however, Newcrest acknowledges that targeted engagement with the community on tailings site selection and technology was limited in nature, prior to the announcement of CCOP in 2021.

Following the announcement of CCOP in October 2021, Cadia held 23 personal meetings with a total of 43 proximal landholders. Cadia engaged with the NSW Government across six project briefings. Briefings were attended by the DPE representatives from the Water and the Biodiversity, Conservation and Science divisions. Briefings were also held with Department of Regional NSW representatives from the Resources Regulator, the Mining Exploration and Geoscience division, and the Mine Development Panel of the Mining Concierge. The NSW Environmental Protection Agency (EPA) and the Natural Resources Access Regulator (NRAR) were also briefed on the project. The Blayney, Cabonne and Orange City Councils were briefed and invited to provide feedback on CCOP concepts, including this time the proposed construction of a new TSF. Three community drop-in sessions were also held in November 2021 where project information was provided to interested community members. Since November 2021 Newcrest has held ongoing Cadia District Resident Meetings as well as individual discussions with landholders as required (Umwelt, 2022).

During March 2022, Newcrest distributed a project sheet that summarised stakeholder and community feedback received during the October to December 2021 period. At this time Umwelt were engaged to prepare a SISR as part of the CCOP as per EIS requirements for an extractive industry project in NSW. This led to consultation with over 50 neighbouring landholders and close to 40 other community representatives (see Table 2.1).

Stakeholders were asked a range of questions in relation to CCOP's three aspects:

- Proposed additional water storage to maintain security of water supply to the mine;
- Options for realignment of public roads; and
- The proposed construction of a new TSF to the south of the existing STSF to allow capacity for storage of tailings produced beyond the existing approved mine life (Umwelt, 2022).

Table 2.1 details the number of stakeholders consulted by Umwelt for the SISR on the above-mentioned aspects of CCOP, including the proposed South option for STSFX during March and April 2022.

Table 2.1 Stakeholder consulted and informed of CCOP during EIS scoping phase

| Stakeholder group | Mechanism | Number of surveys/meetings conducted | Number of participants |
|---|---|---|---|
| **Proximal Landholders** | Personal interview with Umwelt / Completion of SIA online survey | 53 | 53 (may have been engaged by both Umwelt and Cadia at various consultation phases) |
| | Personal meetings with Cadia | 23 | 43 |
| **Local Community** | Cadia District Residents Meetings | 2 | 11 |

| Stakeholder group | Mechanism | Number of surveys/meetings conducted | Number of participants |
|---|---|---|---|
| | CCOP Meeting | 1 | 17 |
| | Maildrop of Project Information Sheet | 134 | NA |
| | Email of Project Information Sheet | ~300 | NA |
| **Aboriginal Representative Groups** | Personal meeting | 1 | 1 |
| **Local Government** | Project briefing | 2 | 12 |
| **State Government** | Project briefing | 6 | ~24 |
| **Community and Special Interest Groups** | Project briefing to the CDPG and subsequent interviews with members | 1 | 6 |
| | Personal interview with Umwelt / Completion of online survey | 2 | 2 |
| **Broader Community** | Local newspaper media with invitation to Community Information Session | 3 | NA |

Source: (Umwelt, 2022)

Figure 2.2 illustrates the timeline of community and stakeholder engagement since the commencement of the socio-economic study (Umwelt, 2020). Engagement activities will continue during the preparation of the EIS for CCOP, both for the purpose of the SIA as well as the broader EIS engagement scope. Stakeholders will be consulted on all aspects of CCOP, including the site and tailings deposition system technology preferred option for STSFX (hydrocyclone sand wall embankment, refer to Section 4 for more information).

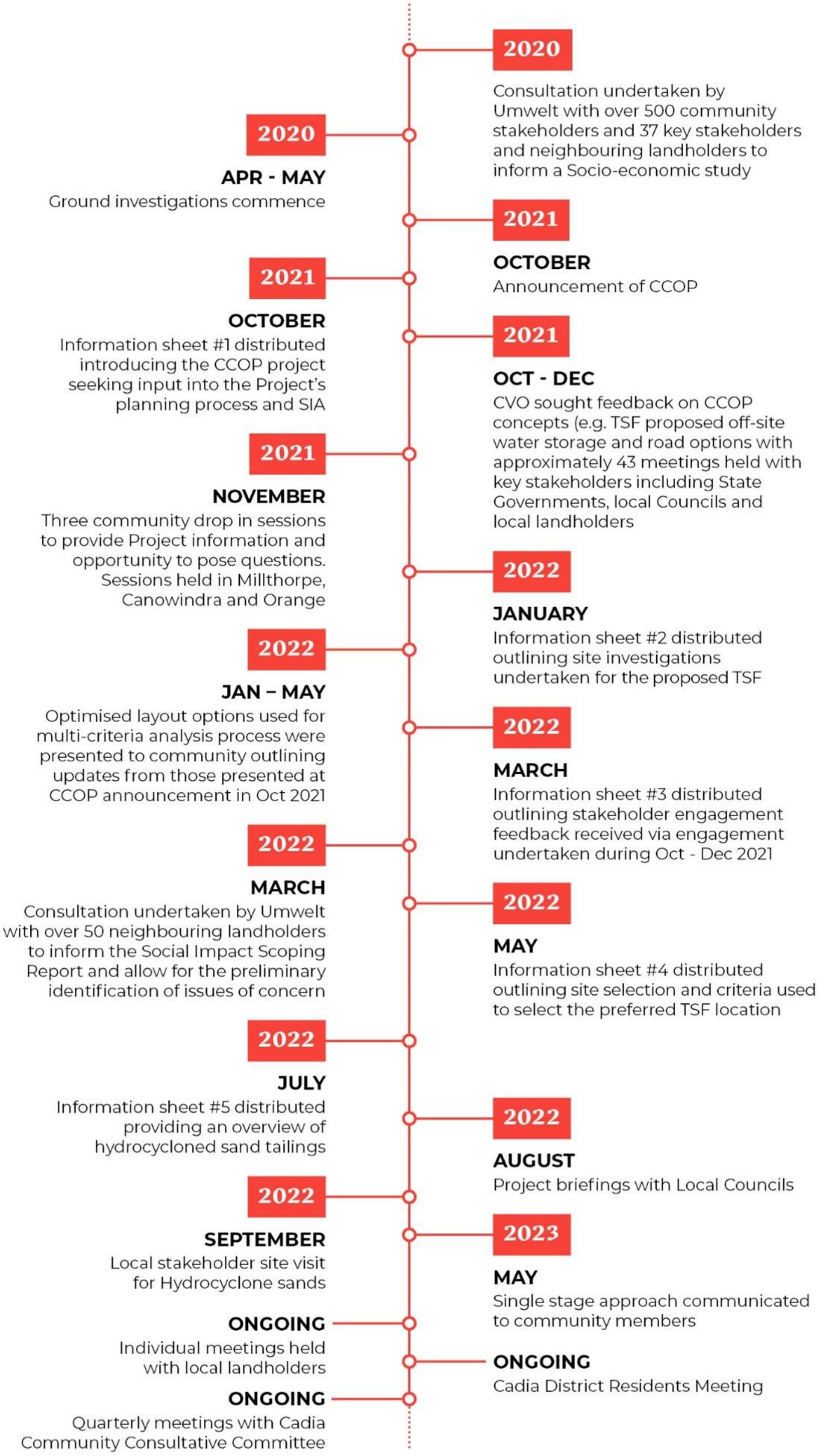


Figure 2.2 Community engagement timeline (Source: (Umwelt, 2022))

## 2.2 Key issues raised by stakeholders

Prior to 2016 the issue of most concern to the community was traffic impacts and a desire for infrastructure improvements to accommodate increasing traffic associated with CVO. Umwelt's 2020 socio-economic study notes that, since the 2018 NTSF dam wall breach at Cadia, the number of complaints relating to dust has increased significantly. Between July 2013 and December 2021, 51.7% of complaints related to dust. The vast majority of these complaints were made in the 12 months following the dam wall breach (Umwelt, 2020).

The top five environmental and social concerns raised by community members, via survey in March and April 2022, during preparation for the CCOP Social Impact Scoping Report included:

- Dust disturbance
- Increased traffic and travel times
- Conflicting land use and/or reduced land for agricultural use
- Noise disturbance
- Access and use of groundwater.

The most positive perceived benefit of the project related to employment opportunities followed by the expected subsequent economic contribution to the broader region (Umwelt, 2022)

### *2.2.1 Dust from tailings*

The Cadia District Protection Group (CDPG) was formed following the emergence of public concern over environmental and health impacts of tailings storage at Cadia. The 2018 dam wall breach was reported in local media in 2019 and set off a series of complaints being made to Newcrest on the topic of dust emissions. Of particular concern is the community's perception of the severity of potential health impacts caused by ingesting dust particles from tailings (Logan, 2021). Media articles indicate that the uncertainty around the composition of the dust is the underlying issue. Figure 2.3 presents a photograph of the site showing tailings dust above a TSF.

Figure 2.3 Tailings dust above a TSF at Cadia. Photo: Sally Green

# 3 Site selection process

Newcrest recognises that tailings deposition technologies and site selection are directly linked. Numerous factors were considered during the siting and design phases for the new TSF.

Figure 3.1 sets out the interrelationship between three most critical site selection considerations for a new TSF.

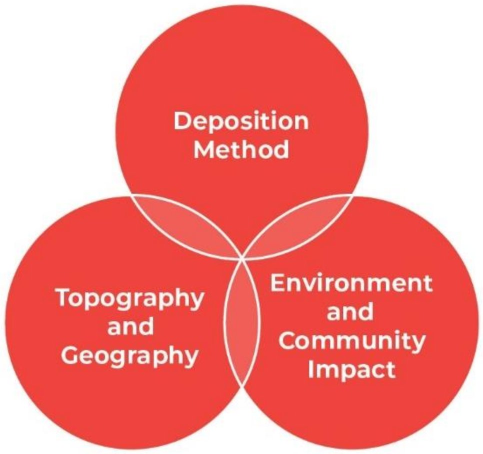


Figure 3.1 Interrelated TSF siting considerations

- Topography and geography inform the possible foundation issues and limitations to embankment and TSF construction.
- Deposition method is often a continuation of the previously used method or a change, brought about by technological improvements or industry demands.
- Environment and community impact affect site and tailings deposition method selection, it is preferrable to select sites and deposition methods that limit impacts to the environment and community.

## 3.1 TSF location requirements

The site selection process for a new TSF typically starts with the following design requirements:

### *3.1.1 Technical requirements*

The technical requirements for a new TSF typically are:

- Capacity for tailings storage to meet the remaining LOM;
- Selection of a suitable site(s), both topographically and geotechnically;
- Suitable TSF construction methods;
- Appropriate technical risks associated with these construction methods, execution and long term stability; and
- Consideration of the capital and operating costs of the TSF construction methods.

### 3.1.2 Social and environmental

The social and environmental requirements seek to limit:

- Minimisation of the disturbance areas and biodiversity impacts;
- Minimisation of noise and dust emissions associated with operation of the TSF;
- Minimisation of impacts on existing water bodies – both quality and quantity.
- Minimisation of impacts to the visual amenity of neighbouring landholders.

## 3.2 Earlier studies

The following sections provide a brief overview of the earlier TSF location studies, the considered locations are shown in

Figure 3.2 (the red dotted boundary indicates the proposed CCOP boundary). The intent was to identify alternative sites within Cadia mining lease, mindful of the productive farming land surrounding Cadia and the impact a new TSF would have on the community, though sites located outside of the lease were also considered, predominately in the interests of due diligence.

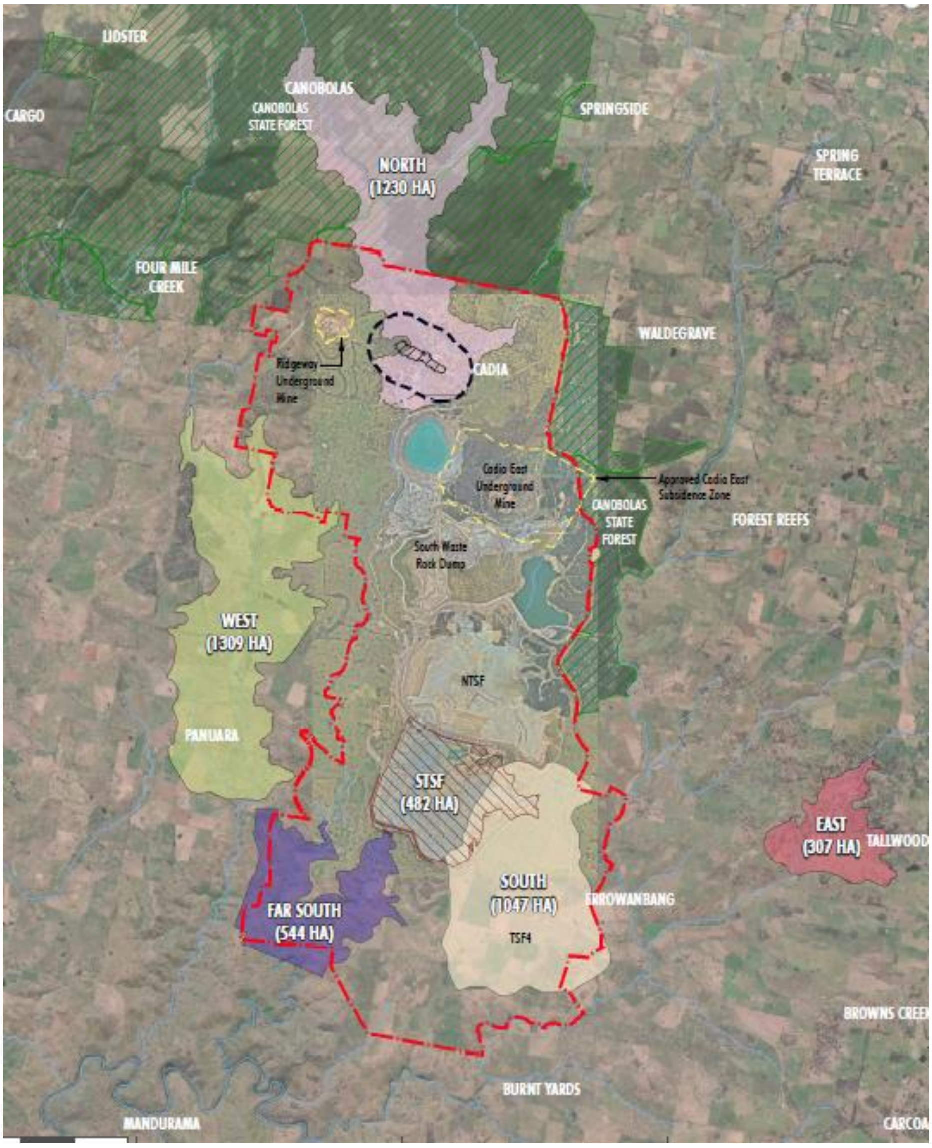


Figure 3.2 TSF sites studied since 2005 (Newcrest Mining Limited, 2023)

## 3.3 URS 2005-2006

The first study commissioned by CVO in 2005 by URS was based on a tailings production rate of 25 Mtpa[3], looking at all or part of this output going to the new TSFs, with the balance to be sent to the NTSF and STSF (URS, 2005). The 2005 study was subsequently further refined to develop some of the preliminary concepts to PFS level in 2006 (URS, 2006).

### 3.3.1 Study scope

URS sought to identify potential locations for future tailings storage facilities to accommodate the predicted tailings generated by the processing of Cadia East ore, approximately 830 Mt of dry tailings. URS provided indicative costings for the locations identified and listed alternative tailings storage locations. The study quantified the predicted maximum capacity of the NTSF and the STSF in operation at the time.

### 3.3.2 Tailings disposal methods

The methods considered were:

- Conventional (thickened) slurry – as operated for NTSF and STSF: tailings leave the process plant in a slurry with a slurry solids concentration of at about 25% w/w. Conventional or high-rate thickeners are used to thicken the slurry to a 55% solids concentration and this is then pumped to the TSF using conventional centrifugal pumps for transport and deposition. Processing was considered to be straightforward, as it would be as per the existing system in place for NTSF and STSF. The conceptual study was focussed on this option.
- Central thickened discharge: thickening the tailings (with reference to conventional slurry) to typically 60% to 65% solids concentration and depositing from a central deposition point within the basin, towards the perimeter embankments, resulting in a cone-shaped deposit of tailings. The main constraint which led to exclusion of this option is the lack of space for tailings disposal as central thickened discharge. This option was therefore not further explored.
- Paste: for the purpose of URS studies, 'paste' system referred to relatively dense tailings streams with a 'paste' consistency (i.e. increased solids concentration, minimum of 65%). The report indicated that paste systems are often associated with relatively low tailings generation and high capital and operating costs. The estimated tailings generation rate of 3 000 tonnes per hour (at the time of the report) at Cadia East was one order of magnitude higher than what was indicated in the available literature. Combined with the anticipated relatively high costs, paste was not considered a feasible option and was not elaborated further.
- Underground disposal: this option comprises disposal of tailings into existing underground voids. The report stated that there was no existing underground void at Ridgeway which could provide sufficient storage volume for the 800 Mt of dry tailings to be generated. This option was therefore not further explored.
- Subsidence void disposal: similar to the underground disposal, this option considers tailings discharge into underground voids formed by mining operations. The anticipated underground extraction was in the order of 17 Mm$^3$[4], which would be equivalent to less than 25 Mt of dry tailings, being much less than the anticipated 800 Mt of dry tailings to be generated. This option was therefore not further explored.

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3 Megatons (1 000 000 t) per annum

4 Mega m$^3$ (1 000 000 m$^3$)

- Co-disposal with waste rock: this system consists of disposal of coarse mine waste (cobbles and boulders) similar to a landfill operation, with concurrent disposal of tailings slurry. The report indicated a much larger anticipated volume of tailings, in comparison to that of waste rock, making it unfeasible to implement a co-disposal operation. However, the report indicated that waste rock and tailings storage concepts should be discussed in conjunction, in order to identify possible synergies.
- In pit disposal: this option consists of discharging the tailings into excavated pits at which mining activities were undertaken (i.e. 'store the tailings where they came from'). The report considers which Cadia Hill void a candidate for this option, as Cadia Eat open cut pit cannot be used simultaneously for mining and tailings disposal. Nevertheless, Cadia East pit could be used for future developments at Cadia Valley.

### 3.3.3 Potential TSF sites

The 2005/2006 URS study found six potential locations as shown in Figure 3.3 and listed as follows.

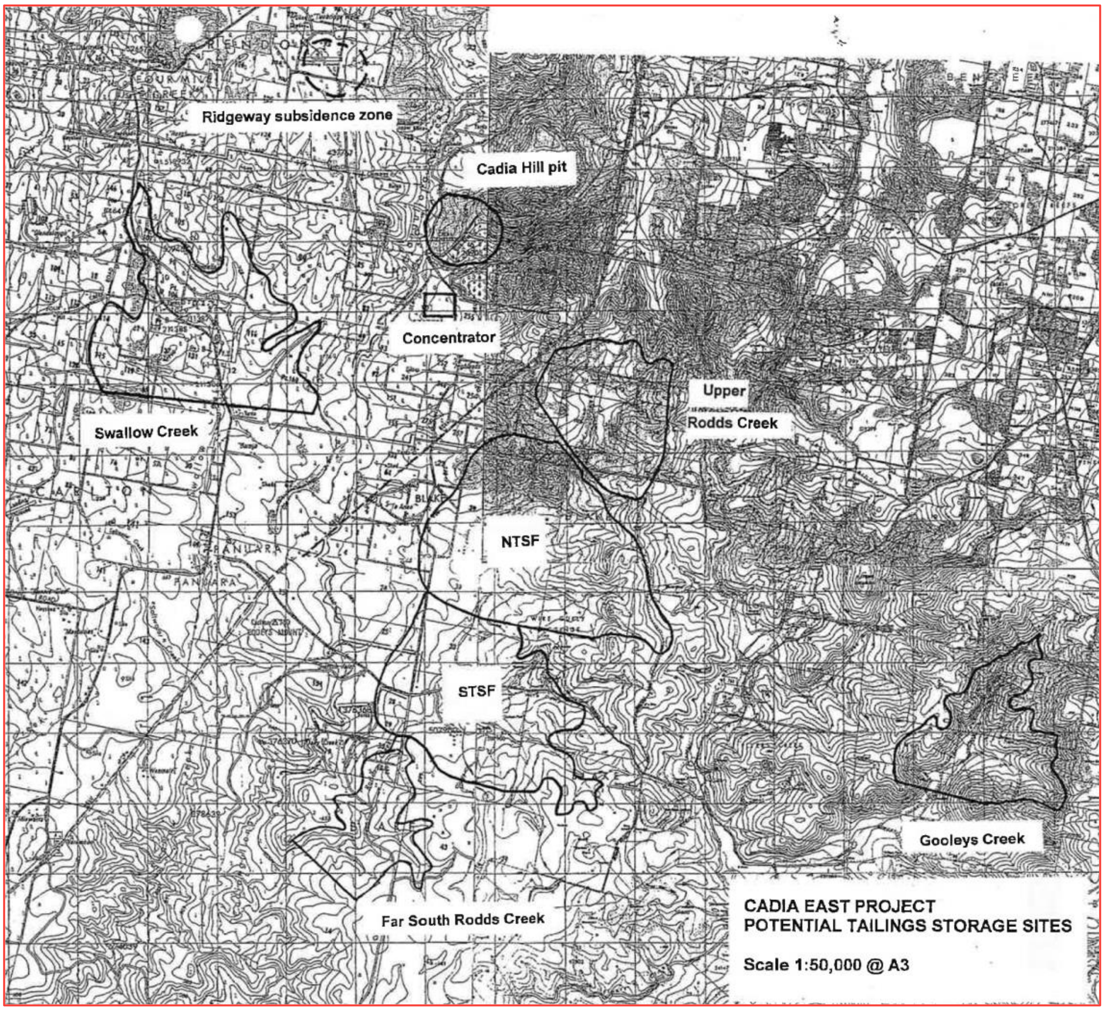


Figure 3.3 Early site location study (URS, 2005)

1. Ridgway subsidence zone
2. Swallow Creek
3. Far South Rodds Creek
4. Upper Rodds Creek
5. Gooleys Creek
6. Cadia Hill open cut.

In addition to the sites noted above, potential additional TSF sites were identified in the Cadiangullong and Flyers creek valleys. These sites were not further assessed, due to the presence of large upstream catchments, which would need diversion of flood runoff through or around the TSF, which would be expensive and difficult to implement.

### 3.3.4 Storage capacity outcomes

The storage capacity of the above-listed TSFs is presented in Table 3.1, where URS adopted an average dry density of 1.5 t/m³ when converting the storage volume to tonnage.

Table 3.1 URS study TSF capacities

| TSF | CAPACITY (Mt) |
|---|---|
| NTSF | 190 |
| STSF | 135 |
| Ridgway subsidence zone | 25 |
| Swallow creek | 285 |
| Far South Rodds Creek | 100 |
| Upper Rodds Creek | 150 |
| Gooleys creek | 360 |
| Cadia Hill open cut | 260 |
| **POTENTIAL COMBINED CAPACITY** | **1,505** |

### 3.3.5 Study outcome

The combined storage capacity of the TSFs presented in the URS study would have been more than sufficient to meet the then LOM requirement, based on the following assumptions:

- The NTSF and STSF could be raised safely to the heights suggested by URS.
- The establishment of multiple TSFs would be acceptable, requiring a significant volume of rock for each of the TSF embankments.

However, the URS study further notes that:

- The efficiency of these TSFs would be generally poor, where efficiency is the ratio between the tailings storage volume and the embankment material volume.
- Some of the TSFs are located in new stream catchments, for which there would be potential environmental and regulatory hurdles associated.

It was considered that given the poor efficiency outcome, it was unsuitable to use multiple TSF sites. CVO concluded that the URS study did not yield a suitable site and technology solution to support future tailings requirements and that further options studies were required to select a site that met environmental, resource potential and community criteria.

## 3.4 Golder 2012

Engineering and consulting firm Golder Associates (Golder) was engaged by CVO in 2012 to carry out a TSF location study review.

### 3.4.1 Study scope

Golder was engaged to assess alternative sites for additional storage capacity for approximately 100 Mt of dry tailings, which would be required by 2030 (the date for which tailings operations at the mine were licensed) (Golder, 2012). This storage capacity was required in addition to the available capacities of NTSF and STSF when raised to their expected full heights (URS, 2005).

This arose from the increased tailings generation rate of 35 Mtpa, compared to the initially assumed generation rate of 27 Mtpa. The 100 Mt capacity was required over a period of approximately 12 years, resulting in a tailings generation rate of approximately 8 Mtpa (equivalent to the ramp up in production).

Though the additional 730 Mt (resulting in the total required storage capacity of 830 Mt of dry tailings to the LOM, refer Section 3.3.1) of dry tailings were not the main focus of the assessment, they were considered for potential longer-term requirements.

### 3.4.2 Tailings disposal methods

The studies considered the following deposition methods:

- Paste: thickened tailings to a 'paste' consistency, similarly to the method described in Section 3.3.2, but proposing a solids concentration of 68% to 70% w/w (or higher).
- Dry stack (filtered tailings): this method consists of a further step from tailings thickening undertaken for paste system and can dewater tailings to a solids concentration of more than 75% solids w/w, resulting in a filter cake that has to be moved on a conveyor belt or by truck.
- Hydrocyclone sand wall embankment: this system uses hydrocyclones which split the tailings into two fractions, being a coarser (underflow) fraction used to construct the confining embankments and a finer overflow fraction (sometimes referred to as 'slimes') that is stored behind the embankments. The hydrocyclone sands construction method allows for relatively steeper more stable outer slopes.
- Co-disposal with waste rock: similarly to the method described in Section 3.3.2, but considering tailings disposal into existing waste rock dumps.
- Central thickened discharge: as described in Section 3.3.2.
- Conventional (thickened) slurry: as described in Section 3.3.2.

### 3.4.3 Potential TSF sites

The potential TSF sites identified by URS (URS, 2006) were reassessed by Golder in 2012 (Golder, 2012). The TSF sites considered are shown in Figure 3.4 and are as follows:

1. Ridgeway void and underground
2. Copper Gully
3. Cadia creek (Cadiangullong)
4. Cadia Open Cut Pit
5. Rodd's Creek dam
6. Cadia East
7. Waste rock dump
8. Bundella Valley (Swallow Creek)
9. Far South Rodds creek
10. NTSF and STSF.

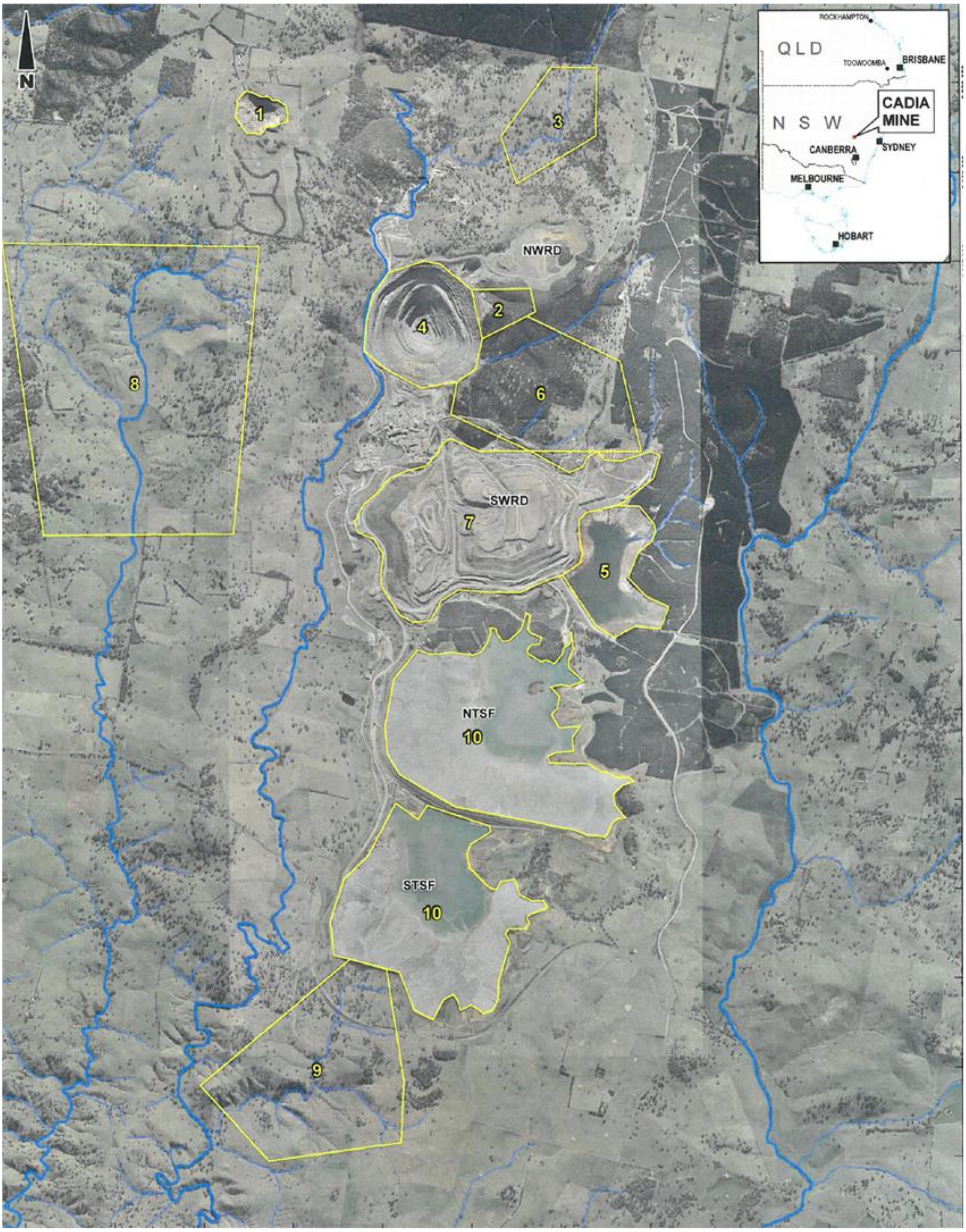


Figure 3.4 Potential TSF sites considered

### 3.4.4 TSF option ranking

The TSF options were ranked using a weighted semi-quantitative method, which allowed for the identification of a shortlist of the following options:

1. Use the existing NTSF and STSF by converting to thickened tailings (high density with central discharge or paste).
2. Place tailings into the Cadia Pit as a paste.
3. Place tailings as a paste into the subsidence zone above the Cadia East workings.
4. Convert Upper Rodd's Creek Dam into a supplementary TSF, establish a new process water storage dam and continue deposition into all three facilities with tailings as a thickened slurry.
5. Convert the existing TSFs into facilities with hydrocyclone sand wall embankment, potentially accommodating a higher volume of material within the same footprint area.
6. Construct a new TSF to the south of the STSF – the "Far South Rodd's Creek TSF" and operate in tandem with the NTSF and STSF, assuming slurry tailings deposition (58% to 62% by mass).
7. Discharge of tailings into existing waste rock dump (WRD) Pit 1 and Pit 2.

### 3.4.5 Storage capacity outcomes

The tailing storage capacities of the options studied by Golder as of 2012, all for a conventional thickened tailings slurry, are shown in Table 3.2, based on a 1.5 t/m³ average stored dry density for the tailings.

Table 3.2 Golder TSF ranking outcomes

| OPTION | CAPACITY (Mt) |
|---|---|
| 1 – NTSF & STSF | 497 |
| 2 – Cadia pit (PTSF) | 237 |
| 3 – Cadia East subsidence | 320 |
| 4 – Upper Rodd's Creek Dam – raised | 120 |
| 5 – Existing TSFs with hydrocyclone sand wall embankments | ~497 |
| 6 – Far South Rodd's Creek | 264 |
| 7 – Waste rock dumps | 75 |
| **POTENTIAL COMBINED CAPACITY** | **2,010** |

The caveats for the TSFs presented in Table 3.2 from this assessment are:

- Assumed NTSF and STSF can be raised safely to their full heights.
- A tailings slurry could be pumped into the Cadia East subsidence without causing life-threatening mud-rushes underground – though this was later proven not to be correct, mud rushes/flows into pits were a critical risk.
- An alternative water dam could be constructed to replace the Upper Rodd's Creek Dam and it could be successfully raised – previous studies undertaken identified that the two preferred locations for construction of additional water dams at the site were the Lower Cadiangullong Creek and the Lower Rodd's Creek sites.

### 3.4.6 Study outcome

Despite most alternatives providing sufficient storage capacity for the additional 100 Mt (except for Option 7), not one single tailings facility would be able to accommodate the total additional tailings of 830 Mt to the LOM. A combination of options would need to be considered. As such, it was concluded that the options presented in the 2012 Golder report did not adequately meet CVO's technical requirements.

## 3.5 Golder 2016 to 2018 studies

### 3.5.1 Initial study scope

In 2016 Golder investigated storage capacity options for an increased total tailings output of 960 Mt delivered at a rate of 32 Mtpa for 30 years. This study re-considered the sites identified in previous studies and extended the study area, in view of considerations of the previous study outcomes.

### 3.5.2 Tailings disposal methods

Only conventional thickened and dry stack tailings disposal methods were considered in the Golder 2016 study. Hydrocyclone sand wall embankment was not considered as it had not been previously used in Australia for the construction and operation of TSFs.

### 3.5.3 Potential TSF sites

The following sites were considered for conventional thickened tailings (Golder, 2017a). These locations are shown in Figure 3.5.

- TSF1: Swallow Creek, north end
- TSF2: Swallow Creek, middle
- TSF3: Swallow Creek, south
- TSF4: South Rodd's Creek
- TSF5: Gooleys Creek.

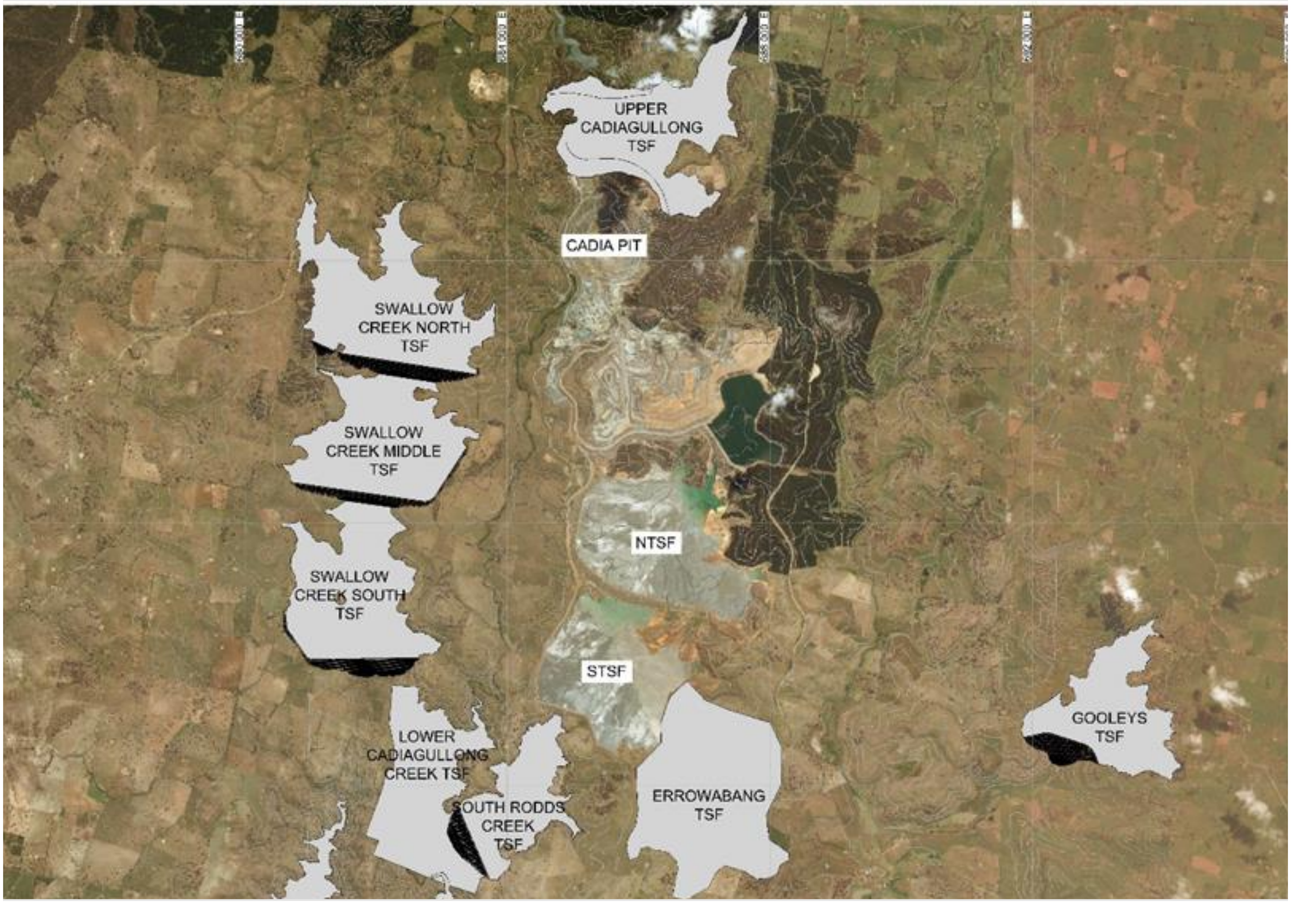


Figure 3.5 TSF sites considered in Golder 2017 studies

### 3.5.4 *Storage capacity outcomes*

The tailing storage capacities of the options studied by (Golder, 2017a), all for a conventional thickened tailings slurry, are shown in Table 3.3.

Table 3.3 TSF capacities

| TSF | CAPACITY (Mt) | CAPACITY (M3) |
|---|---|---|
| Swallow Creek north | 214.1 | 158.6 |
| Swallow Creek middle | 229.2 | 169.8 |
| Swallow Creek south | 133.6 | 98.9 |
| South Rodd's Creek | 94.3 | 69.9 |
| Gooleys Creek | 88.7 | 65.7 |
| **POTENTIAL COMBINED CAPACITY** | **759.8** | **562.8** |

The combined storage capacity of the proposed TSFs did not meet the LOM tailings requirement.

The option of dry stacking the tailings in the Swallow creek TSFs was also investigated and this provided about 167 Mt of capacity. However, the technical challenges constructing a dry stack across a valley counted against this option.

## 3.6 Wider site search

A decision was made by Cadia to carry out further site assessments to attempt to locate a LOM site for a TSF in the vicinity of Cadia (Golder, 2017b), outside and adjacent to its mining lease area. The search was extended to a 40 km radius around the mine, as shown in Figure 3.6.

The criteria used for this search included:

- Relatively flat ground area.
- Site not located on intensive agriculture land.

A single site was identified about 35 km to the west of CVO, in broad farmland. This site could only be regarded as suitable in theory and was not credible for a range of reasons, not the least of which was the cost and complexity associated with mitigating risk to the environment and rural enterprises at both the site and along the transport pipe corridor.

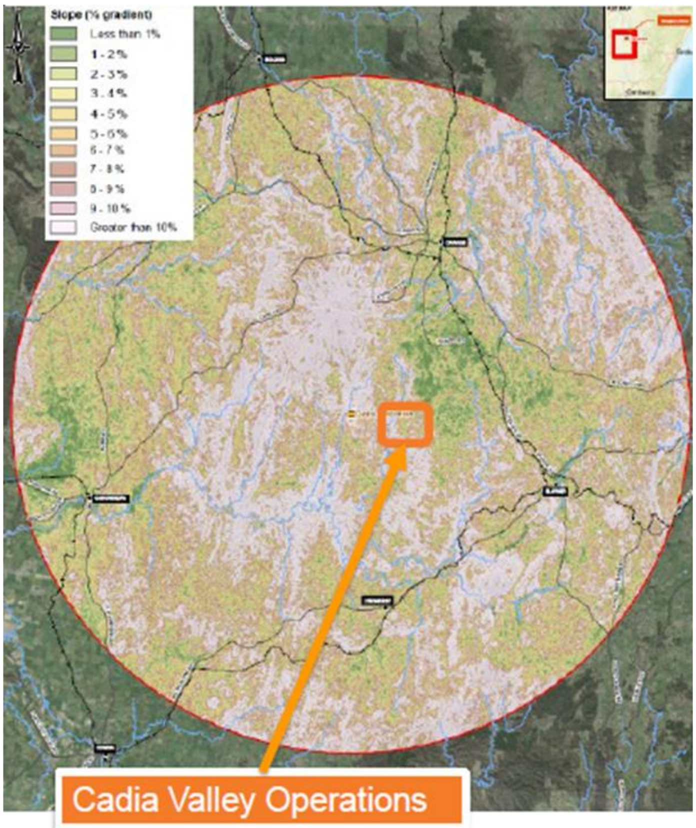


Figure 3.6 40 km radius TSF site search area

## 3.7 Alternative TSF site options

CVO then received a request from the Environmental Protection Agency (EPA) to assess feasibility of using existing pits/mine voids for tailings disposal. This conceptual study was carried out by Golder (2017c).

### *3.7.1 Ridgeway subsidence zone*

The Ridgeway mine is some 8 km to the north-west of the two process concentrators and has a void volume of about 23.8 $Mm^3$, which would potentially store some 35.7 Mt of tailings, assuming an average placed dry density of 1.5 $t/m^3$. The life of this storage would be 1.1 years at the current full mine tailings output rate of 32 Mtpa.

The Ridgeway subsidence zone was not inspected, but it was assumed that it was intact and would be able to store wet tailings without a risk of flooding the underground mine or causing significant environmental harm, such as negative impacts on the local groundwater regime. These are significant assumptions and would need to be verified during any studies leading to a modification or approval. Note that, at the time of these studies, Ridgeway was not being mined and therefore was considered a siting option. Newcrest currently intends to recommence mining activities at Ridgeway and therefore it is no longer considered an option for tailings storage.

The following works would be required in order to use the Ridgeway mine for storing tailings:

- Installation of a new slurry pumping and delivery pipeline system.
- Installation of a return water pipeline.
- Installation of a power line to the pit to power the return water pumps.

This option was not considered further due to its very limited storage capacity and the high cost of providing the required infrastructure.

### 3.7.2 Ridgeway underground

The storage volume available in the Ridgeway underground workings is reported to be 1.8 $Mm^3$, which would store just 2.6 Mt of tailings at the same average dry density assumed above. Not only is the storage volume underground very small, the challenges with using this storage are:

- Obtaining safe access underground to install the required equipment and to manage the tailings deposition operation.
- Installation of a new slurry pumping and delivery pipeline system.
- Installation of a return water pipeline.
- Installation of a power line to power the return water pumps.

This option was not considered further due to its extremely limited storage capacity and the high cost of providing the required infrastructure.

### 3.7.3 Cadia Hill pit

The Cadia Hill pit, located close to the two concentrators, had a potential tailings storage volume of 185 $Mm^3$, about 278 Mt of tailings at an average stored dry density of 1.5 $t/m^3$. While the Cadia Hill pit is close to the Cadia East underground mine, the underground workings plan indicates that neither the pit nor underground mine is likely to be compromised. This pit would thus be suitable to receive tailings in a slurry form and is currently receiving the full tailings output until the STSF is recommissioned. The pit has a remaining life of about 4.3 years (as at June 2023) at a rate of 32 Mtpa tailings output rate.

### 3.7.4 Cadia East underground mine

The Cadia East block-caving underground mine has a substantial subsidence zone that is continually increasing and would seem to be an ideal repository for tailings. However, there is a substantial risk that any tailings placed into the void, whether as a slurry or filtered, would either flow down or be washed down by rainfall into the mine and cause a serious mud-rush that could lead to fatalities. The only way tailings could be safely stored in this void would be to form cemented briquettes, so that they would not disintegrate and cause a mud flow.

In view of this risk, the Cadia East underground mine was discarded as a viable tailings disposal option at this time.

## 3.8 Additional TSF sites and storage capacity

Following liaison with CVO, Golder (2018a) updated the capacity modelling undertaken for the sites identified in 2017 (refer Section 3.5), to consider revised embankment heights and more accurate survey, and considered additional locations.

The updated modelling indicated that only Swallow Creek North and Swallow Creek Middle satisfied the annual tailings generation, but the combined storage capacity still did not meet the LOM tailings requirement.

The additional locations considered are as follows:

- Cadiangullong
- Lower Cadiangullong Creek
- Belubula River
- Errowanbang

The estimated capacities of the additional sites are listed in Table 3.4.

Table 3.4 Additional TSF capacities

| TSF | CAPACITY (Mt) |
|---|---|
| Cadiangullong | 489 |
| Lower Cadiangullong Creek | 210 |
| Belubula River | 766 |
| Errowanbang | 234 |
| **POTENTIAL COMBINED CAPACITY** | **1,699** |

### *3.8.1 Study outcome*

The combined storage capacity of these TSFs met the LOM tailings requirement, considering that:

- Cadiangullong and Lower Cadiangullong Creek TSFs would be located in new catchments, largely unaffected by mining activities at the time of the study.
- Errowanbang TSF was unlikely to affect any new catchments but was outside the mining lease.
- Belubula River TSF could only be regarded as an option in theory given the critical role the river plays in supporting local and downstream agricultural industries.

Most of the sites considered in the 2005-2018 studies had a limited storage capacity, so a combination of two or more TSFs would have to be operated simultaneously to meet the expected tailings output. In addition, these TSFs had a very limited tailings tonnage they could accept in their early years, due to the narrow valley topography and technical limits on rate of rise.

The TSF site options studies undertaken between 2005 and 2018 provided valuable insights (as described above) that led to CVO narrowing the list of final options to the Cadiangullong creek (North site, referred to as “Upper Cadiangullong TSF” in Figure 3.5) and the STSF Errowanbang (South site, referred to as “Errowanbang TSF” in Figure 3.5).

Additional studies were commissioned by CVO to test a range of disposal methods for each of the two chosen locations.

Further detail on this analysis process is provided in Section 3.9.

## 3.9 Golder 2018 to 2019 studies

In 2018, Golder investigated the Cadiangullong Creek site, known as the North site, and the Errowanbong site, known as the South site. These studies were provided in separate reports (Golder, 2018b) (Golder, 2018c).

In 2019, Golder prepared a single report (Golder, 2019), which included:

- A compilation of the findings from the 2018 reports.
- A range of geometries and combinations of disposal methods for the new TSF (both North and South sites).
- Options for extending the existing STSF.
- Information on the preparation and construction works required, as well as high level quantities associated with the works.

The tailings disposal methods considered in the Golder (2019) report were as follows:

- Conventional (thickened) slurry: similar to the method described in previous sections of this report.
- Paste: similar to the method described in previous sections of this report.
- Dry stack (filtered tailings): similar to the method described in previous sections of this report.
- Hydrocyclone sand wall embankment: similar to the method described in Section 3.4.2.

The only use of hydrocyclones for construction to date, in Australia, had been in the mineral sand dredge mining operations, where hydrocyclones were used to dewater the sands to re-construct sand embankments upstream of the dredge path. Hydrocyclone sand wall embankment is used widely in South and North America, a system dictated by law, to prevent liquefaction failures triggered by earthquakes. Hydrocyclone sand wall embankment TSF construction and operation was considered in subsequent studies in 2018, after Newcrest acquired a hydrocyclone sand wall embankment TSF in Canada. This acquisition provided CVO with a link to in-house operating experience and confidence in the method.

In total, 22 options are considered in the Golder (2019) report. A summary of the findings for the North and South sites are presented in Sections 3.9.1 and 3.9.2, respectively.

### *3.9.1 Cadiangullong Creek (North site)*

#### 3.9.1.1 Study scope

Golder investigated the Cadiangullong Creek site, known as the North site, as a potential TSF location and tested a range of tailings disposal methods for suitability.

The Cadiangullong creek site (North) is located immediately upstream of the Cadia Hill pit. Cadiangullong Creek flows around the pit in a diversion channel, flowing down from the water storage dam used to supply the Cadia mine, in a channel cut into the rock through the lower part of this valley. An earlier pit was excavated in this valley and was backfilled with random mine waste rock, there are also numerous mine infrastructure buildings and a disused farmhouse through the valley.

The valley is quite narrow in the lower elevations and only widens out at a height of about 80 m above the elevation at the outlet of the valley, north of the Cadia Hill pit. The creek rises further to the north, in land not held by Cadia, to the north of the Four Mile Creek road. A zoomed-in view of the site location is presented in Figure 3.7.


Figure 3.7 Cadiangullanong creek - North site (circled) (Golder, 2018b)

#### *3.9.1.2* TSF configurations considered

The following configurations were investigated in the study:

1. Option N1 – Upstream, slurry: embankment constructed across the Cadiangullong Valley, just upstream of the Cadia Hill pit and located partly over a backfilled pit. This option has a 40 m high starter embankment and tailings slurry would be deposited from the embankment, with 3 m upstream raises to a final 110 m height (vertical height between lowest point on the downstream toe of the embankment and the crest).
2. Option N2 - Downstream, upstream slurry: 109 m high embankment constructed downstream across the Cadiangullanon valley, located raised over the backfilled pit. Tailings slurry would be deposited upstream from the embankment.
3. Option N3 - Upstream, central discharged paste: 42 m high starter embankment and then uses 3 m upstream raises to contain the paste tailings, raised to a final height of 112 m.
4. Option N4 – dewatered tailings, stack: dry stack constructed in two 50 m raises, the outer faces would be dozed to a 4H:1V slope (approximately 14° with the horizontal plan) and covered with a 1 m thick erosion and dust suppression rock-mulch layer.
5. Option N5 - Cadia Hill pit, downstream, slurry: the embankment is located downstream of the Cadia Hill pit and upstream of the Process Plant. The height of the embankment is restricted by the need to maintain a 15 m offset from the embankment toe to the Cadia Hill pit and the Process Plant. The embankment would be constructed downstream raised to a height of 66 m through the life of the facility.
6. Option N6A – North of old pit, downstream, slurry: located north of the backfilled pit in the Cadiangullong valley. This option utilises downstream raises of the embankment through life of the facility to 100 m final height.
7. Option N6B – North of old pit, downstream, slurry: similar to Option N6A, but with the embankment crest raised to a height of 129 m, to take advantage of the topography.

8 Option N7A – South of water dam, downstream, slurry: located immediately south of the water storage dam. This option has a 100 m high downstream raised embankment, tailings slurry would be deposited from the embankment.

9 Option N7B – South of water dam, downstream, slurry: similar to Option N7A, but with the embankment raised downstream to a height of 130 m.

10 Option N8 – North of water dam, downstream, slurry: located north of the water storage dam. This option has the embankment constructed downstream raised to 97 m through the life of the facility. Tailings slurry would be deposited from the embankment, with the decant pond located at the upstream end of the tailings beach.

11 Option N9 – South of water storage dam (WSD), Downstream, paste: located south of the water storage dam. This option has the embankment constructed downstream raised to 100 m through the life of the facility. Paste tailings would be deposited into the TSF from 3 discharge locations, creating an essentially down-valley beach slope, to increase its tailings storage capacity.

12 Option N10A – South of water dam, downstream, slurry: located south of the water storage dam. This option raises the embankment downstream to 100 m through the life of the facility. Slurry tailings would be deposited into the TSF from three discharge locations, creating a beach slope towards the embankment, to increase tailings storage. The decant pond would be located against the embankment.

13 Option N10B – South of water dam, downstream, slurry: south of the water storage dam. This option raises the embankment downstream to 120 m through the life of the facility. Tailings slurry would be deposited from two discharge locations up the valley, creating down-valley beach slope, to maximise tailings storage, with the decant pond held against the embankment.

14 Option N11 – South of water dam, downstream, slurry, 0.4% beach slope: located south of the water storage dam. This option raises the embankment to 100 m through the life of the facility with downstream raise. Tailings slurry would be deposited from the upstream of the facility with three spigot points, creating a down valley discharge structure, to increase tailings storage, using a 0.4% (the NTSF and STSF beach slope at Cadia, at the time of the study).

#### 3.9.1.3 Advantages of North site

The main advantages associated with the North site were:

- The narrow valley results in reduced construction quantities for embankment.
- The site is within 5 km of the process plant.
- The site is located relatively further from neighbouring properties, compared to the South site.

#### 3.9.1.4 Impacts associated with North site

There were many issues associated with the north site that eliminated it from further consideration, including:

- The land is forested area to the north of the site, implementing the TSF at this location would result in significant impacts to biodiversity and plant community species as well as fauna.
- The Four Mile Creek road would need to be relocated.
- Increases failure risk profile when compared with the South site, due to process plant downstream.
- High capital cost associated with sediment and runoff control infrastructure.
- Cadiangullong Dam WSD would need to be replaced.
- The embankment would be founded on loosely backfilled mine waste over the Cadia north pit.
- TSF footprint extended over the existing Cadiangullong Dam.

- A major diversion channel and drop-structure would be needed to carry runoff from the 90 km² catchment located upstream of the TSF, divert runoff around the TSF and deliver it to the Cadiangullong diversion channel around the Cadia pit, which would:
    - Require a major excavation into the rock to form the diversion channel.
    - Result in significant environmental impacts.

#### 3.9.1.5 Study outcome

The early site layouts provided in the Golder concept design report (2019) indicated storage capacities varying between 76 and 937 Mt of capacity, as a function of the TSF configuration.

The North site option significantly contradicted several of CVO's agreed technical (failure risk, loose embankment foundation, relocation of Cadiangullong Dam), environmental and community (relocation of public road, disturbance of forested area and impact to biodiversity and plant community species, major diversion channel and drop structure to divert runoff from catchment area upstream, resulting in major environmental impacts) criteria and was discounted from further examination.

### *3.9.2 Errowanbang (South site)*

#### 3.9.2.1 Study scope

This study looks at the tailings disposal options on the Errowanbong (South) site valley, to the south of the Southern Tailings Storage Facility (STSF), a site that covers an area of about 1 000 Ha.

The South site is located immediately south of the STSF and is bounded to the east and south by Flyers Creek, with the lower Rodds Creek valley at the western end of this area. An overview of the site location is presented in Figure 3.8.

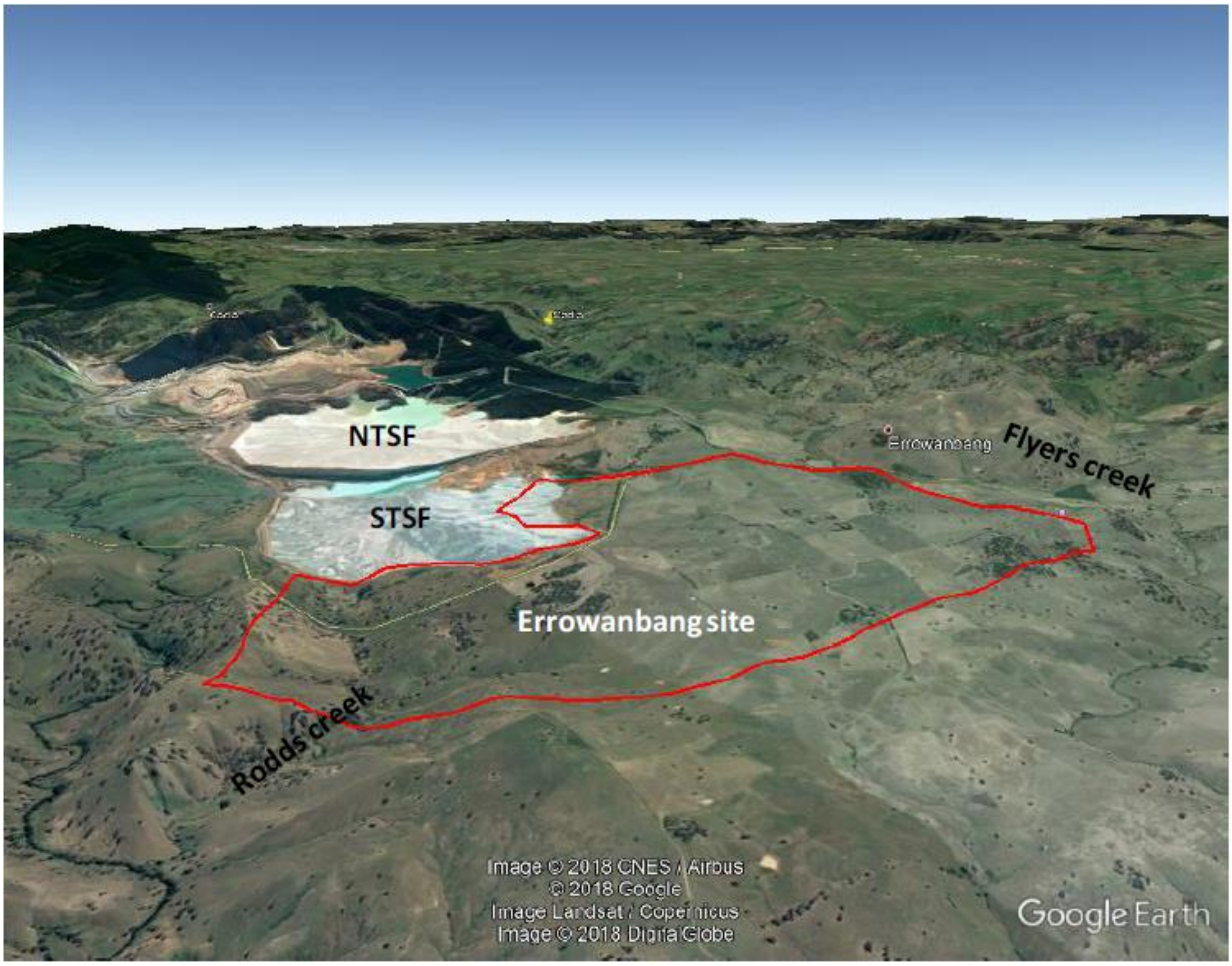


Figure 3.8 Errowanbang (South) site (Golder, 2018c)

#### 3.9.2.2 TSF configurations considered

The following disposal methods were investigated in the study:

1. Option S1 – downstream, slurry: spigot slurry discharge from a 110 m high downstream constructed embankment, allowing the full 32 Mtpa tailings output to be deposited through the life of this TSF.
2. Option S2 – upstream, slurry: a 30 m high starter embankment with a series of 3 m high upstream raises to the maximum height of 100 m.
3. Option S3 – upstream, paste, southern embankment discharge: a 30 m high starter embankment with a series of 3 m high upstream raises to the maximum height of 100 m. Paste tailings are deposited from a single discharge location at the high point of the site on the north side of the TSF.
4. Option S4 – upstream, paste, central discharge location: centrally discharged paste, with a 30 m high starter embankment and 3 m high upstream raised embankments.
5. Option S5 – dewatered tailings, stack: Similar to Options S1, S2, S3 and S4, Option S5 is located in the Errowanbang Valley east of the STSF.
6. Option S6 – cyclone tailings, stack: located in the Errowanbang Valley east of the STSF, as are Options S1, S2, S3, S4 and S5.
7. Option ST1 – East extension, downstream, slurry: extension of the STSF to the east of the STSF, to fill a valley up to the crest of the ridge, to the same final elevation of the STSF (RL 702 m).

8 Option ST2 – East extension and raise, upstream, slurry: comprises six 3 m upstream raise of the STSF to RL720 m and includes the eastern extension presented in Option ST1.

We note that during this study, in 2018, the failure of the NTSF occurred and, as a result, TSF upstream raising was discontinued at Cadia.

#### 3.9.2.3 Advantages of South site

Some advantages of the South site are:

- Adequate foundation conditions may be achieved.
- Most of the ground has a low slope of ±2.5%, falling from east to west.
- There is a very limited external catchment (it is within the current TSF catchment area and river system) and this runoff can be diverted relatively easily.
- There is a suitable location for a surface runoff sediment control dam in the lower Rodds Creek valley.
- Lower land disturbance, compared to the North site.
- Waterway impacts are negligible and no new catchment affected.

#### 3.9.2.4 Impacts associated with South site

The main impacts identified to be associated with the South site were:

- All options would be visible, to some extent, to the landholders to the east, south and west.
- The footprint is adjacent to Flyers Creek.
- The Panuara and Meribah roads would need to be relocated.
- The site is about 6.5 km from the process plant.

#### 3.9.2.5 Study outcome

The early site layouts provided in the Golder concept design report (2019) indicated storage capacities varying between 21 and 843 Mt of capacity, as a function of the TSF configuration.

The assessments undertaken indicated that the South site was the preferred option for expansion of tailings storage capacity.

## 3.10 Hatch 2019

### *3.10.1 Study scope*

The objective of the 2019 Hatch Concept Study (CS) (Hatch, 2019) was to prepare a multi criteria assessment and detailed risk and cost assessments of the TSFs options identified during the previous studies undertaken, in order to confirm that the South site was the most suitable option.

### *3.10.2 Tailings disposal methods*

The assessment considered the following tailings disposal methods:

- Conventional (thickened) slurry.
- Paste.
- Dry stack (filtered tailings).

- Co-mingling (tailings and coarse waste rock are mixed together within a storage facility or as a single discharge stream). Note that CVO no longer produces waste rock so this is no longer consider a viable option.
- Hydrocyclone sand wall embankment.

### 3.10.3 Potential TSF sites

The potential TSF sites considered were North, South, Far South, Far Far South, West Upper, West Middle, West Lower and STSF extension, as presented in Figure 3.9. These sites were later grouped as North, South, West and East.

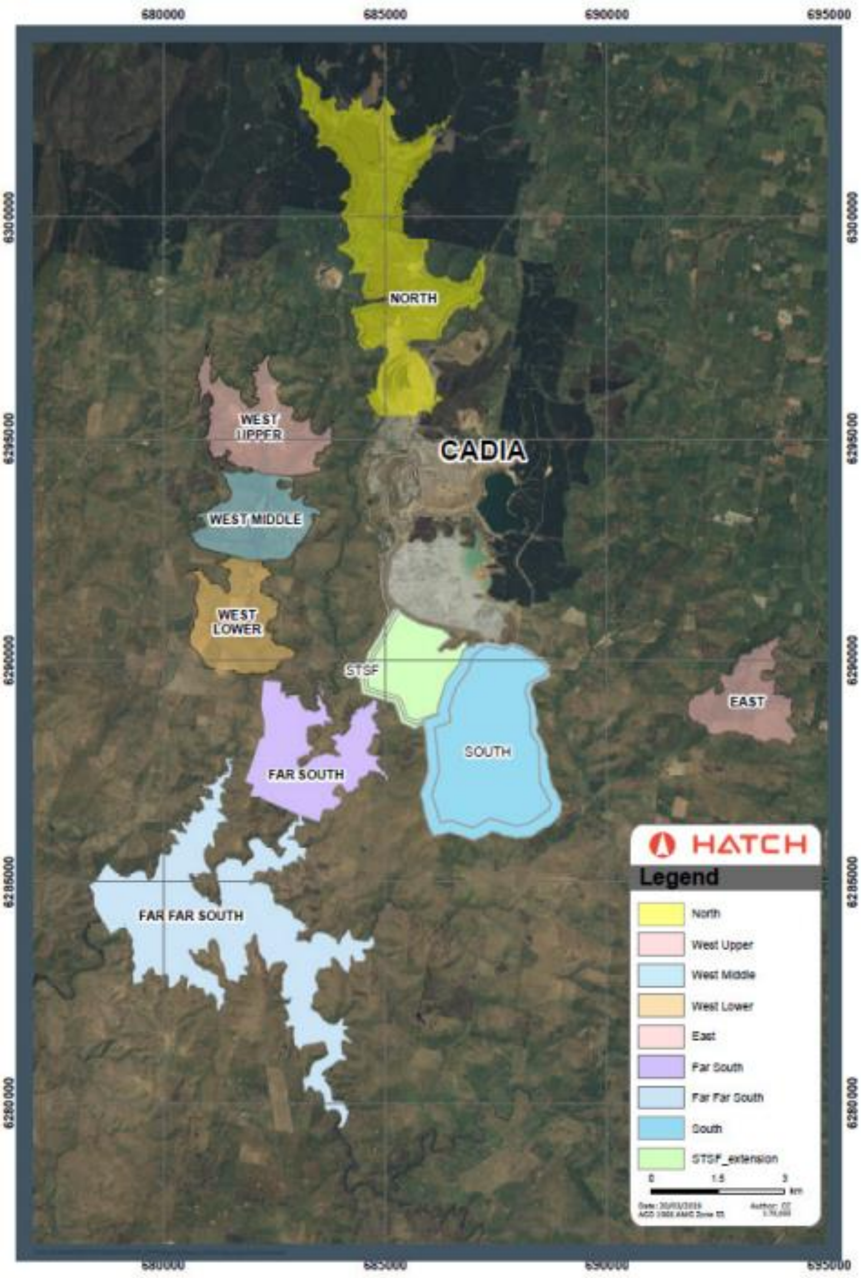


Figure 3.9 Locations considered for new TSFs (Hatch, 2019)

### 3.10.4 Multi criteria assessment

Hatch used the available information from previous studies undertaken and developed capital and operating costs for each of the options. Hatch combined these costs with the criteria listed below into a high-level multi criteria assessment (MCA) to select the most suitable sites and deposition methods.

#### 3.10.4.1 Criteria considered

The criteria used for the high-level MCA comprised of:

- Geotechnical Failure Impact Consequence Catastrophic (GFICC): assesses whether potential TSF failure is catastrophic or not. Rating was independent of probability of failure, rather it was a function of the consequence if it occurred.
- Single or multiple TSFs required: based on whether the TSF could provide storage capacity to LOM tailings storage (approximately 700 Mt) and annual tailings generation rate (32 Mtpa). The criterion was rated either a 'YES' (the TSF meets both LOM and annual tailings rate) or 'NO' (the TSF option does not meet both LOM and annual tailings rate, therefore a secondary TSF would be required).
- Resource sterilisation: assesses whether there is a potential for coverage of unexplored mineral resources by the TSF, making them inaccessible and hence impractical to mine.
- Community and environmental acceptance: based on whether the TSF would be accepted by the community and environmental stakeholders or deemed unacceptable.
- Financial: considers capital costs (once-off initial investments to establish the facility) and operational costs throughout the life of the facility. Provides support information at a high level for decision. Further information on financial estimates is presented in Section 3.10.6.

#### 3.10.4.2 Outcome

The assessment indicated that:

- Several TSF options could not meet the annual tailings generation rate and/or the LOM tailings storage requirements.
- All the East and West TSF options failed due to insufficient storage capacity and extreme environmental and community concerns associated with them.
- All North options assessed as part of the Golder (2019) study were deemed high risk and were eliminated, due to the following:
    - The consequence of failure of the TSFs located upstream of the Process Plant was deemed unacceptable. This has been defined in the context of the permanent presence of the downstream population at risk (PAR) at the Process Plant, in comparison to the presence of itinerant population downstream of the South locations.
    - The need for relocation of the water dam would result in major works.
    - The North site options would result in resource sterilisation, which was not acceptable.
- The only TSF options that satisfied all the 'YES' or 'NO' criteria were the South site options, being:
    - South conventional (thickened) slurry downstream raised embankment (Option S1 in Golder (2019)).
    - South conventional (thickened) slurry upstream raised embankment (Option S2 in Golder (2019)).
    - South dry stack (filtered tailings) (Option S5 in Golder (2019)).
    - South hydrocyclone sand wall embankment (Option S6 in Golder (2019)).
- The South conventional (thickened) slurry downstream raised embankment (Option S1 in Golder (2019)) was regarded as unfeasible due to extensive quantities of materials required for the construction works.
- The South sites associated with upstream embankments for conventional (thickened) slurry and paste have limited allowable rates of rise that do not meet the CVO production rates at the time. However, subject to the possibility of concurrent operation with the existing TSFs and the size of starter embankment, this option could still be viable.

As a result, only Options S2, S5 and S6 were considered worthy of further investigation.

The findings of this MCA are summarised in Figure 3.10, in which terminology is adopted as follows:

- Method:
    - ‘Wet’ refers to conventional (thickened) slurry and paste.
    - ‘Dry’ refers to dry stack (filtered tailings).
    - ‘Cyclone’ refers to hydrocyclone sand wall embankment.
- Construction:
    - ‘US’ refers to upstream raised embankments.
    - ‘DS’ refers to downstream raised embankments.
    - ‘NA’ refers to not applicable (relevant for dry stack deposition method).

| LOCATION | NORTH | | | SOUTH | | | | EAST | | | WEST | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | Wet | | Dry | Wet | | Cyclone | Dry | Wet | | Dry | Wet | | Dry |
| CONSTRUCTION | U/S | D/S | NA | U/S | D/S | U/S | NA | U/S | D/S | NA | U/S | D/S | NA |
| Geotechnical Failure Impact Consequence Catastrophic (GFICC) (Unacceptable) | Y | Y | Y | N | N | N | N | N | N | N | N | N | N |
| Multiple TSF required to accommodate annaul or LOM tonnage | Y | N | Y | Y | N | N | N | Y | Y | Y | Y | Y | Y |
| Resource Sterilisation | Y | Y | Y | N | N | N | N | N | N | N | N | N | N |
| Community & Environment Acceptance | Y | Y | Y | Y | Y | Y | Y | N | N | N | N | N | N |
| Financial ($/t for LOM): $\frac{CAPEX + Total\ OPEX\ over\ Life}{Total\ Capacity}$ | 1.5 | 1.1 | 4.68 | 0.87 | 3.31 | 1.75 | 4.24 | 4.13 | N/A | N/A | 1.54 | N/A | 17.0 |
| **RECOMMENDED OPTIONS**<br>FAIL - A TSF Option is failed if the:<br>GFICC = Y or,<br>Multiple TSF = YES, or<br>Resource Sterilisation = YES | **FAIL** | **FAIL** | **FAIL** | **Y** | **Y** | **Y** | **Y** | **FAIL** | **FAIL** | **FAIL** | **FAIL** | **FAIL** | **FAIL** |

Figure 3.10 MCA of locations against high-level thresholds (Hatch, 2019)

### 3.10.5 Risk assessment

Risk assessment activities were undertaken to identify health, safety, environmental and community risks associated with establishing a new TSF. These activities entailed a HAZard IDentification (HAZID) workshop, a high-level project risk register and a detailed community and environmental review.

#### 3.10.5.1 Main risks identified

The main risks related to health, safety, environment and community that were identified for the project are summarised in Figure 3.11.

| No. | Risk Description | Inherent Rating | Current Rating | Target Rating |
|---|---|---|---|---|
| 6 | Environmental impact of project | 8 - High | 8 - High | 12 - Medium |
| 7 | Permits not granted s required | M7 - Material Risk (Action Required) | M7 - Material Risk (Action Required) | M9 - Material Risk (Ongoing Control) |
| 8 | Inability to acquire required land | M7 - Material Risk (Action Required) | M7 - Material Risk (Action Required) | M9 - Material Risk (Ongoing Control) |
| 9 | Embankment failure | M7 - Material Risk (Action Required) | M7 - Material Risk (Action Required) | M11 - Material Risk (Ongoing Control) |
| 10 | Community objection to project | M7 - Material Risk (Action Required) | M7 - Material Risk (Action Required) | M9 - Material Risk (Ongoing Control) |

Figure 3.11 Summary of risks identified during project risk review (Hatch, 2019)

### 3.10.5.2 HAZID workshop

The HAZID workshop was held on 2 November 2018 and was facilitated by Allman Consulting Pty Ltd (risk consultant), with attendees from Hatch, Newcrest and Golder. A summary of the HAZID findings is presented in Figure 3.12, which shows a table of Current and Target ratings for hazards identified to be associated with combinations of the tailings disposal methods and potential TSF sites described in Sections 3.10.2 and 3.10.3. For example, 'Dry Stack North' has 29 'High' level risks, compared to a target of 23 High level risks in the Newcrest risk assessment tool.

| | CURRENT RATINGS | | | | | | TARGET RATINGS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Option | Material Risk (Action Required) | Material Risk (Ongoing Control) | Extreme | High | Medium | Low | Material Risk (Action Required) | Material Risk (Ongoing Control) | Extreme | High | Medium | Low |
| Cyclone South | | 1 | 8 | 7 | 4 | 3 | | | | 12 | 2 | 9 |
| Dry Stack South | | 1 | 15 | 27 | 9 | 5 | | | 1 | 23 | 20 | 13 |
| Dry Stack North | | 1 | 13 | 29 | 9 | 5 | | | 1 | 23 | 20 | 13 |
| Dry Stack Upper West | | 1 | 13 | 29 | 9 | 5 | | | 1 | 23 | 20 | 13 |
| Dry Stack Middle West | | 1 | 13 | 29 | 9 | 5 | | | 1 | 23 | 20 | 13 |
| Dry Stack Lower West | | 1 | 13 | 29 | 9 | 5 | | | 1 | 23 | 20 | 13 |
| Paste South | | 2 | 4 | 8 | 6 | 4 | | | | 9 | 4 | 11 |
| Paste North | | 2 | 4 | 8 | 6 | 4 | | | | 9 | 4 | 11 |
| Wet Upper West | | 1 | 8 | 6 | 3 | 2 | | | | 12 | 2 | 6 |
| Wet Middle West | | 1 | 8 | 6 | 3 | 2 | | | | 12 | 2 | 6 |
| Wet Lower West | | 1 | 8 | 6 | 3 | 2 | | | | 12 | 2 | 6 |
| Wet South West | | 1 | 8 | 6 | 3 | 2 | | | | 12 | 2 | 6 |
| Wet East | | 1 | 8 | 6 | 3 | 2 | | | | 12 | 2 | 6 |
| Wet South | | 1 | 8 | 6 | 3 | 2 | | | | 12 | 2 | 6 |
| Wet North – Option 1 | | 1 | 8 | 6 | 3 | 2 | | | | 12 | 2 | 6 |
| We North – Option 2 | | 1 | 8 | 6 | 3 | 2 | | | | 12 | 2 | 6 |
| Existing thickener | | | 9 | 15 | 4 | 2 | | | | 14 | 9 | 7 |
| High density paste | | 2 | 2 | 9 | 6 | 5 | | | | 7 | 4 | 13 |
| High density filtered | | 2 | 11 | 20 | 7 | 6 | | | 1 | 15 | 15 | 15 |
| Comingled waste | | 1 | 5 | 16 | 5 | 3 | | | | 11 | 10 | 9 |
| Split system | | 1 | 5 | 16 | 5 | 3 | | | | 11 | 10 | 9 |

Figure 3.12 Current and target ratings for hazards associated with TSF options (Hatch, 2019)

### 3.10.5.3 Community and environmental review

Newcrest undertook a community and environmental review in November 2018, to identify potentially material issues and rank the options relative to these issues. The review was conducted during a workshop on-site attended by the Newcrest Study Manager, HSEC Manager and the Superintendent – Environment and Community Relations.

A snapshot of the key issues raised from the workshop is presented in Table 3.5.

Table 3.5 Summary of key environmental, community and capital impacts (Hatch, 2019)

| | **Preferred Locations** | | | |
|---|---|---|---|---|
| Impact | West | South | North | East |
| Environment | New catchment (destruction of new creek ecology, required creek diversion. | Same catchment (no new creek diversion). | Same catchment (potential to use Forestry Land which is already degraded), features creek diversion. | New catchment (destruction of new creek ecology, requires creek diversion). |
| | | Possible Endangered Ecological Communities (EEC). | Possible EEC. | Possible EEC. |
| | Prime agricultural land. | Prime agricultural land. | | Prime agricultural land. |
| Community | Public road diversion – greater isolation for Panuara community. | Two directly impacted stakeholders. | Not directly visible to surrounding community. | Predominantly new stakeholder community – no previous relationship with Cadia, have formed an activist group to oppose the Flyers Creek Wind Farm with some success. |
| Capital Considerations | Land acquisition for footprint and buffer. | Land acquisition for footprint and buffer. | Land acquisition for footprint and buffer. | Land acquisition for footprint and buffer. |
| | | Offset for EEC. | Offset for EEC. | Offset for EEC. |
| | | | Sacrifice Cadiagullong Dam. | |
| | | | Sterilises Big Cadia resources. | |
| Community/Regulatory Opposition (1 Low to 10 High) | 10 | 7-8 | 4 | 10 |

### 3.10.5.4 Outcome

The assessments undertaken indicated that the North and South sites were preferred, as they were within the existing Cadiangullong Creek catchment that is already affected by Cadia. These sites were then considered for the Concept Study.

### 3.10.6 Investment evaluation and financial analysis

Hatch undertook an investment evaluation and financial analysis as part of the Concept Study, which included assessments of Capital Expenditure (CAPEX) and Operating Expenditure (OPEX), to support progressing towards a PFS.

#### 3.10.6.1 TSF configurations considered

Following the MCA (refer Section 3.10.4) and risk assessment (refer Section 3.10.5) processes, the range of combinations between tailings disposal methods and potential sites was progressively filtered, based on considerations of functional adequacy, risk, community and environmental impact and cost.

This process led to the following list of limited TSF configurations, to be considered for the financial analysis:

- Option S2 – South site, conventional (thickened) slurry, upstream raised embankment.
- Option S4 – South site, paste, upstream raised embankment.
- Option S5 – South site, dry stack (filtered tailings).
- Option S6 – South site, distributed hydrocyclone sand wall embankment.
- Option S7 – South site, centralised hydrocyclone sand wall embankment.
- Option N9 – North site, paste, downstream raised embankment. Note that this was the only North site considered, given the outcomes shown in Section 3.10.5.2 – this option was deemed to have an acceptable level of risk to progress to the next step.

#### 3.10.6.2 Investment outcome

The key findings from the TSF financial analysis were:

- On a cost and risk basis, only three options located in the South site were considered viable:
  - S5 - South Dry Stack
  - S6 - South Cyclone
  - S7 - South Cyclone
- The TSF required to fulfil the Cadia LOM was not within the current mine-owned land.

As previously stated in Section 3.9.2.2, upstream raising was subsequently dismissed as a viable option due to the 2018 dam wall breach at the NTSF.

### 3.10.7 Study outcome

In combination, the initial high-level MCA, the HAZID workshop, the community and environmental review, and the investment and financial analysis indicated that three options in the South site (Options S5, S6/S7) should be progressed to PFS stage. This conclusion is based on the following factors:

- Environmental: the South sites are situated within the same catchment meaning there is no new creek diversion, there is possible EEC and it is prime agricultural land.
- Community: the South sites are in proximity to two directly impacted stakeholders, including one landholder who owns four properties. The sites are subject to strong community attention.
- Capital: the South sites require land acquisition for footprint and noise impact buffer, and offsets for EEC.

The North site would include a new creek diversion, possible EEC, heritage issues, land acquisition for the footprint and the sacrifice of Cadiangullong Dam and sterilisation of Big Cadia resources. On balance, in contrast to the impacts identified for the North site, the South sites were considered to hold an acceptable level of risk to progress to PFS stage.

The findings from these analyses therefore informed the development of the PFS completed by Golder in 2021 (see Section 3.11).

This report acknowledges that the initial MCA undertaken by Hatch in 2019 did not use weighed criteria (it only included ‘yes’ or ‘no’ ratings, except for the cost assessment). Therefore, Newcrest and WSP (now incorporating Golder) undertook an additional MCA in 2023 applying a detailed weighting system in retrospect, which is presented in Section 3.11.

## 3.11 Golder 2021

### *3.11.1 Study scope*

Following completion of the 2019 Hatch concept study, in 2021 Golder completed the PFS for one LOM TSF option located at the South site. This option was then termed TSF4 (Golder, 2021), which later became the STSFX. The approximate location of TSF4 is presented in Figure 3.13, the boundary of additional land purchased by Newcrest (the Knox property) is presented in orange.

The report included detailed engineering studies to a sufficient level to support the PFS, including preliminary geotechnical investigation, slope stability analysis, seepage analysis, assessment of liquefaction potential, freeboard assessment, deformation analysis, deposition plan, water management, consequence category assessment and risk assessments. One of the key outcomes of this study was to optimise the alignment of the TSF.

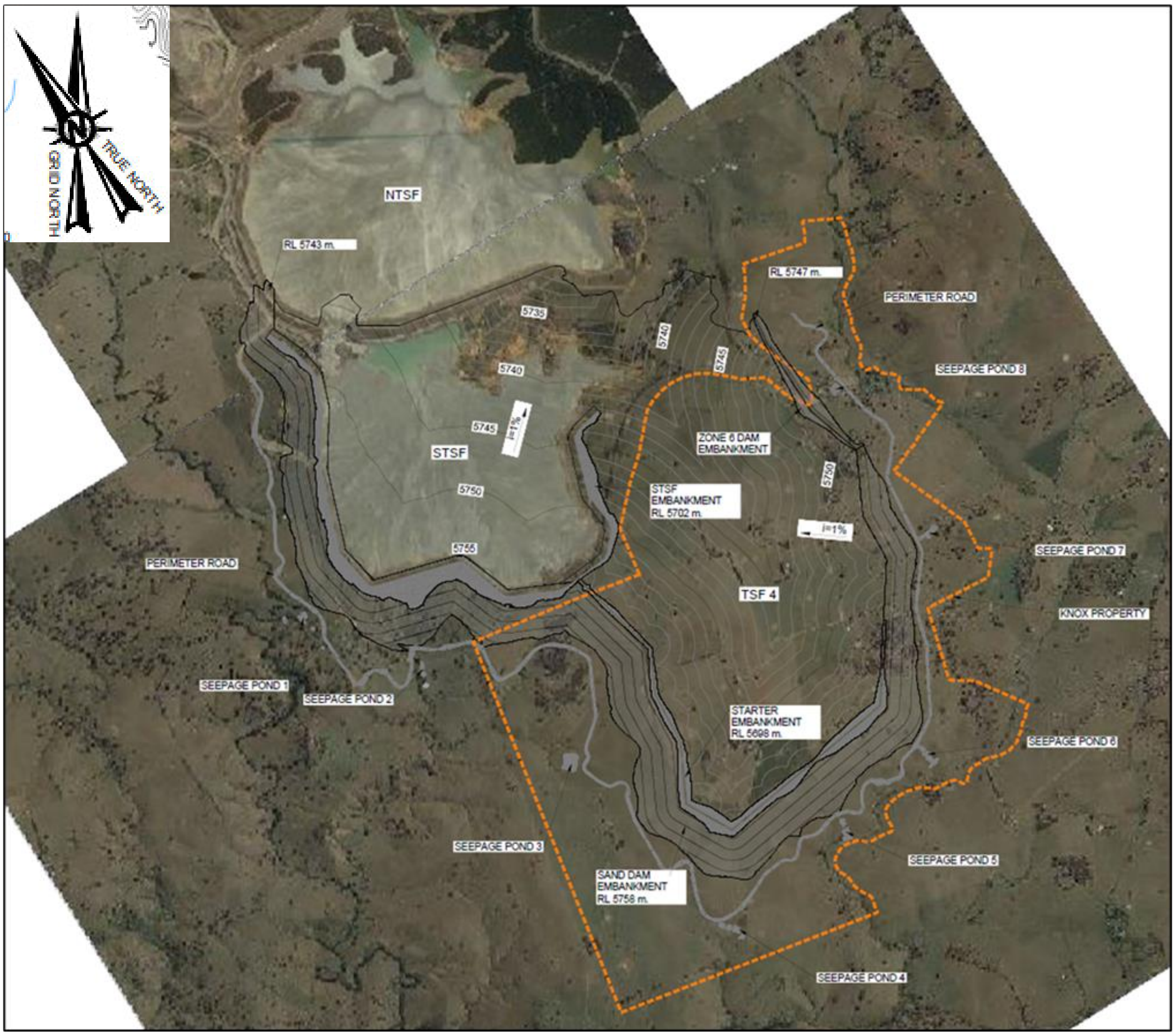


Figure 3.13 Approximate location of TSF4 (Golder, 2021)

The shortfall in tailings storage capacity considered in the report was equivalent to 1,084 Mt.

### 3.11.2 Tailings disposal methods

Four tailings storage options were initially considered as part of the PFS, which are outlined below. Note that a detailed description of the selection of the tailings deposition method is presented in Section 5.

1. Option 1 – Conventional (thickened) slurry.
2. Option 2 – Paste.
3. Option 3 – Dry stack (filtered tailings).
4. Option 4 – Hydrocyclone sand wall embankment, with a sand slurry (underflow) fraction at 70% solids content w/w and slimes slurry (overflow) fraction at 55% solids content w/w.

During the PFS:

- ATC Williams was responsible for the design of paste and thickened tailings TSFs.
- Golder was responsible for dry stacking and hydrocyclone sand wall embankment TSFs

- Wood was responsible for development of process and infrastructure to support above TSF options. Wood produced a consolidated PFS report that documented the above studies.

In the Golder 2021 study, dry stacking was initially considered, but it was not feasible from a technical or environmental perspective, so it was not progressed further. Further discussion about consideration of tailings disposal methods in included in Section 5. Therefore, the Golder 2021 study predominantly progressed Option 4, considering the centreline construction method, adopted based on initial estimates of sand availability.

### 3.11.3 Study outcome

The key outcome from the Golder study was the refinement of the TSF4 layout, away from properties to the east and Flyers Creek and Errowanbang woolshed. The TSF layout was also integrated with the STSF to minimise the overall disturbance area and limit the height of the facility.

Newcrest completed a review of the PFS documents prepared for TSF4. Following liaison with Newcrest stakeholders and consideration of the risks associated with each TSF option, Newcrest opted to further progress Option 4 (hydrocyclone sand wall embankment) for TSF4.

The Golder (2021) report provided a list of items that should be considered/investigated as the design progresses, ranging from operational parameters, design criteria, further investigations and site characterisation, design activities, construction planning, operations and governance.

## 3.12 Klohn Crippen Berger 2022

### 3.12.1 Study scope

The Golder (2021) report identified opportunities to improve the alignment of TSF4 embankment. During the PFS stage, it was also recognised that consultation with the community would be required prior to finalising the final alignment of TSF4 embankment. Following the announcement of CCOP, CVO then carried out consultation with the local stakeholders, to gather feedback on the alignment of TSF4 at its southern and eastern boundaries (Klohn Crippen Berger, 2022). From here on, TSF4 was referred to as 'STSFX'.

The final alignment for STSFX needed to be defined prior to advancing the feasibility studies (FS) design stage, to produce the environmental impact statement (EIS) and was required as an input for the design of adjacent structures (for example, realignment of Panuara Road) (Klohn Crippen Berger, 2022).

Acknowledging the importance of definition of the TSF4 alignment and the associated impacts, CVO engaged engineering consulting firm Klohn Crippen Berger (KCB) to undertake a MCA process to assess various alignment options considered for STSFX.

### 3.12.2 Multi-criteria analysis

Nine layout options were presented for consideration and considered for the MCA process. A modified version of Option 5 was also presented, referred to as Option 5A. The layout options considered are summarised in Figure 3.14.

| Option # | Configuration Change from PFS |
| --- | --- |
| 1 | Realigned in northeast corner to avoid Cadia Road. Eastern embankment moved to west (further from residences to east). |
| 2 | As for Option 1 with western embankment moved to west into Rodds Creek Valley. Footprint retained within Project Area Boundary. |
| 3 | As for Option 1 with southern embankment moved ~2km north, away from residences to south. Overall footprint is reduced which increases TSF4 height. |
| 4 | Similar to Option 3 but southern embankment moved ~1km north. |
| 5 | Western embankment of Option 4 reconfigured to optimise storage and better align with proposed Panuara Road realignment and Project Area Boundary. |
| 5A | Optimised configuration of Option 5 that removes embankment corners and more favourably follows topography. |
| 6 | Based on Option 5 with southwestern embankment extended into Rodds Creek Valley. Embankment follows Project Area Boundary. |
| 7 | Similar extent to Option 1 however the western, southern and eastern embankments are reconfigured to (a) remove corners, and (b) offset from proposed Panuara Road realignment. |
| 8 | Western embankment reconfigured to optimise storage within Rodds Creek Valley (outside of Project Area Boundary). Eastern embankment alignment. |

Figure 3.14 Options considered for TSF4 realignment in the MCA and key change from PFS design (Klohn Crippen Berger, 2022)

The MCA process for STSFX alignment is outlined in Figure 3.15.

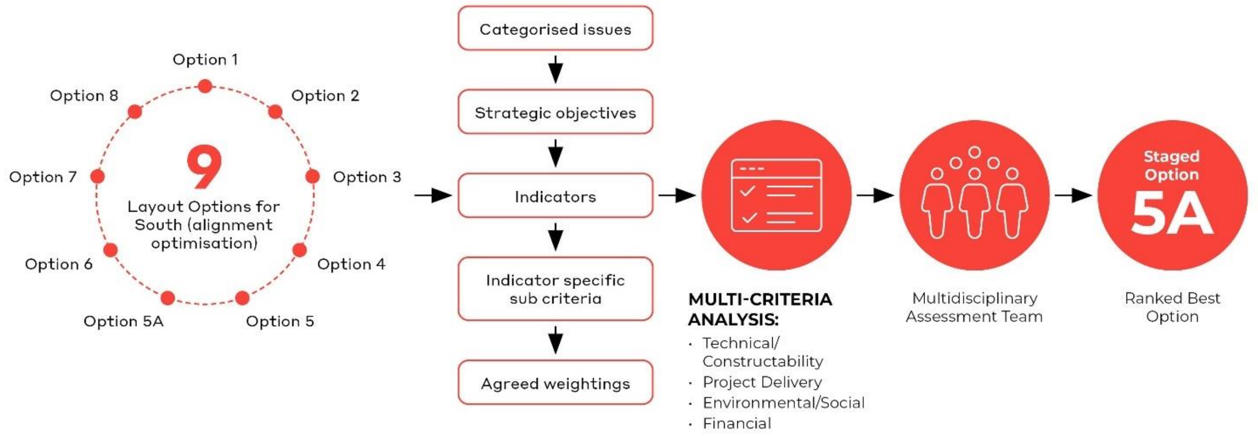


Figure 3.15 Multi-criteria analysis process

The MCA was conducted across two workshops in February 2022 and attended by KCB and Newcrest stakeholders. Each of the nine options was assessed against the evaluation criteria presented in Figure 3.16, as follows (Klohn Crippen Berger, 2022). The total MCA uses the evaluation criteria and goes through the process shown in Figure 3.16.

- Criteria were scored on a scale of 1 to 5 with a score of 1 denoting a lower preference / high constraint and a score of 5 indicating a higher preference / lower constraint. Scoring was conducted by subject matter experts for each discipline.
- Each evaluation criterion was assigned a values-based weighting: the weighting was first defined according to an individual's perspective on the relative importance of each objective / indicator against each other, then as a group, consensus was reached for each weighting.
- Weightings were assigned on a scale ranging from 1 (lowest importance) to 10 (highest importance). Sensitivity analyses were then applied to reflect the inferred priorities of different stakeholder perspectives that may not have been reflected in the workshops.

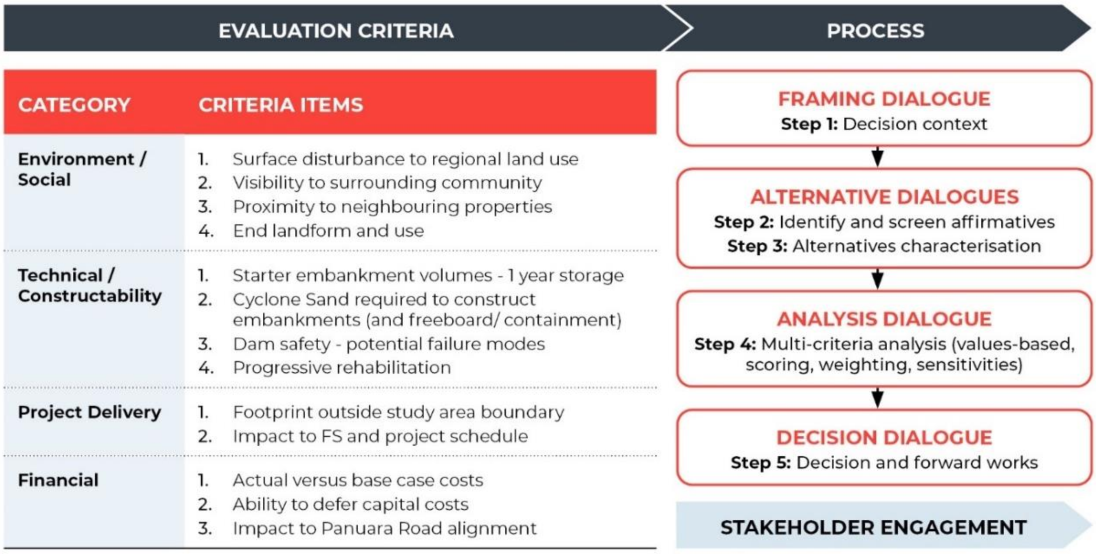


Figure 3.16 Multi-criteria analysis evaluation criteria

The above-shown process is then followed by a process of stakeholder engagement, leading to the confirmation of a TSF site, tailings disposal method and management system.

### 3.12.3 *Consideration of environmental and community impacts*

Newcrest appreciates the impact of ongoing operations at Cadia on surrounding neighbours and their livelihoods. The MCA included three key strategic objectives relating to environmental and social factors that informed the scoring and recommendation of the preferred layout option (Klohn Crippen Berger, 2022)

1. Reducing land disturbance – this was raised as a key concern for the community as larger surface areas within areas of higher agricultural value sterilises this area for future post-mining users.
2. Reducing height to improve visual amenity / closure landform aesthetics into surrounding landscape – this was raised as a key concern by the community and the NSW Government in relation to the dam wall height, stability, overall dam safety risk and the visual amenity of the dam wall on the surrounding landscape.
3. Avoiding proximity to the community / landowner dwellings to the east and west to mitigate potential impacts from visual amenity, dust and noise disturbance – raised as a concern from the community. It was noted that TSFs that are less likely to blend into the natural landscape at closure are less favourable.

Newcrest recognises that dust management is a critical component of the operation of STSFX. We will continue to listen to stakeholder concerns on this issue and ensure that dust particles in the air caused by tailings do not pose a threat to human health. Figure 3.17 details the community concerns and priorities that influenced the optimisation of the TSF layout that resulted in the selection of 5A.

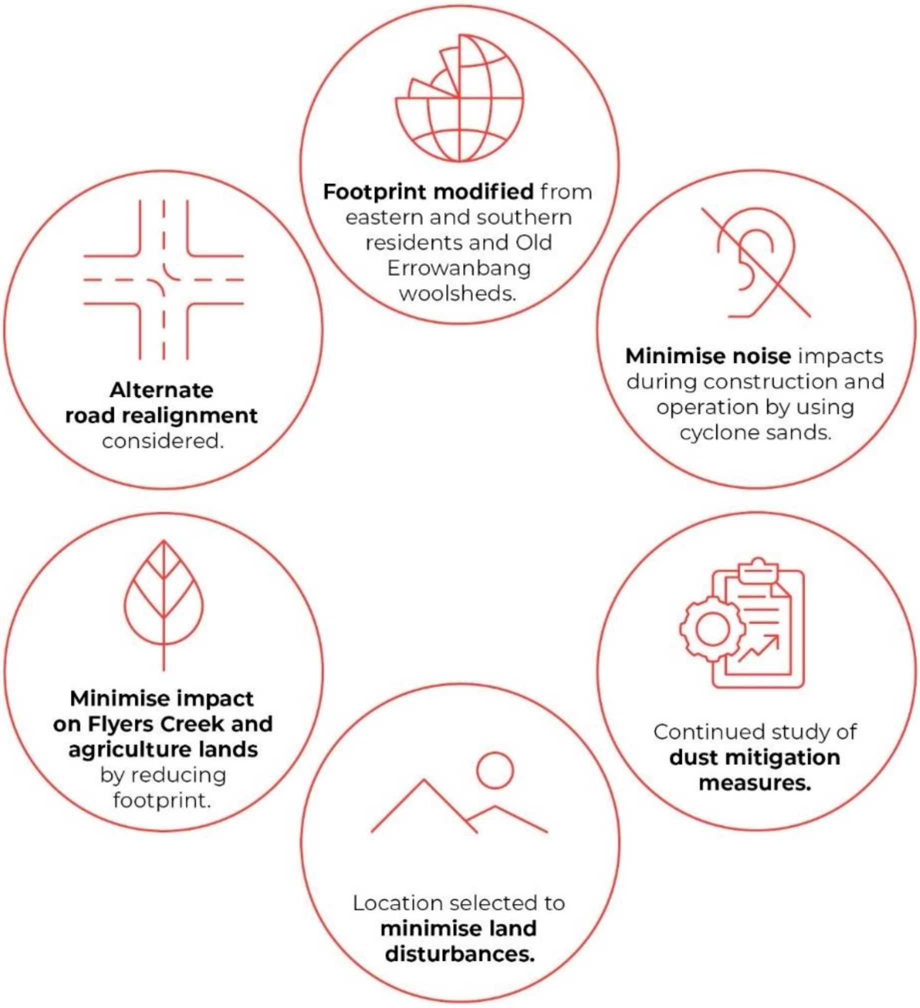


Figure 3.17 Community concerns and priorities

### 3.12.4 Study outcome

The MCA indicated that Option 5A was considered the preferred option to be further developed. Option 5A has the following characteristics:

- The smallest footprint of all the southern options.
- Greatest water efficiency.
- The lowest quantities of materials required for construction.
- Reduced energy consumption for operations.
- Reduced total tailings surface footprint to mitigate the risk of dust lift off.
- The highest crest of all options although lower than original concept design.
- The toe has been relocated further away from proximal neighbours to the east of State heritage areas.
- The ability to integrate with the existing STSF to minimise the overall footprint.

### 3.12.5 Feasibility study of Option 5A: Option 5B

Further to the selection of Option 5A, an assessment was completed to consider a staged approach to STSFX, referred to as Option 5B. The work undertaken considered a stage approach to extending the STSFX to the east and south as well as an alternative to raising the STSFX to a similar elevation to the current height of the NTSF. Option 5B FS design is currently being prepared by KCB.

The Option 5B includes two alternate footprints, namely Stage 1B and Stage 2, as illustrated in Figure 3.18. Stage 1B has a reduced footprint and is therefore the preferred option to be progressed. Stage 2 has an increased footprint with higher propensity for dust emanation, it is located closer to residents and mine lease boundary and has a higher direct impact on the environment (due to its larger footprint). The Stage 1B option is referred to as STSFX and is presented in Figure 3.19.

The STSFX will provide the following benefits:

- Reduced footprint reducing disturbance and biodiversity impacts;
- Reduced impacts from dust and noise on local community stakeholders;.
- Creates an integrated single facility with the existing STSFX and NTSFX reducing visual amenity for neighbouring landholders;
- Adjusts the facility to match the 25-year approval extension timeframes allowing all stakeholders to assess any future request for another facility at a time closer to the approval date. This includes the opportunity to utilise currently excluded locations (e.g.: Ridgeway and/or Cadia East subsidence zones) or currently underdeveloped technologies, to further reduce impacts.
- The potential for temporary or progressive closure and rehabilitation in areas where construction and tailings placement is complete.

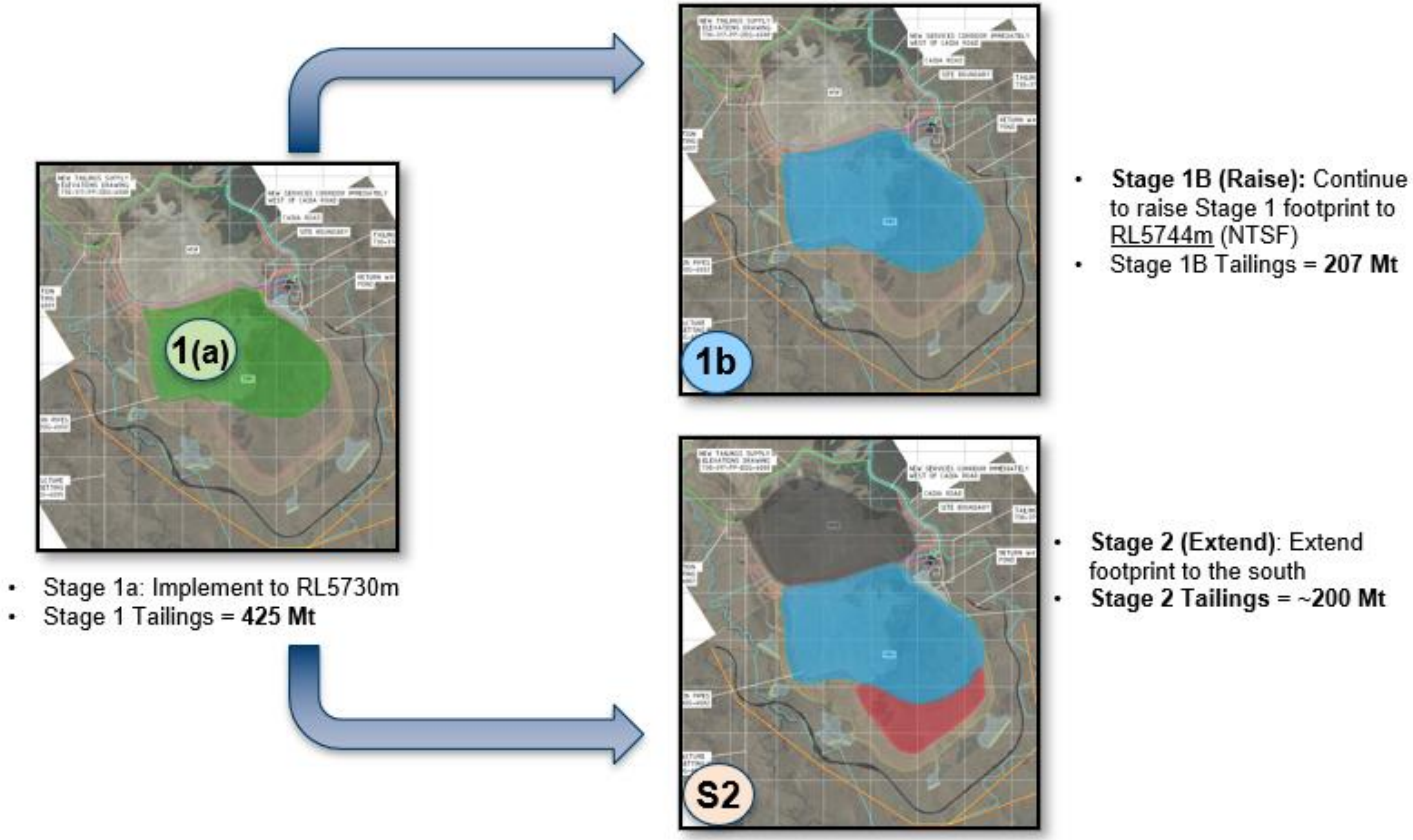


Figure 3.18 Comparison of Stage 1B and Stage 2

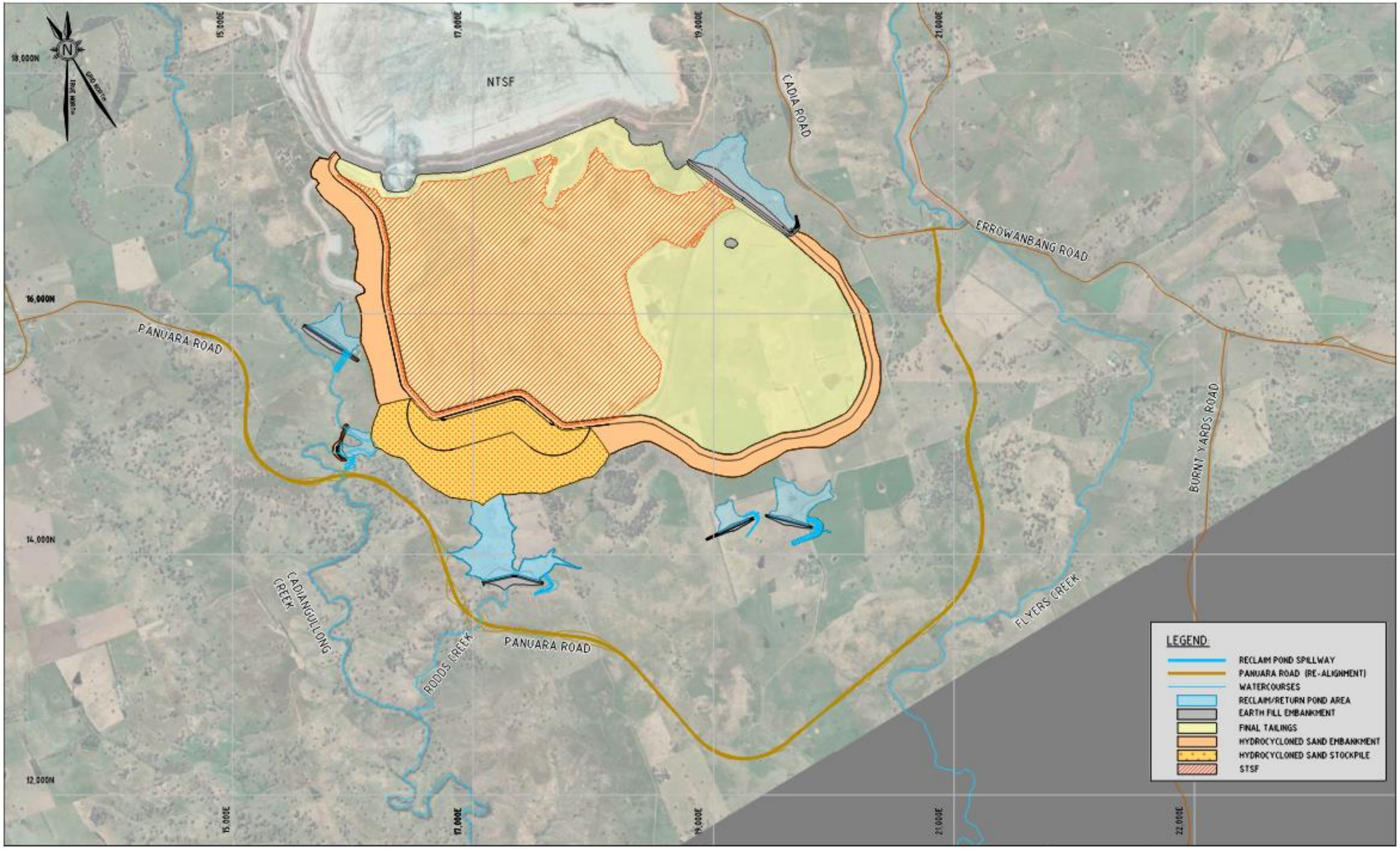


Figure 3.19 STSFX layout

# 4 Detailed multi-criteria assessment

## 4.1 Scope

The scope of the detailed Multi Criteria Analysis was to review for consistency the site selection and technology options aligned to the stated CCOP goals of minimising the impact of the facility on the environmental setting, reducing so far as practicable the impact on the local community and creating a facility that is fit for purpose and meets world best practice design principals.

To complete this scope Newcrest and WSP (now incorporating Golder) undertook an MCA, with the intent to:

- Consider semi-quantitative criteria (including weightings) for the site and tailings disposal options considered, based on risk assessments completed by Hatch in 2019.
- Align with GISTM's[5] Requirement 3.2, "For new tailings facilities, the Operator shall use the knowledge base and undertake a multi-criteria alternatives analysis of all feasible sites, technologies and strategies for tailings management (…)".

## 4.2 Assessment criteria

As previously stated in Section 3.10, the initial high-level multi-criteria assessment undertaken by Hatch in 2019 did not consider weighted criteria (it only included 'yes' or 'no' ratings, except for the cost assessment). For this assessment Newcrest and WSP adopted the same criteria from the Hatch 2019 study for consistency.

The criteria assessment included:

- Noise and fugitive lighting impacts
- Dust generation capacity
- Catastrophic foundation failure potential
- Embankment failure potential
- Visual amenity impacts
- Waterway impact potential
- Construction safety
- Facility capacity
- Life of Facility Cost

Each criterion had a descriptor for its scoring, to allow for relative assessment of each concept. For example, the hazard/criteria for 'dust generation' was broken into the following to allow for scoring:

Additional TSF surface area:

**1** (worst): >1,000 Ha

**2** (marginal): 900 to 1,000 Ha

**3** (fair): 800 to 900 Ha

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[5] Global Industry Standard on Tailings Management

4 (good): 700 to 800 Ha

5 (best): < 700Ha

Weightings for each criterion were applied as the inverse of the hazard rating from the Hatch study – for example, the dust generation criteria had a hazard rating of 5 – Extreme, and so the weighting is 1/5 = 20%.

Newcrest and WSP assessed each concept against the assessment criteria. Each concept was assigned a score between 1 and 5 for each of the criteria, where a score of 1 represents very poor potential to satisfy a particular criterion and 5 represents a very good potential to satisfy that criterion. The total score for each concept was calculated by multiplying the score for each criterion by its relative weighting, and then all individual criterion scores were then summed up to produce a total score, to allow for ranking of the options.

The options considered were as follows. The code in parentheses, for example (S5) are those adopted in the prior sections of this report as described below.

- Dry Stack South (S5): refer to Option S5 in Section 3.9.2.
- Dry Stack North (N4): refer to Option N4 in Section 3.9.1.
- Dry Stack Upper West (W1): refer to Swallow Creek, north end in Section 3.5.
- Dry Stack Middle West (W2): refer to Swallow Creek, middle in Section 3.5.
- Dry Stack Lower West (W3): refer to Swallow Creek, south in Section 3.5.
- Paste South (S3): refer to Option S3 in Section 3.9.2.
- Paste North (N9): refer to Option N9 in Section 3.9.1.
- Wet Upper West (W1): refer to Swallow Creek, north end in Section 3.5.
- Wet Middle West (W2): refer to Swallow Creek, middle in Section 3.5.
- Wet Lower West (W3): refer to Swallow Creek, south in Section 3.5.
- Wet South West (SW1): refer to South Rodd's Creek in Section 3.5.
- Wet East (E1): refer to Gooleys Creek in Section 3.5.
- Wet South (S1, D/S): refer to Option S1 in Section 3.9.2.
- Wet North - Option 1 (N6B, 242MT): refer to Option N6B in Section 3.9.1.
- Wet North - Option 2 (N10B, 635MT): refer to Option N10B in Section 3.9.1.
- Cyclone South (S7): south centralised cyclone embankment, refer to Option S7 in Section 3.10.6.1.

## 4.3 Assessment outcome

The results of the assessment are presented in Table 4.1.

Table 4.1 Detailed MCA

| Site and technology option | Average score |
|---|---|
| Dry Stack South (S5) | 666 |
| Dry Stack North (N4) | 480 |
| Dry Stack Upper West (W1) | 465 |
| Dry Stack Middle West (W2) | 440 |
| Dry Stack Lower West (W3) | 440 |
| Paste South (S3) | 742 |

| Site and technology option | Average score |
|---|---|
| Paste North (N9) | 587 |
| Wet Upper West (W1) | 615 |
| Wet Middle West (W2) | 632 |
| Wet Lower West (W3) | 632 |
| Wet South West (SW1) | 689 |
| Wet East (E1) | 692 |
| Wet South (S1, D/S) | 697 |
| cWet North - Option 1 (N6B, 242MT) | 520 |
| Wet North - Option 2 (N10B, 635MT) | 534 |
| Cyclone South (S7) | 857 |

The MCA indicated the following as the top three options, from the highest to the lowest ranking option:

1 Hydrocyclone sand wall embankment disposal method for the South site.

2 Paste tailings discharge with upstream raised embankments at the South site.

3 Slurry tailings discharge at the South site with downstream raised embankments.

The outcome was driven by the following key factors:

- The South site scores better than other sites, mainly on the basis of having more favourable foundation conditions (compared to the North site) and being within an already disturbed water catchment.
- The foundation conditions for a TSF at the North sites are not favourable, which lowered the scores for North sites.
- The dry stack options have the lowest scores predominantly due to their size, the risk of dust generation and their CAPEX. The three lowest scoring options in the MCA were dry stack options.

The MCA confirmed the hydrocyclone sand wall embankment disposal method for the South site as the preferred option for the project.

# 5 Tailings deposition selection process

## 5.1 Overview

There are two components to a tailings deposition system, namely:

1. The condition of the tailings when transported and deposited in the TSF
2. The method used to raise the TSF above the initial earthworks.

Tailings are generated for 24 hours per day and 365 days per year, with the exception of periodic plant maintenance periods. This continuous operating requirement for the deposition system needs to be considered when selecting the system to be used, especially the noise associated with the deposition system.

Assessment of the most appropriate tailings deposition method continued throughout the Concept and Pre-feasibility design phases of the project, between 2019 and 2021, associated with the optimisation studies which resulted in the selection of STSFX site, see Figure 5.1.

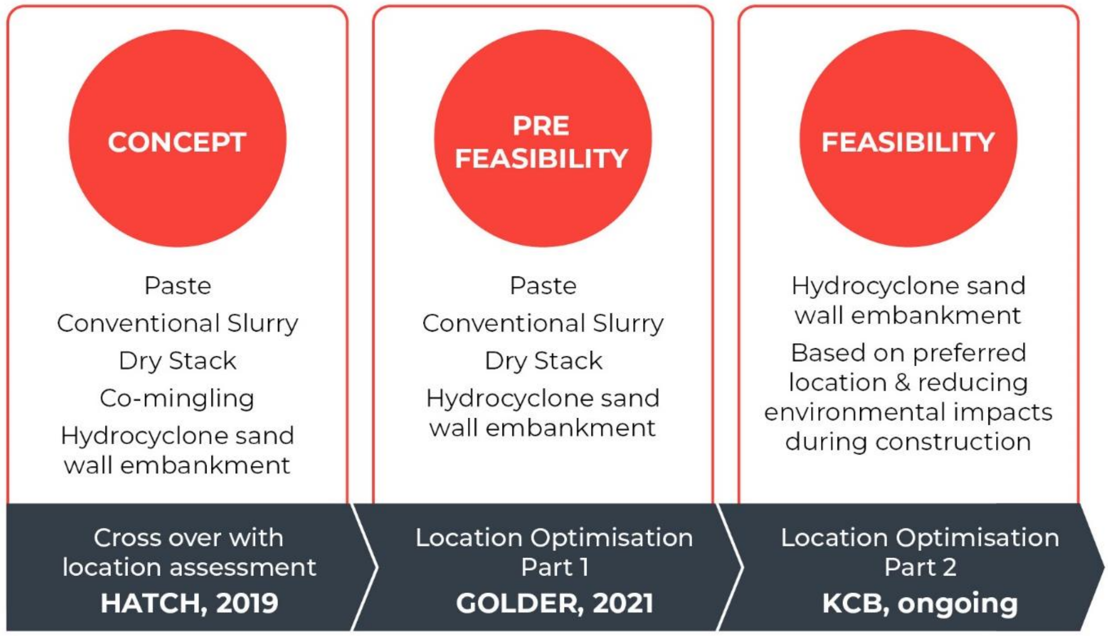


Figure 5.1 Deposition system selection process

In summary, all sites assessed between 2019 and 2021 considered the following deposition methods:

- Conventional (thickened) slurry – currently used at Cadia.
- Paste.
- Co-disposal with waste rock.
- Co-mingling.
- Dry stack (filtered tailings).
- Hydrocyclone sand wall embankment.

Some of the deposition methods were eliminated progressively through this process for the STSFX, leaving hydrocyclone sand wall embankment as the system considered the most appropriate to develop. The following sections summarise the characteristics associated with each deposition system and reasons for their elimination.

## 5.2 Thickened (conventional disposal)

The tailings leave the process plant as a slurry with a solids concentration of at about 25% w/w. Conventional or high-rate thickeners are used to thicken the slurry to a 55% solids concentration and this is then pumped to the TSF using conventional centrifugal pumps for disposal. This disposal technology requires that earthworks are used to construct embankments around the footprint of the TSF to contain the tailings. Waste rock is typically used at Cadia to form the required initial embankment and ongoing raises.

Thickening the tailings at the process plant before sending to the TSF recovers a significant percentage of the initial slurry water for reuse and reduces the size of the pumping system and the power requirements. Supernatant water is released by the tailings on settling and this water is also returned to the process plant for reuse.

It is recognised that the conventional disposal system offers the following advantages with respect to dust management:

1. The spigot deposition system can be manipulated to keep the tailings beach moist enough to minimise dust generation.
2. There is no dust from outer slope as this consists of erosion resistant rock.
3. The embankment construction activities are generally a daytime and weekday operation only, reducing noise generation from the site.

Thickened disposal was eliminated on the basis of needing some 220 Mm³ of waste rock to construct the starter embankment and the ongoing embankment raises, requiring the opening of a substantial quarry to supply this rock – in essence a small open cut mine.

## 5.3 Paste

A deep tank thickener is used to produce a paste, typically with a solids content of 65% w/w or greater. A paste generally has to be pumped to the TSF using positive displacement pumps, as it can have a consistency of toothpaste. Embankments are also required to contain the deposited paste tailings, similar to those required for the thickened tailings.

The paste pumping system recovers more water for reuse at the thickener than the conventional system, but requires more power to drive the paste to the TSF, where there is no supernatant water to recover.

It is recognised that the paste disposal system offers the following advantages with respect to dust management:

1. A crust forms on the top of the paste beach, limiting dust generation.
2. There is no dust from outer slope as this consists of erosion resistant rock.
3. The embankment construction activities are generally a daytime and weekday operation only, reducing noise generation from the site.

Paste disposal was eliminated on the basis of also needing some 220 Mm³ of waste rock to construct the starter embankment and the ongoing embankment raises, requiring the opening of a substantial quarry to supply this rock – in essence a small open cut mine.

## 5.4 Co-mingling

Co-mingling is being used in the coal mining industry to dispose of their tailings. In this case the tailings are dewatered on belt press filters and trucked to the mine, where they are placed in the same location as the mine waste rock is dumped (co-dispose and co-place), effecting an in-situ mixing process (co-mingle).

Co-mingling was eliminated on the basis of Cadia no longer producing the large volumes of waste rock that the Cadia open pit generated, as it is an underground mining operation now.

## 5.5 Dry Stack

The tailings need to be dewatered to allow them to be mechanically transported (as opposed to hydraulic transport) to a "stack" and then compacted sufficiently to reduce its likelihood of liquefying under earthquake loading. This requires the use of a large number of large plate filter presses. The dry (filtered) tailings are then either trucked or conveyed to the stack, where they are spread and compacted or dumped by a stacker over an advancing stack face. The high tailings tonnage rate produced by Cadia limits the tailings transporting and deposition options to conveying and stacking.

An example of dry stack operations is presented in Figure 5.2.

An obvious advantage of dry stacking is the increased water recovery and decreased water loss due to the filtration process.

- Dry stacking was eliminated from further consideration due to:
  - The dust that would be generated off the sides and top of the dry stack that could not be controlled in the same manner as is practised in slurry deposition systems.
  - The continuous noise generated by the conveyor and stacker system, which would be required to operate 24 h/day to meet the capacity required for Cadia.
  - The light pollution required to provide a safe working environment for the operational crew through the night.

Figure 5.2 Dry stack tailings deposition at La Copa Mine, Chile

### 5.5.1 Benchmarking

Dry stacking is used for mine tailings, but to date these have been much smaller mines with a lower tailings production rate, using both trucking and conveyor/stacking transport systems. Dry stacking is also used for power station ash, using both trucking and conveyor/stacking transport systems. Note that, for this case, that the ash is collected dry at the power station, using ash collection systems and then a small quantity of water is added to reduce dust and to allow the ash to be adequately compacted.

A number of very large copper mines in Chile have looked at dry stacking as a water saving measure, noting that dry stacking is now favoured in the global mining industry to reduce the risk of flow failure occurring. However, the technical challenges of dewatering such high tailings throughputs is yet to be overcome.

See Appendix A for an expanded examination of dry stack tailings storage examples in Australia and overseas.

## 5.6 Hydrocyclone sand wall embankment

Hydrocyclone sand wall embankment has not been used in Australian mineral mining (although many of the sand mining operations use hydrocyclones to re-construct sand dunes) and for this reason it was not pursued in the earlier studies. Hydrocyclone sand wall embankment dams were, however, are mandatory in Chile under legislation introduced in late 2006.I

Noting that Newcrest operates sand dams in the Americas and has this experience available to assist the design of the hydrocyclone sand wall embankment dam and in training of their operators.

### 5.6.1 Sand wall embankment advantages

Sand wall embankment TSFs provide several advantages when compared with the systems listed above, including:

- They do not need the large volumes of rock to construct the containment embankments.
- The hydrocyclone sand wall embankment and the fine balance of the tailings can both be pumped to the discharge locations, which is the tailings transportation system associated with the lowest cost.
- A higher percentage of the process slurry water is recovered for reuse, compared with conventional disposal.
- The hydrocyclone sand wall embankment (which in a conventional disposal system, is discharged as tailings) is used to form the containment embankments. This reduces the total tailings containment volume required, as a percentage of the tailings is stored in the embankments.
- Mobile equipment use is limited in number and to daylight hour operations.

The sand wall embankments can be constructed in a downstream (embankment foundation comprising of competent ground) or centreline (embankment foundation comprising of competent ground and tailings) direction. This is a significant improvement in stability, compared to upstream embankment raising (embankment foundation comprising of tailings only).

### 5.6.2 Dust management

Dust off any TSF can be a problem if not managed, but the hydrocyclone sand wall embankment system maintains the advantage that conventional disposal has, namely the ability to keep the tailings beach wet, provided that tailings deposition is planned accordingly.

The outer slope of the sand dam is compacted, to reduce its propensity to liquefy under earthquake loading. This action also helps with the control of dust generation from the outer slopes.

The management of dust on the beach and the slopes will be augmented, when needed, by large area water cannons, whilst early development of the final toe and slope will allow implementing temporary vegetation and early rehabilitation, further reducing the propensity for dust.

## 5.7 Outcome of deposition technology selection for Cadia

The TSF construction and operation technologies available to Cadia for the proposed TSF are listed in Chapter 5, Table 5.1.

In summary, Table 5.1 confirms that a hydrocyclone sand wall embankment system provides the most applicable tailings disposal and management technology for this site. This conclusion is based on the low technical risk, lower energy usage, lower land disturbance requirement, no increase to dust disturbance and the significantly reduced quarry requirement.

This report acknowledges that dry stack is the preferred technology for community stakeholders. Significant consideration was given to this option, however dry stacking was eliminated from further consideration due to:

- Management of the dust that would be generated off the sides and top of the dry stack was going to be difficult to control.
- There would be continuous 24-hour noise generated by the conveyor and stacker system that would carry a distance during the night.
- The site would need to be well lit to enable continuous operation, which would produce light pollution clearly visible from the surrounding properties.
- The capital and operating costs were significantly higher than for the other tailings disposal systems considered.

Table 5.1 TSF construction and operation technologies assessment (Newcrest Mining Limited, 2023)

| CONSIDERATION | THICKENED & PASTE | CO-MINGLING | DRY STACK | HYDROCYCLONE SAND WALL EMBANKMENT |
|---|---|---|---|---|
| Land disturbance (biodiversity impacts) | Significantly higher levels of land disturbance due to topography. | Similar land disturbance and technical risk to other options presented. | Similar land disturbance & technical risk to other options presented. | **Marginally lower** land disturbance requirements to other options. |
| Noise | Increased noise due to need for new rock quarry. | Increased due to higher mobile equipment requirements and new rock quarry. | Increases in noise due to 24-hour operation of conveying and deposition equipment and large workshop adjacent to tailings facility. | Quieter operation**.**<br>**Lower noise levels** for impacted residents.<br>Significantly **reduced** quarry. |
| Dust | Increased dust due to need for new rock quarry. | Similar to other options. | Increased dust due to dry nature of the material and intervention required. | Similar dust levels to those on current facilities (pre-2019). |
| Water | High water recovery, requiring improved water management. | High water recovery, requiring water management. | High water recovery, requiring improved water management. | **No increase** in water recovery above current requirements. |
| Technical Risks | Similar technical risk to other options. | - | High due to liquefaction during high rainfall events / placement in potential water pathways. | **Low** - increased embankment stability. |
| Quarrying requirement | New rock quarry required to create embankments. | New rock quarry required to co-dispose the tailings. | No requirement for waste rock to store tailings. | Rock only required for starter embankment. |
| Other | - | - | Upstream diversions required to prevent inundation of stack.<br>Not used anywhere else at required tonnage rates of Cadia.<br>Increased energy consumption. | Hydrocyclone sand wall embankment construction **uses less energy** than some other tailings technologies (paste, dry stack, rock placement) |

# 6 Conclusions

This report summarises the process undertaken to select the most appropriate site and deposition technology for an additional TSF at Cadia, which is required to provide sufficient storage capacity for the LOM.

The key outcomes of the location assessment were that:

- Each site within the mining lease area were valley fill options within pristine creek systems.
- No single site could accommodate the LOM tailings.
- Most sites were visible to nearby neighbours.

A decision was made by Cadia to carry out further site assessments to attempt to locate a LOM site for a TSF in the vicinity of Cadia, outside its mining lease area. The search was extended to a 40 km radius around the mine.

The criteria used for this search included sites with relatively flat ground and not located on intensive agriculture land. The only suitable site identified that was i) within a reasonable distance from Cadia, ii) on relatively flat ground and iii) not within a river course was the South Errowanbang site, now named the STSFX.

CVO narrowed the site options to the Cadiangullong creek (North site) and the STSF Errowanbang (South site) and assessed different tailings disposal methods for these options. Golder assessed the pros and cons associated with the North and South sites from 2018 to 2019, as follows.

The main advantages associated with the Cadiangullong creek (North site) are:

- The narrow valley results in reduced construction quantities for embankment.
- The site is within 5 km of the process plant.
- The site is located relatively further from neighbouring properties, compared to the South site.

The main disadvantages associated with the Cadiangullong creek (North site) are:

- The land is forested area to the north of the site, implementing the TSF at this location would result in significant impacts to biodiversity and plant community species as well as fauna.
- Four Mile Creek Road would need to be relocated.
- Increases the dam consequence rating compared with the South site, due to process plant downstream. This has been defined in the context of the permanent presence of the downstream PAR at the Process Plant, in comparison to the presence of itinerant population downstream of the South locations.
- High capital cost associated with sediment and runoff control infrastructure.
- Cadiangullong Dam would need to be replaced and a site identified which would increase potential environmental impacts.
- The embankment would be founded on loosely backfilled mine waste over the Cadia north pit and would be extremely technically challenging.
- A major diversion channel and drop-structure would be needed to carry runoff from the 90 km² catchment located upstream of the TSF, divert runoff around the TSF and deliver it to the Cadiangullong diversion channel around the Cadia pit, which would:
    - Require a major excavation into the rock to form the diversion channel.
    - Result in significant environmental impacts.

The main advantages associated with the Errowanbang (South site) are:

- Most of the ground has a low slope of ±2.5%, falling from east to west.

- There is a very limited external catchment (it is within the current TSF catchment area and river system) and this runoff can be diverted relatively easily.
- There is a suitable location for a surface runoff sediment control dam in the lower Rodds Creek valley.
- Lower land disturbance, compared to the North site.
- Waterway impacts are negligible and no new catchment affected.

The main disadvantages associated with the Errowanbang (South site) are:

- All options would be visible, to some extent, to the landholders to the east, south and west.
- The footprint is adjacent to Flyers Creek.
- The Panuara and Meribah roads would need to be relocated.
- The site is about 6.5 km from the process plant.

The North site option significantly contradicted several of CVO's agreed technical (failure risk, loose embankment foundation, relocation of the water storage dam, WSD), environmental and community (relocation of public busy road, disturbance of forested area and impact to biodiversity, major diversion channel and drop structure to divert runoff from catchment area upstream, resulting in major environmental impacts) criteria and was discounted from further examination.

The South site TSF was therefore selected as the most suitable option (most of the ground has flat slope, it is within the current TSF catchment area and river system, it provides the ability to integrate with STSF, resulting in lower land disturbance area compared to the North site, waterway impacts are negligible with no new catchment affected, adequate foundation conditions may be achieved) and later was redesignated as the South TSF eXtension (STSFX).

Each deposition technology was assessed for suitability at the preferred South Errowanbang site. It was assessed that the hydrocyclone sand wall embankment method was most suitable to the STSFX site. It was assessed that the hydrocyclone sand wall embankment tailings deposition system was most suitable to Cadia for the following reasons:

- Marginally lower land disturbance requirements compared to other options (in alignment with previously presented *Social and environmental requirement 1*);
- Significantly reduced quarry rock and borrow requirements (in alignment with previously presented *Social and environmental requirement 1*);
- Hydrocyclone sand wall embankment construction uses less energy than some other tailings technologies (paste, dry stack, rock placement) and is more amenable to Newcrest's zero carbon emissions goals (in alignment with previously presented *Social and environmental requirement 1* and *Technical requirement 5*).
- Noise levels similar to the current NTSF and STSF operations and lower than other options (in alignment with previously presented *Social and environmental requirement 2*);
- Similar dust levels to the dust generated by the NTSF and STSF when operating and lower than other options (in alignment with previously presented *Social and environmental requirement 2*);
- Lower technical risk due to increased embankment stability inherent in the technology (in alignment with previously presented *Technical requirement 4*);
- No increase in water recovery above current requirements (in alignment with previously presented *Technical requirement 5*);

In considering the community's primary concern about dust management (*Social and environmental requirement 2*), the advantages of this technology are as follows:

- It maintains the advantage conventional disposal has, namely the ability to keep the tailings beach wet, provided that tailings deposition is planned accordingly.
- The outer slope of the sand dam is compacted to minimise its propensity to liquefy under earthquake loading and this action assists to control dust generation from the outer slopes.
- To further reduce dust generation from the beach and the slopes, large area water cannons will be used, whilst early development of the final toe and slope of the embankment will allow implementing temporary vegetation and early rehabilitation, further reducing the propensity for dust.

Nine different site layout options were prepared, from which the MCA process identified that Option 5A was the most suitable option for STSFX. Two MCA processes included a range of environmental and social criteria that informed the final selection. In response to community concerns across a range of issues, Option 5A has been further refined and is now known as Option 5B. The incorporation of stakeholder feedback into the design process for the STSFX resulted in a reduced impact due to the footprint of STSFX, being the furthest distance from community and State heritage areas.

The layout progression from before the Hatch MCA, up until Option 5A and the final STSFX design based on community feedback is illustrated in Figure 6.1 to Figure 6.3.

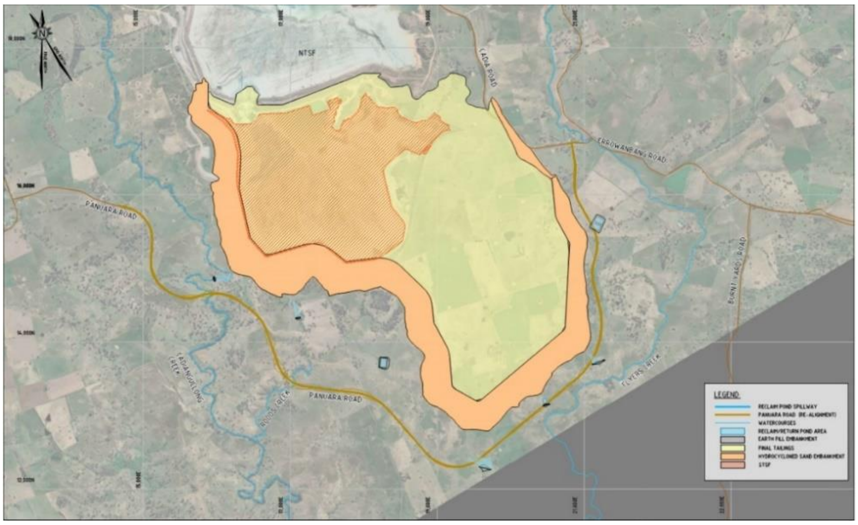


Figure 6.1 STSFX configuration prior to MCA

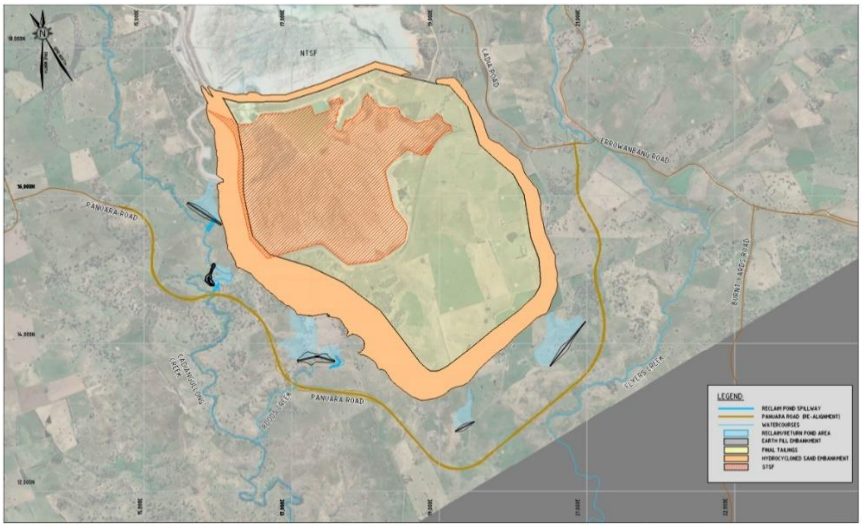


Figure 6.2 Option 5A selected as a result of the MCA

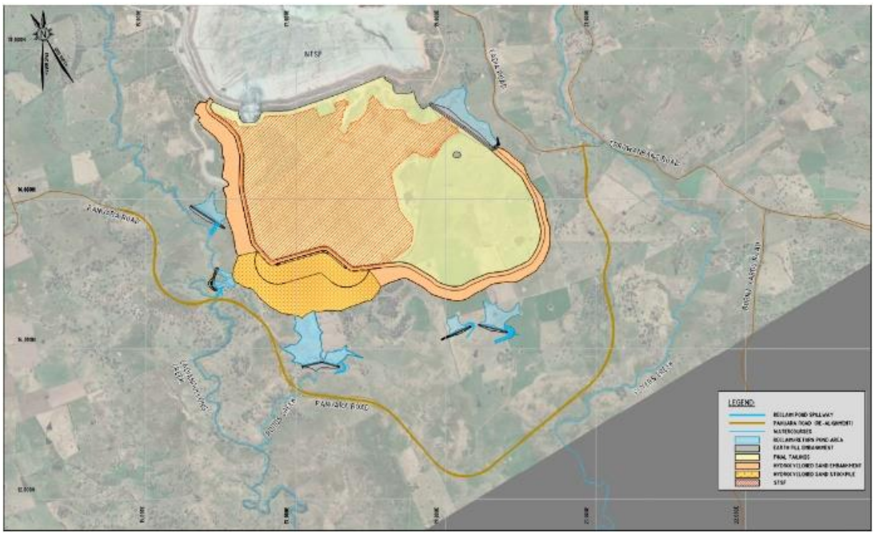


Figure 6.3 STSFX

This report demonstrates that, on balance, the South Errowanbang site coupled with hydrocyclone sand wall embankment method provides CVO and the community with the best opportunity to secure continued operations at Cadia while reducing adverse environmental and social impacts.

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# Appendix A

Benchmarking of dry stack as a tailings deposition technology

# A1 Dry stack benchmarking

Usage of dry stack tailings deposition technology has been benchmarked across Australia, North America, South America, the South Pacific and Africa.

Table A.1 Dry stack benchmarking

| Site | Country | Mineral | Production (tpd)6 | Deposition topography | Processing & equipment | Transport equipment | Climate | STATUS | OPERATIONS | References |
|---|---|---|---|---|---|---|---|---|---|---|
| Karara Mine | WA, Australia | Iron ore | 35,000 of tailings | Dry stacked onto flat terrain | — Mechanically dewatered to around 15% moisture (course and fine fraction)<br>— Dewatering screens (course fraction)<br>— Mechanical press filtration (fine fraction) | Stacking conveyor | Dry; annual average precipitation 310mm; annual average evaporation 3,875 | Operating | Fixed infrastructure solution - Dry tailings will be stacked in 4 Lifts to the maximum height approved by the WA government. This has created a smaller tailings storage footprint and improved site rehabilitation potential. | (FLSmidth, 2020)<br>(International Mining, 2020)<br>(Bis Industries, 2022)<br>(Hore & Luppnow, 2014) |
| La Coipa Gold Project | Northern Chile | Gold, silver | 18,000 of tailings | Dry stacked onto sloping topography. | — Excess water removed via filter belt to <20-25% moisture.<br>— Transported via conveyor.<br>— Distributed via mobile stacker - spread out and compacted to increase density of the stack. | Truck or stacking conveyor.<br>Distributed via mobile stacker. | Dry/cold; temps between -5C to 29C; average rainfall between 12 to 20mm | Operating | Stored in a series of cells that are constructed using compacted, stacked layers of the filtered tailings<br>Each cell is designed with a specific slope and height to maximise storage capacity, while minimising risk of slop failure/instability | (Tailings.info, 2021)<br>(Williams, et al., 2012) |
| Goro Mine | New Caledonia | Nickel, cobalt | 70,000 of material per year<br>60 m height | Dry stacked onto flat terrain | — Dewatered and filtered via thickeners and vacuum belt filter to remove approx. 20% moisture.<br>— Transported and dumped into stacking area. | Conveyors, storage bins, articulated dump trucks, and front-end loaders | Warm tropical; temp between 17C to 35C; annual average rainfall of ~1060mm | Operating | Backed by Tesla<br>Tailings dam leak released salt-laden liquid following heavy rain in Aug 2022<br>Tailings are compacted into thin layers, sloping slightly towards the centre of storage cell, minimising risk of slope instability and maximising storage capacity. This is regularly monitored | (New Century Resources, 2020)<br>(Mining Technology, 2020) |
| Pumpkin Hollow Mine | Nevada, USA | Silver, gold, copper, | Maximum tailings generation rate of 65,700 dry tons | Dry stacked onto flat terrain; deposited underground as paste | — Dewatered and filtered via thickeners and vacuum belt filter (pressure filter) | Mechanical belt conveyors and truck transport and placement | Arid; average annual precipitation ~127mm | Operating (temporary closure) | Last update 2020 confirmed filter presses for the dry stack tailings operating to design specs | (Nevada Copper, 2019)<br>(Nevada Copper, 2020)<br>(Nevada Copper Corp., 2019) |
| Rosemont Mine | Arizona, USA | Copper, molybdenum, silver | ~75,000 – 90,000 | Dry stacked onto flat terrain | — High compression thickeners and pressure filtration | Stacking conveyor | Arid; average annual rainfall ~440mm; average annual evaporation 1800mm | Proposed | The water extracted through this process will be reclaimed and reused for mining purposes. | (Hudbay, 2023)<br>(Hudbay, 2019) |

6 Tons per day

| Site | Country | Mineral | Production (tpd)6 | Deposition topography | Processing & equipment | Transport equipment | Climate | STATUS | OPERATIONS | References |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Waste rock (the non–ore bearing rock) will be used to construct a buttress around the tailings facility. | |
| Greens Creek Mine | Alaska, USA | Silver, lead, gold, zinc | 1,600 of tailings | Unknown | — Dewatered via thickening and filtrating to create moisture levels acceptable for transport.<br>— Transported to a smaller area at the same site. | 40t trucks, spread by dozer, compaction with vibratory roller | Cool climate: -6.7C to 18.3C<br>Annual precipitation 1,400 mm to 2,290 mm | Operating | Polymetal underground tailings - tailings are placed at a series of 1-foot layers within cells.<br>Underlain by a liner system to prevent groundwater from flowing into or water leaching.<br>Has sufficient capacity to accommodate tailings to the end of life in 2030. Early-stage engineering studies underway to determine modifications to accommodate additional material beyond the life | (Condon, 2012)<br>(Hecla Mining Company, 2022)<br>(SLR International Corporation, 2022) |
| Raglan Mine | Northern Quebec, Canada | Nickel, copper, cobalt | ~3,500 of tailings | Unknown | — Dewatered using high pressure filtration (filter press) | Conveyor system (4kms long) | Arctic, permafrost: average temp -10C | Operating | Tailings is deposited in layers and compacted using heavy machinery | |
| Minto Mine | Yukon, Canada | Copper, gold silver | 4,200 of metals | Unknown | — Thickener and pressure filter system dewatering to below 20% moisture | Truck | Subarctic<br>Moderate precipitation in the form of rain and snow<br>Annual temperature below 0C | Closure | Once mining was complete in the Minto Main pit, Capstone applied for permission to shut down the dry-stack facility and instead pipe slurry tailings into the pit. In 2013 the Yukon government granted the water-licence amendment, so slurry tailings are now being deposited in the pit. | (Access Consulting Group, 2007)<br>(Canadian Mining Journal, 2014) |
| Skorpion Zinc Project | Southern Namibia | Zinc | 116,280 of tailings per month | Unknown | — Belt filter<br>— High average moisture content of 40% | Conveyor stacker system | Hot/cold/dry<br>>1cm rain annually<br>Average coastal temp 9C to 20C<br>Inland regions hot during the day and cold at night | Operating | Water scarce region favours filtered tailings to minimise water consumption<br>The filter cake is a fine grained material with significant clay and mica fractions and has a high average moisture content of 40% | (Copeland, Lyell, & van Greunen, 2006) |
| Twin Hills | Namibia | Gold | 5 Mtpa | Unknown | Filtration tests on thickener underflow demonstrated that tailings filter cake containing about 23% moisture on average could be generated for disposal, to | | Hot/cold/dry<br>>1cm rain annually<br>Average coastal temp 9C to 20C<br>Inland regions hot during the day and cold at night | PFS stage | A double-lined, dry-stack tailings storage facility constructed adjacent to the process plant for deposition of the process plant tailings as stacked filter cake. It is expected all contained solution will be evaporated preventing any | (Mining Stock Education.com, 2022) |

| Site | Country | Mineral | Production (tpd)6 | Deposition topography | Processing & equipment | Transport equipment | Climate | STATUS | OPERATIONS | References |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | reduce plant water consumption. | | | | possibility of it being recycled to the plant. | |
| Alunorte refinery | Brazil | Aluminium refinery | | Unknown | — Press filtration<br>— Pipe conveyors<br>— Mechanical compaction | Pipe conveyors | Average temp 30C, 76.6% humidity, annual precipitation 140mm | Operating | The filter presses produce a dry cake and is transported to the DRS2 disposal site by using a pipe conveyor. At the deposit, the dry cake is spread out in layers and then compacted using machinery | (Castilho, Melo, Diniz, & Pantoja, 2019) |
| Alcoa Pinjarra Alumina Refinery | Western Australia | Aluminium refinery | ~10,000 of material | Unknown | — Thickening<br>— Press filtration technology<br>— Stacking method - deposited it in layers ~0.4-0.7m thick. After initial drying, the mud is turned by bulldozers or Amphirols which turn the dry top surface in and places the wet mud on top | Bulldozers/ Amphirols | Warm, dry summers and mild, wet winters<br>Max summer temp average over 30C and can exceed 40C. Winter max temp ~17C.<br>Average annual rainfall 706 mm | Operating (last update 2019) | Bauxite residue generated from the alumina refining process will be forced through very large filters that squeeze out the waste water, which will be recycled in the refining process.<br>About 50 percent of the mud fraction of the bauxite residue is processed. | (Alcoa, 2019)<br>(Alcoa, 2018) |
| Zijin Buritica Gold Mine | Antioquia, Colombia | Gold | 4,000 of material | Unknown | — Filtered | | | Proposed | The dry-stack construction started mid-2019 | (SRK Consulting, 2017) |
| Salares Norte Mine | Atacama, Chile | Gold, silver | | Unknown | — Cyanide detoxification<br>— Thickening<br>— Dewatering by filtration – 3 vertical place pressure filters (moisture content (17.6%)<br>— Transported<br>— Compacted | Trucks | Dry/arid | Proposed (2022) | | (Golder, 2022) |

# Appendix B

Hatch 2019 TSF option summary

# B1 Tailings disposal characteristics summary

The following assumptions were used to formulate characteristics on the following TSF options

| | | |
|---|---|---|
| Average dry density of whole tailings (consolidated, end of filling) | 1.50 | $t/m^3$ |
| Average dry density of cyclone tailings sand (underflow, consolidated, end of filling) | 1.65 | $t/m^3$ |
| Average dry density of cyclone overflow (consolidated, end of filling) | 1.35 | $t/m^3$ |

Table B.1 TSF Options characteristics

| # | Alternative - construction type, tailings type (non-embankment deposition) | Construction type[1] | Tailings type | Minimum downstream toe RL (m AHD) | Final embankment/ stack crest RL (m AHD) | Maximum tailings RL (m AHD) | Final embankment/ stack crest height[7] (m) | Starter embankment height (m) | Starter embankment volume (Mm3) | Volume of upstream or centreline raises (Mm3) | Total embankment (non-tailings) volume[6] (Mm3) | Total tailings or stack volume (Mm3) | Volume ratio[10] | Tailings capacity (Mt) | Distance[2] (m) | Controlled rate of rise (m/y) | Life (y) | Tailings output (Mtpa) | Topsoil stripping - 3D area: Embankment footprint (Ha) | Basin footprint (Ha) | Total stripping area[3] (Ha) | Closure - 3D area: Tailings beach or platform area (Ha) | Exposed embankment or stack slope area (Ha) | Total closure area[3] (Ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N1 | CG Old quarry - U/S, slurry[8] | U/S | Slurry | 725 | 835 | 834 | 110 | 40 | 0.92 | 1.30 | 2.2 | 124.5 | 56.1 | 186.8 | 2,300 | 2.5 | 28.5 | 2.7 to 32.0 | 7.1 | 295.4 | 302.5 | 295.4 | 7.1 | 302.5 |
| N2 | CG Old quarry - D/S, slurry | D/S | Slurry | 725 | 835 | 834 | 110 | N/A | N/A | N/A | 14.7 | 115.2 | 7.9 | 172.9 | 2,300 | N/A | 5.4 | 32.0 | 41.5 | 297.9 | 339.4 | 312.5 | 26.9 | 339.4 |
| N3 | CG Old quarry - U/S, paste (central) | U/S | Paste | 725 | 835 | 856 | 110 | 40 | 0.92 | 1.30 | 2.2 | 177.2 | 79.8 | 265.8 | 3,600 | 2.5 | 39.2 | 1.0 to 9.3 | 5.6 | 371.4 | 377.0 | 371.4 | 41.5 | 412.9 |
| N4 | CG Old quarry - stack, cake[9] | Stack | Cake | 725 | 835 | 980 | 110 | N/A | N/A | N/A | 2.1 | **561.2** | 273.6 | **841.8** | 5,800 | N/A | 26.3 | 32.0 | | | 1,380.0 | | | 1,380.0 |
| N5 | CG Plant - D/S, slurry | D/S | Slurry | 707 | 773 | 772 | 66 | N/A | N/A | N/A | 2.6 | 78.3 | 30.2 | 117.4 | 700 | N/A | 3.7 | 32.0 | 14.8 | 110.9 | 125.7 | 219.1 | 10.7 | 229.8 |
| N6A | CG Nth of old quarry - D/S, slurry | D/S | Slurry | 737 | 837 | 836 | 100 | N/A | N/A | N/A | 10.7 | 72.1 | 6.7 | 108.1 | 3,000 | N/A | 3.4 | 32.0 | 32.5 | 239.6 | 272.1 | 242.2 | 21.5 | 263.7 |
| N6B | CG Nth of old quarry - D/S, slurry | D/S | Slurry | 736 | 865 | 864 | 129 | N/A | N/A | N/A | 21.5 | 161.5 | 7.5 | 242.2 | 3,000 | N/A | 7.6 | 32.0 | 51.1 | 427.9 | 479.0 | 429.9 | 33.5 | 463.5 |
| N7A | CG Sth of water dam - D/S, slurry | D/S | Slurry | 745 | 845 | 844 | 100 | N/A | N/A | N/A | 6.7 | 50.5 | 7.5 | 75.8 | 3,500 | N/A | 2.4 | 32.0 | 21.1 | 183.4 | 204.5 | 182.9 | 14.8 | 197.7 |
| N7B | CG Sth of water dam - D/S, slurry | D/S | Slurry | 745 | 875 | 874 | 130 | N/A | N/A | N/A | 14.8 | 130.7 | 8.8 | 196.1 | 3,500 | N/A | 6.1 | 32.0 | 39.6 | 384.4 | 424.0 | 369.7 | 29.0 | 398.8 |
| N8 | CG Nth of water dam - D/S, slurry | D/S | Slurry | 783 | 880 | 879 | 97 | N/A | N/A | N/A | 7.9 | 77.7 | 9.8 | 116.5 | 4,800 | N/A | 3.6 | 32.0 | 27.7 | 258.3 | 286.0 | 250.8 | 20.5 | 271.3 |
| N9 | CG Old quarry - D/S, paste (DVD) | D/S | Paste | 725 | 835 | 970 | 110 | N/A | N/A | N/A | 14.7 | **517.7** | 35.3 | **776.6** | 8,900 | N/A | 24.3 | 32.0 | 30.9 | 1,252.5 | 1,283.4 | | | 1,230.8 |
| N10A | CG Old quarry - D/S, slurry (DVD) | D/S | Slurry | 725 | 835 | 894 | 110 | N/A | N/A | N/A | 14.7 | 252.5 | 17.2 | 378.8 | 7,400 | N/A | 11.8 | 32.0 | 30.9 | 681.0 | 711.90 | 702.5 | 21.5 | 724.0 |
| N10B | CG Old quarry - D/S, slurry (DVD) | D/S | Slurry | 725 | 855 | 917 | 130 | N/A | N/A | N/A | 24.5 | **423.5** | 17.3 | **635.3** | 8,400 | N/A | 19.9 | 32.0 | 52.9 | 949.3 | 1,002.20 | 979.7 | 30.4 | 1,010.1 |
| N11 | CG Old quarry - D/S, slurry 0.4% (DVD) | D/S | Slurry (0.4%) | 725 | 835 | 854 | 110 | N/A | N/A | N/A | 14.7 | 198.1 | 13.5 | 297.2 | 6,300 | N/A | 9.3 | 32.0 | 30.9 | 534.4 | 565.30 | 555.9 | 21.5 | 577.4 |
| | | | | | | | | | | | | | | | | | | | | | | | | - |
| S1 | ER South - D/S, slurry | D/S | Slurry | 670 | 780 | 779 | 110 | N/A | N/A | N/A | 168.4 | **463.9** | 2.8 | **695.9** | 8,800 | N/A | 21.7 | 32.0 | | | 1,064.3 | | | 1,079.3 |
| S2 | ER South - U/S, slurry | U/S | Slurry | 670 | 770 | 769 | 100 | 30 | 7.1 | 13.5 | 20.6 | **501.1** | 24.3 | **751.7** | 8,700 | 2.5 | 30.0 | 18.8 to 32.0 | | | 1,022.4 | | | 1,037.7 |
| S3 | ER South - U/S, paste | U/S | Paste | 670 | 770 | 769 | 100 | 30 | 7.1 | 13.5 | 20.6 | **445.7** | 21.6 | **668.5** | 8,700 | 2.5 | 29.6 | 16.4 to 32.0 | | | 1,022.4 | | | 1,048.9 |
| S4 | ER South - U/S, paste (central) | U/S | Paste | 670 | 770 | 787 | 100 | 30 | 7.1 | 13.5 | 20.6 | **524.8** | 25.4 | **787.2** | 7,800 | 2.5 | 30.8 | 22.8 to 32.0 | | | 1,022.4 | | | 1,048.0 |
| S5 | ER South - stack, cake | Stack | Cake | 670 | 770 | 789 | 100 | N/A | N/A | N/A | 0.7 | **561.9** | 828.2 | **842.9** | 7,800 | N/A | 26.3 | 32.0 | | | 994.4 | | | 1,000.3 |
| S6 | ER South - cyclone tailings sand | Centreline | Slurry (0.4%) | 670 | 770 | 769 | 100 | 35.0 | 7.2 | 121.6 | 7.2 | **558.0** | 77.5 | **789.8** | 7,800 | 4.0 | 26.7 | 32.0 | | | 1,011.1 | | | 1,070.0 |
| ST1 | STSF Ext - D/S, slurry[4] | D/S | Slurry | 674 | 702 | 701 | 28 | N/A | N/A | N/A | 0.8 | 13.9 | 17.8 | 20.9 | 5,800 | N/A | 0.7 | 32.0 | 5.4 | 89.2 | 94.6 | 89.2 | 4.7 | 93.9 |
| ST2 | STSF Raise to 720 (with ext) - U/S, slurry[5] | U/S | Slurry | 610 | 720 | 719 | 110 | N/A | N/A | 2.4 | 2.4 | 83.8 | 35.4 | 125.7 | 5,900 | 2.5 | 7.2 | 12.5 to 24 | - | - | N/A | 552.0 | 62.0 | 614.0 |

Notes:
1. D/S - downstream; U/S - upstream; DVD - down valley discharge; Centreline - cyclone underflow embankment
2. The approximate distances are straight line distances from the middle deposition point (or centre of the stack platform) to the existing tailings thickener located at reference coordinates 685 320 mE, 6 294 900 mN (MGA 94 Zone 55).
3. 3D areas reported.
4. Characteristics of extension wall only
5. Final embankment height and starter dam height includes consideration of the existing STSF arrangement. Upstream raise volume only includes walls above RL 702 m.
6. For stacked tailings, assume on average a 3 m high embankment with a 10 m crest width is provided to manage contact and non-contact runoff and provide access around the entire perimeter.
7. For stacked tailings, final stack platform elevations are not considered, only the elevation at the crest of the side slopes.
8. Starter dam crest width 30 m and upstream raises based on 4H:1V planar slope stepped back to inside crest of starter. Starter and raise volumes from N3 Muck modelling adopted.
9. Bench RL 785 m, bench width 100 m, crest RL 835 m with platform rising upstream at 2%
10. Total tailings to non-tailings embankment materials.

# Appendix B

## Conditional Gateway Certificate

New South Wales Government
Independent Planning Commission

# Mining and Petroleum Gateway Panel
# Conditional Gateway Certificate
# Cadia Continued Operations Project

Division 4 of *State Environmental Planning Policy (Resources and Energy) 2021*

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Pursuant to section 2.31 of the *State Environmental Planning Policy (Resources and Energy) 2021*, we determine the application made by Cadia Holdings Pty Limited by issuing this certificate.

We certify that in the opinion of the Mining and Petroleum Gateway Panel (**Gateway Panel**), with regard to the relevant criteria in section 2.31 of *State Environmental Planning Policy (Resources and Energy) 2021*, the proposed development described in Schedule 1:

- does meet the following relevant criteria:
  - section 2.31(4)(a)(v)
  - section 2.31(4)(b)(i)
  - section 2.31(4)(b)(ii)
  - section 2.31(4)(b)(iii)
  - section 2.31(4)(b)(iv)
  - section 2.31(4)(b)(v)
  - section 2.31(4)(b)(vi)

- does not meet the following relevant criteria:
  - section 2.31(4)(a)(i)
  - section 2.31(4)(a)(ii)
  - section 2.31(4)(a)(iii)
  - section 2.31(4)(a)(iv)
  - section 2.31(4)(a)(vi)

The reasons for forming the opinion on each of the relevant criteria, together with recommendations of the Gateway Panel, are contained in Schedule 2.

| Neal Menzies | Clinton Foster PSM | Hugh Middlemis |
|---|---|---|
| **Member of the Gateway Panel (Chair)** | **Member of the Gateway Panel** | **Member of the Gateway Panel** |

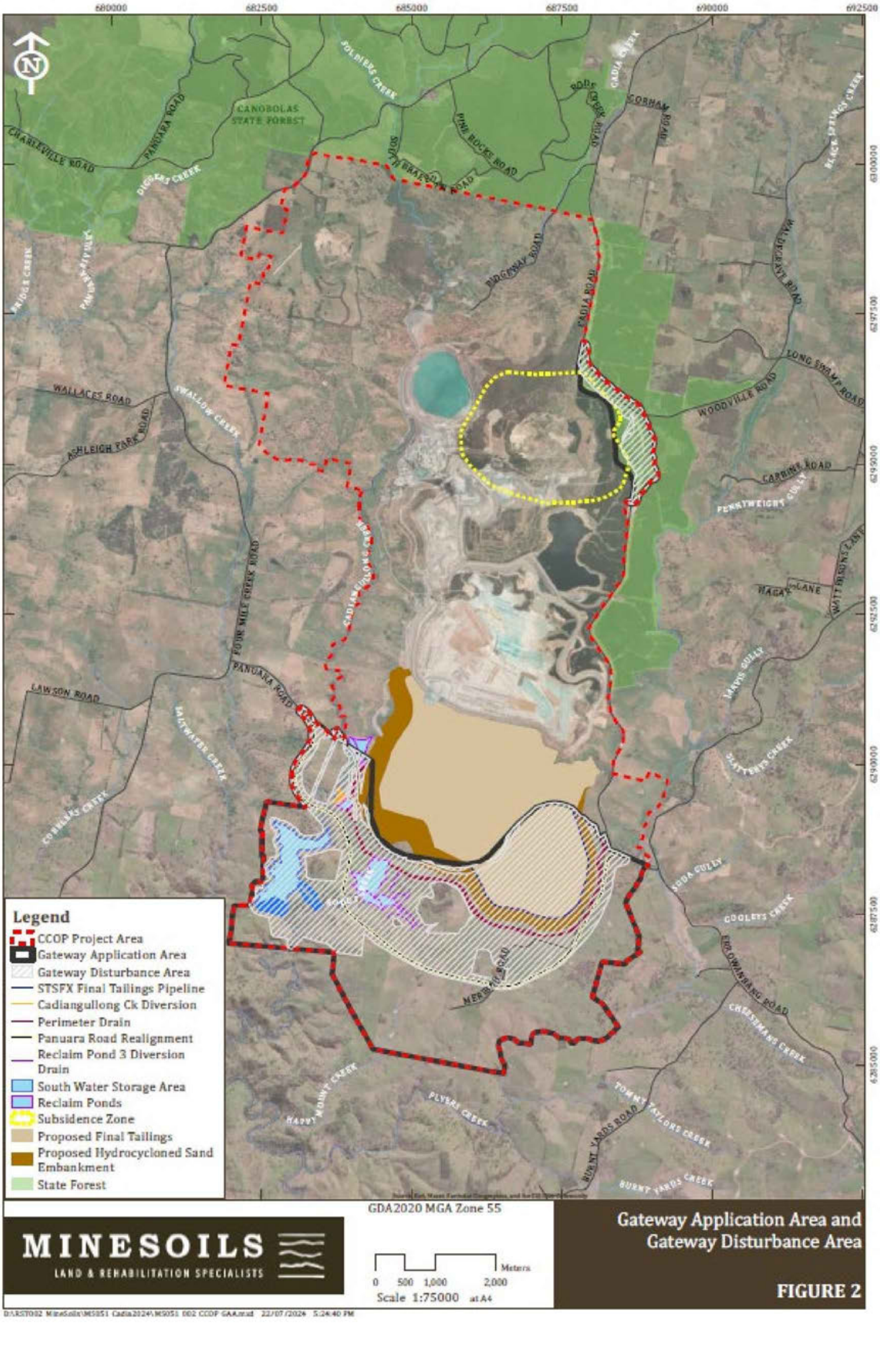
Date certificate issued: 25 October 2024

**This certificate will remain current for 5 years after the date of issue.**

## SCHEDULE 1

**Site:**
The Gateway Certificate Application area is located approximately 25 kilometres south-south-west of Orange, in the Central West region of NSW and is associated with the existing Cadia mine. The site consists of parts of the Cadia Continued Operations Project (CCOP) area which represents a broad envelope or perimeter of the site, where new mining leases are required for the activities proposed. Areas that will be subject to direct ground disturbance by the CCOP within the Gateway Application area are referred to as the Gateway Disturbance Area and cover 1,253 ha. These areas are shown on Figure 1.

*Figure 1 – Gateway Certificate Application Area*
*(Source: Gateway Application Report: Figure 1)*



**Development description:**
The CCOP is proposed to involve:

- Continuation of operations beyond 2031 (for a period of 25 years from the date of approval, nominally to 2050) using existing and approved but not constructed infrastructure and supporting site services.
- Continuation of and extension to underground mining within the Cadia East and Ridgeway mining areas, and associated changes in subsidence surface expression.
- The continued emplacement of tailings from ore processing over the life of the continued operations within existing approved storage facilities and an extension of the existing Southern Tailings Storage Facility (STSF)
- Development of an additional water storage on Cadiangullong Creek (known as the South Water Storage) to provide improved security of water supply.
- Realignment of portions of Panuara Road and Cadia Road to maintain public safety and account for the above project features.
- Changes to site infrastructure and facilities to enable ongoing mining operations.

A new development consent will be sought for CCOP, which will replace the existing Project Approval (PA 06_0295) and provide for a new and modern consent to govern future operations at Cadia.

**Applicant:**
Cadia Holdings Pty Limited.

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## SCHEDULE 2

| **Section 2.31(4) The *relevant criteria* are as follows –**<br>• in relation to biophysical strategic agricultural land – that the proposed development will not significantly reduce the agricultural productivity of any biophysical strategic agricultural land, based on a consideration of the following: | | |
|---|---|---|
| **Relevant criteria** | **Opinion and reasons** | **Recommendations** |
| *(i) any impacts on the land through surface area disturbance and subsidence* | The Gateway Panel finds that 378 ha of verified BSAL land will be impacted:<br>• the majority of this area is agricultural land that will be buried under the Southern Tailings Storage Facility extension (STSFx). In this area, an Agricultural Impact Risk Ranking consequence value of 1 (Severe and/or permanent damage - Irreversible impacts) and probability of A (Almost certain) is appropriate.<br>• a smaller area of BSAL land currently used for forestry is located to the northeast of the mine and may be impacted by subsidence. There will be no direct ground disturbance in this area, and the impacts to existing forestry practices are expected to be negligible; an Agricultural Impact Risk Ranking consequence value of 4 (Minor damage and/or short-term impact to agricultural resources or industries - Can be managed as part of routine operations) and probability of B (Likely) is appropriate. | The Gateway Panel recommends that the EIS:<br>• gives consideration to the long-term monitoring and maintenance of the STSFx with respect to the potential for settling/subsidence to influence water flows, potentially causing water to concentrate in defined flow paths and reducing the overall stability of the landform;<br>• establishes a baseline to allow any subsidence in the northeastern area over the life of the Project to be determined; and<br>• considers opportunities for additional avoidance and reductions in impacts to BSAL. |
| *(ii) any impacts on soil fertility, effective rooting depth or soil drainage* | The Gateway Panel finds that construction of the STSFx will result in burial of the existing agricultural land surface. A new land surface consisting of tailings material will have altered soil fertility and soil drainage. Effective rooting depth cannot be estimated on the basis of existing information. It is anticipated that land in the tailings storage area (STSFx tailings area and | The Gateway Panel recommends that the EIS includes a management plan to ensure that the land proposed to be temporarily disturbed by the Application is rehabilitated to the highest practically achievable Land and Soil Capability (LSC) class appropriate for agriculture at the end of the Project. |

| | | |
|---|---|---|
| | tailings embankment) will be permanently removed from agricultural land use. | |
| *(iii) increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH* | The Gateway Panel finds that construction of the STSFx will result in the existing land surface being buried and a new surface consisting of tailings material being created. This new surface is likely to have reduced micro-relief and reduced surface rockiness without rock outcrops. Levels of soil salinity and soil pH cannot be estimated on the basis of existing information. | The Gateway Panel recommends that the EIS addresses the matters identified in section 2.31(4)(a)(i) and (ii). |
| *(iv) any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy)* | The Gateway Panel finds that the Gateway Disturbance Area directly overlies mapped areas of the Orange Basalt Groundwater Source, which is classified as a highly productive aquifer. Although there is evidence to indicate that the Orange Basalt may be discontinuous in these areas, and may potentially not meet the high yield criterion (>5 L/s), the Panel notes advice from DCCEEW-Water Group that the highly productive categorisation applies to a whole groundwater resource as defined in a water sharing plan, not to the specific groundwater conditions that may be able to be mapped at a particular location. The Panel finds that the Gateway Report does not provide an assessment of potential groundwater impacts consistent with AIP requirements, as required by the SEPP, although it reports that such an assessment is in progress. | The Gateway Panel recommends that the EIS:<br>• demonstrates an improved understanding of surface water and groundwater resources, surface water-groundwater interactions and groundwater dependent ecosystems (GDEs), including:<br>– relevant baseline information on water quality, hydrological connectivity and flow regimes;<br>– the results of site-specific investigations to confirm the presence and groundwater-dependence of aquatic, terrestrial and/or subterranean GDEs in and near the Project area;<br>• describes proposed Project activities in more detail so that potential impact pathways to water resources can be determined with greater certainty;<br>• includes an impact pathway diagram to refine and communicate understanding of how and where the Project may impact water resources; |

| | | |
|---|---|---|
| | | • identifies and quantifies potential surface and groundwater impacts, including:<br>– the likely extent and magnitude of groundwater level and water quality changes from underground mining, tailings deposition and water management infrastructure, including construction and operation of the STSFx, water storage and creek diversion;<br>– changes to hydraulic connection between aquifers, especially in the subsidence zones;<br>– additional water take requirements during and post mining;<br>– impacts to GDEs, landholder bores and licensed water users;<br>– demonstrates the ability to obtain additional water entitlements where required;<br>• assesses the Project against the minimal impact considerations of the AIP for highly productive aquifers including drawdown and water quality impacts to high priority GDEs, high priority culturally significant sites and water supply works;<br>• sets out proposed impact avoidance and mitigation measures<br>• includes a detailed description of a monitoring program to assess the effectiveness of the avoidance and |

| | | |
|---|---|---|
| | | mitigation strategies and detect any residual impacts; and<br>• includes a cumulative impact assessment that explicitly considers the existing Cadia Valley Operations project and other relevant land and water uses in and near the Project area. |
| *(v) any fragmentation of agricultural land uses* | The Gateway Panel finds that the Application will not result in the fragmentation of agricultural land uses as there will be a permanent 378 ha reduction in the area of verified/assumed BSAL land bounding the existing mine. The Application therefore meets the criterion and no recommendations have been made. | Not applicable. |
| *(vi) any reduction in the area of biophysical strategic agricultural land* | The Gateway Panel finds that the Application will result in a permanent 378 ha reduction in the area of verified/assumed BSAL land. | The Gateway Panel recommends that the EIS addresses the matters identified in section 2.31(4)(a)(i), (ii) and (iv). |
| **Section 2.31(4) The *relevant criteria* are as follows –**<br>(b) **in relation to critical industry cluster land – that the proposed development will not have a significant impact on the relevant critical industry based on a consideration of the following:** | | |
| **Relevant criteria** | **Opinion and reasons** | **Recommendations** |
| *(i) any impacts on the land through surface area disturbance and subsidence* | The Gateway Application Report states that there is no Critical Industry Cluster land within the Gateway Application Area. The Gateway Panel accepts this finding and therefore finds that the proposed development will not have a significant impact on any critical industry. | Not applicable. |
| *(ii) reduced access to, or impacts on, water resources and agricultural resources* | As above. | Not applicable. |

| | | |
|---|---|---|
| *(iii) reduced access to support services and infrastructure* | As above. | Not applicable. |
| *(iv) reduced access to transport routes* | As above. | Not applicable. |
| *(v) the loss of scenic and landscape values* | As above. | Not applicable. |
| **Section 2.31(5) In forming an opinion as to whether a proposed development meets the relevant criteria, the Gateway Panel is to have regard to:** | | |
| **Consideration** | **Opinion and reasons** | **Recommendations** |
| *(a) the duration of any impact referred to in subsection (4)* | The Gateway Panel finds that the impacts on BSAL:<br>• will be permanent and severe in the STSFx area to the south of the existing mine; and<br>• will be permanent in the area to the north-east of the existing mine, and while they are unlikely to substantially alter the forestry production system, they will very likely permanently impact the highly productive Orange Basalt Groundwater Source, as mapped by the former NSW Department of Primary Industries (Office of Water) in Groundwater Productivity in NSW – 2013. | The Gateway Panel recommends that the EIS addresses the matters identified in section 2.31(4)(a)(i), (ii) and (iv). |
| *(b) any proposed avoidance, mitigation, offset or rehabilitation measures in respect of any such impac* | No mitigation measures are proposed for the STSFx area. In other areas soil stripping and reuse will be implemented to mitigate impacts. | The Gateway Panel recommends that the EIS:<br>• includes a management plan to ensure that the land proposed to be temporarily disturbed by the Application is rehabilitated to a Land and Soil Capability (LSC) class appropriate for agriculture at the end of the Project.<br>• includes management/mitigation plans for groundwater and connected surface water |

| | | |
|---|---|---|
| | | systems consistent with Aquifer Interference Policy requirements. |

Note: Further information on the Gateway Panel's reasoning in relation to the relevant criteria is contained in the Conditional Gateway Certificate Report available at: https://www.ipcn.nsw.gov.au/cases/2024/08/cadia-continued-operations-project

# Appendix C

Conditional Gateway Certificate Report

New South Wales Government
Independent Planning Commission

ipcn.nsw.gov.au

# Cadia Continued Operations Project

## Mining and Petroleum Gateway Panel Conditional Gateway Certificate Report


Neal Menzies (Chair)
Clinton Foster PSM
Hugh Middlemis


25 October 2024

# Contents

# Defined Terms

| ABBREVIATION | DEFINITION |
|---|---|
| **AIP** | NSW Aquifer Interference Policy |
| **Applicant** | Cadia Holdings Pty Limited, a wholly owned subsidiary of Newcrest Mining Limited |
| **BSAL** | Biophysical Strategic Agricultural Land |
| **BSAL Protocol** | Strategic Regional Land Use Policy – Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land (NSW Government, 2013) |
| **CVO** | Cadia Valley Operations |
| **DCCEEW** | NSW Department of Climate Change, Energy, the Environment and Water |
| **EP&A Act** | *Environmental Planning and Assessment Act 1979* |
| **Gateway Application** | Cadia Continued Operations Project Gateway Application GA-74105771, submitted to the Department of Planning, Housing and Infrastructure on 30 July 2024 |
| **Gateway Application Report** | Gateway Report - Cadia Continued Operations Project MS-051_Final v3, prepared for Cadia Holdings Pty Ltd by Minesoils Pty Ltd and dated July 2024 |
| **Gateway Panel** | Mining and Petroleum Gateway Panel |
| **GDEs** | Groundwater dependent ecosystems |
| **ha** | Hectares |
| **IESC** | Commonwealth Independent Expert Scientific Committee |
| **LSC** | Land and Soil Capability |
| **Material** | Material listed in Section 5 of this report |
| **MLs** | Mining Leases |
| **Project** | Cadia Continued Operations Project |
| **Resources SEPP** | *State Environmental Planning Policy (Resources and Energy) 2021* |
| **Site** | The Cadia Continued Operations Project site, as defined in Section 2 of this report |
| **STSFx** | Southern Tailings Storage Facility extension |

# 1. Introduction

1. On 30 July 2024, Cadia Holdings Pty Limited (**Applicant**) applied for a Gateway Certificate (GA-74105711) (**Gateway Application**) for the proposed Cadia Continued Operations Project (**Project**). The Project involves the continuation of and extension to underground mining at the existing Cadia mine.
2. The Gateway Application has been submitted to the Mining and Petroleum Gateway Panel (**Gateway Panel**) pursuant to sections 2.24 and 2.29 of the *State Environmental Planning Policy (Resources and Energy) 2021* (**Resources SEPP**) because the Project involves the disturbance of Biophysical Strategic Agricultural Land (**BSAL**) outside the existing Mining Lease area.
3. Professor Neal Menzies, as Chair of the Gateway Panel, nominated himself, Dr Clinton Foster PSM and Mr Hugh Middlemis to constitute the Panel determining the Gateway Application in accordance with section 2.40 of the Resources SEPP.
4. In accordance with section 2.31 of the Resources SEPP, this report states the Gateway Panel's reasons for the formation of the opinions in the Conditional Gateway Certificate issued on this day for the Project (and the reasons for the making of any recommendations included in the Certificate).
5. The terms of reference for the Gateway Panel in determining this Gateway Application are those set out in sections 2.31(4) and 2.31(5) of the Resources SEPP.
6. The role of the Gateway Panel is to assess the impacts of State significant mining or coal seam gas proposals on strategic agricultural land and its associated water resources before a development application is lodged. The Gateway Panel's assessment is conducted against targeted scientific criteria relating to agricultural and water impacts. There are certain matters that the Gateway Panel cannot take into account, such as historic applications, any past planning law breaches by the Applicant or the reputation of the Applicant. Additionally, the Gateway Panel is not involved in the Department of Planning and Environment's assessment of State significant development applications.

# 2. The Gateway Application Area

7. The Gateway Application relates to the Cadia mine which is located approximately 25 kilometres south-south-west of Orange, in the Central West region of NSW.
8. The **Gateway Application Area** sits outside the existing mining tenements and is illustrated in Figure 1 below. The area within the Gateway Application Area that will be disturbed by the Project (**Gateway Disturbance Area**) is also illustrated in Figure 1.
9. Verified and assumed BSAL within the Gateway Application Area is illustrated in Figure 2 (below).

*Figure 1 – Gateway Certificate Application Area*
*(Source: Gateway Application Report: Figure 2)*

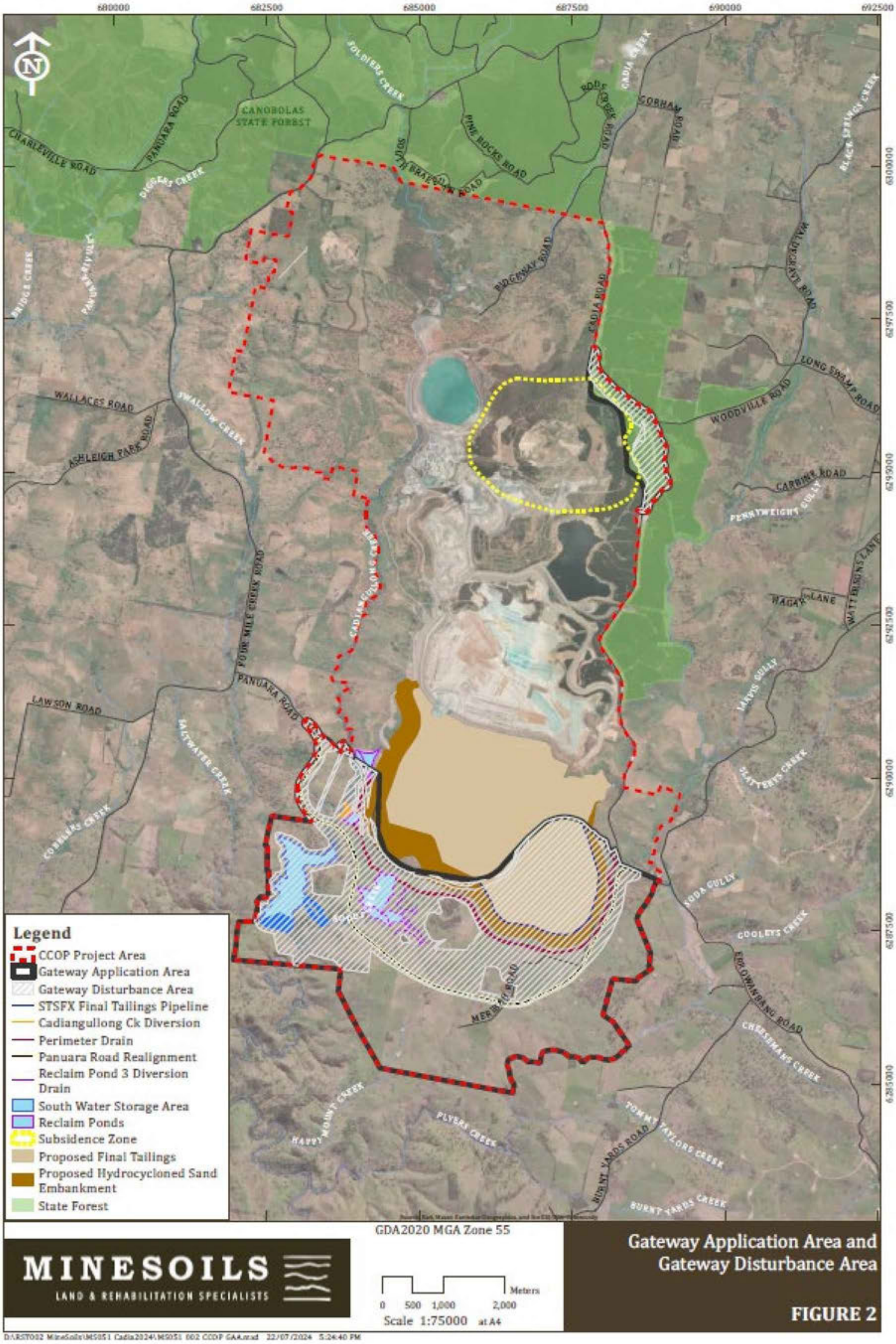
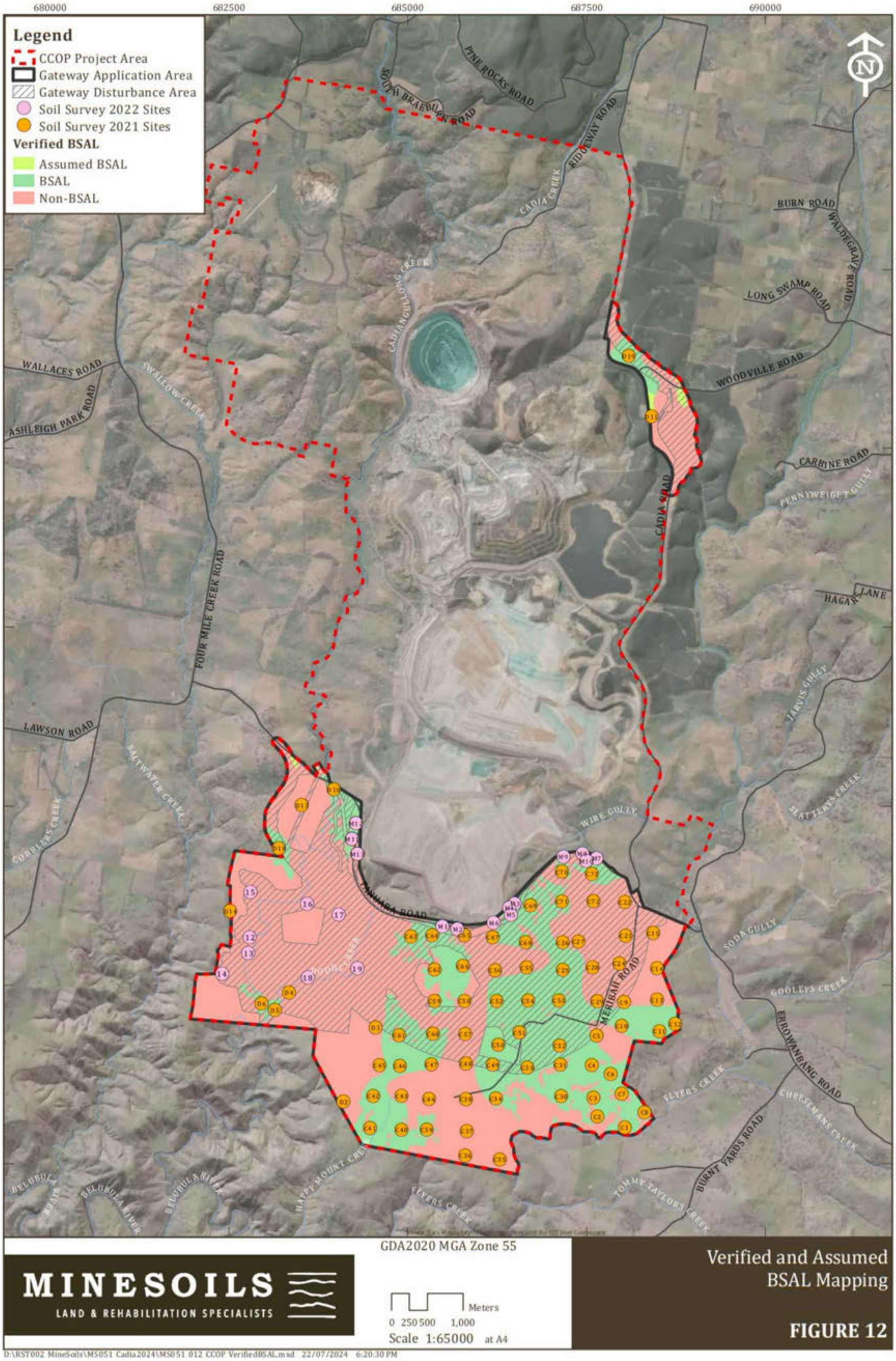


*Figure 2 – Verified and Assumed BSAL Mapping*
*(Source: Gateway Application Report: Figure 12)*



# 3. The Gateway Application

10. The Gateway Application Report, dated 25 July 2024 (**Gateway Application Report**) states that the Project involves the "*continuation of operations beyond 2031 (for a period of 25 years from the date of approval, nominally to 2050) using existing and approved but not constructed infrastructure and supporting site services*".

11. The Project proposes:
    - Continuation of operations beyond 2031 (for a period of 25 years from the date of approval, nominally to 2050) using existing and approved but not constructed infrastructure and supporting site services
    - Continuation of and extension to underground mining within the Cadia East and Ridgeway mining areas, and associated changes in subsidence surface expression
    - The continued emplacement of tailings from ore processing over the life of the continued operations within existing approved storage facilities and an extension of the existing Southern Tailings Storage Facility (Southern Tailings Storage Facility extension or **STSFx**)
    - Development of an additional water storage on Cadiangullong Creek (known as the South Water Storage) to provide improved security of water supply
    - Realignment of portions of Panuara Road and Cadia Road to maintain public safety and account for the above project features
    - Changes to site infrastructure and facilities to enable ongoing mining operations.

12. According to the Gateway Application Report, the Project would extend the Southern Tailings Storage Facility onto land that is verified BSAL in accordance with the *Strategic Regional Land Use Policy - Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (**BSAL Protocol**) and the Applicant is seeking a Gateway Certificate in relation to that land.

13. The Project would result in disturbance of up to 1,253 ha with the Gateway Application Area of which 378 ha is verified BSAL.

# 4. Consultation

14. Pursuant to section 2.30 of the Resources SEPP, this Gateway Application was referred to the Commonwealth Independent Expert Scientific Committee (**IESC**) and the NSW Minister for Water. The Gateway Panel received the following advice on the proposal:
    - advice from the IESC (received 10 October 2024); and
    - advice from the NSW Minister for Regional Water (received 16 October 2024).

15. The Gateway process is an independent scientific assessment of the impact of new State significant mining and coal seam gas proposals on strategic agricultural land and its associated water resources. The process does not involve public consultation. The Project is also the subject of a State significant development application that is subject to public consultation in accordance with the *Environmental Planning and Assessment Act 1979* (**EP&A Act**).

# 5. Material

16. In considering the Gateway Application, the Gateway Panel reviewed the following documents (**Material**):

- Gateway Application Report, dated 25 July 2024;
- BSAL Site Verification Assessment, dated 25 July 2024;
- Soil Survey Summary and Soil Profile Descriptions, dated July 2024;
- Certificate of Analysis, dated July 2024;
- Land and Soil Capability Assessment Ratings, dated July 2024;
- Site and Technology Selection Report, dated July 2024;
- IESC Advice, dated 10 October 2024;
- Advice (including an attached technical assessment by DCCEEW-Water Group) from the NSW Minister for Regional Water, dated 16 October 2024; and
- Groundwater Productivity in NSW – 2013, NSW Department of Primary Industries (Office of Water).

# 6. Strategic agricultural land verification

### *Biophysical Strategic Agricultural Land (BSAL)*

17. As described in paragraph 12, the Gateway Application Report confirms that part of the Gateway Application Area is classified as BSAL in accordance with the BSAL Protocol.

18. The Gateway Panel finds the Applicant's methodology for the verification of BSAL to be in accordance with the BSAL Protocol and that it is acceptable for a Gateway Application.

19. The Gateway Application Report states that the Gateway Disturbance Area covers 1,253 ha and the Project would impact up to 378 ha of BSAL.

### *Critical Industry Cluster land*

20. The Gateway Application Report states there is no Critical Industry Cluster land within the Gateway Application Area. The Gateway Panel accepts this conclusion and notes that Critical Industry Cluster land is confined to the Upper Hunter region of NSW.

# 7. Consideration of impacts on BSAL

21. The Gateway Panel has considered the proposed development's impact on BSAL, duration of impact and proposed mitigation measures in respect of any such impact in accordance with section 2.31(4) and (5) of the Resources SEPP. The Gateway Panel's findings are set out below.

### *Section 2.31(4)(a)(i) Impacts on the land through surface area disturbance and subsidence*

22. The Gateway Panel finds that 378 ha of verified BSAL land will be impacted:

- the majority of this area is agricultural land that will be buried under the STSFx. In this area, an Agricultural Impact Risk Ranking consequence value of 1 (Severe and/or permanent damage - Irreversible impacts) and probability of A (Almost certain) is appropriate.

- a smaller area of BSAL land currently used for forestry is located to the northeast of the mine and may be impacted by subsidence. There will be no direct ground disturbance in this area, and the impacts to existing forestry practices are expected to be negligible; an Agricultural Impact Risk Ranking consequence value of *4 (Minor damage and/or short-term impact to agricultural resources or industries - Can be managed as part of routine operations)* and probability of *B (Likely)* is appropriate.

23. The Gateway Panel recommends that the EIS:
    - gives consideration to the long-term monitoring and maintenance of the STSFx with respect to the potential for settling/subsidence to influence water flows, potentially causing water to concentrate in defined flow paths and reducing the overall stability of the landform;
    - establishes a baseline to allow any subsidence in the northeastern area over the life of the Project to be determined; and
    - considers opportunities for additional avoidance and reductions in impacts to BSAL.

### *Section 2.31(4)(a)(ii) Impacts on soil fertility, effective rooting depth or soil drainage*

24. The Gateway Panel finds that construction of the STSFx will result in burial of the existing agricultural land surface. A new land surface consisting of tailings material will have altered soil fertility and soil drainage. Effective rooting depth cannot be estimated on the basis of existing information. It is anticipated that land in the tailings storage area (STSFx tailings area and tailings embankment) will be permanently removed from agricultural land use.

25. The Gateway Panel recommends that the EIS includes a management plan to ensure that the land proposed to be temporarily disturbed by the Application is rehabilitated to the highest practically achievable Land and Soil Capability (LSC) class appropriate for agriculture at the end of the Project.

### *Section 2.31(4)(a)(iii) Increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH*

26. The Gateway Panel finds that construction of the STSFx will result in the existing land surface being buried and a new surface consisting of tailings material being created. This new surface is likely to have reduced micro-relief and reduced surface rockiness without rock outcrops. Levels of soil salinity and soil pH cannot be estimated on the basis of existing information.

27. The Gateway Panel recommends that the EIS addresses the matters identified in section 2.31(4)(a)(i) and (ii).

### *Section 2.31(4)(a)(iv) Impacts on highly productive groundwater*

28. The Gateway Panel finds that the Gateway Disturbance Area directly overlies mapped areas of the Orange Basalt Groundwater Source, which is classified as a highly productive aquifer. Although there is evidence to indicate that the Orange Basalt may be discontinuous in these areas, and may potentially not meet the high yield criterion (>5 L/s), the Panel notes advice from DCCEEW-Water Group that the highly productive categorisation applies to a whole groundwater resource as defined in a water sharing plan, not to the specific groundwater conditions that may be able to be mapped at a particular location. The Panel finds that the Gateway Report does not provide an assessment of potential groundwater impacts consistent with AIP requirements, as required by the SEPP, although it reports that such an assessment is in progress.

29. The Gateway Panel recommends that the EIS:
    - demonstrates an improved understanding of surface water and groundwater resources, surface water-groundwater interactions and groundwater dependent ecosystems (GDEs), including:
        - relevant baseline information on water quality, hydrological connectivity and flow regimes;
        - the results of site-specific investigations to confirm the presence and groundwater-dependence of aquatic, terrestrial and/or subterranean GDEs in and near the Project area;
    - describes proposed Project activities in more detail so that potential impact pathways to water resources can be determined with greater certainty;
    - includes an impact pathway diagram to refine and communicate understanding of how and where the Project may impact water resources;
    - identifies and quantifies potential surface and groundwater impacts, including:
        - the likely extent and magnitude of groundwater level and water quality changes from underground mining, tailings deposition and water management infrastructure, including construction and operation of the STSFx, water storage and creek diversion;
        - changes to hydraulic connection between aquifers, especially in the subsidence zones;
        - additional water take requirements during and post mining;
        - impacts to GDEs, landholder bores and licensed water users;
        - demonstrates the ability to obtain additional water entitlements where required;
    - assesses the Project against the minimal impact considerations of the AIP for highly productive aquifers including drawdown and water quality impacts to high priority GDEs, high priority culturally significant sites and water supply works;
    - sets out proposed impact avoidance and mitigation measures
    - includes a detailed description of a monitoring program to assess the effectiveness of the avoidance and mitigation strategies and detect any residual impacts; and
    - includes a cumulative impact assessment that explicitly considers the existing Cadia Valley Operations (**CVO**) project and other relevant land and water uses in and near the Project area.

### *Section 2.31(4)(a)(v) Fragmentation of agricultural land uses*

30. The Gateway Panel finds that the Application will not result in the fragmentation of agricultural land uses as there will be a permanent 378 ha reduction in the area of verified/assumed BSAL land bounding the existing mine. The Application therefore meets the criterion and no recommendations have been made.

### *Section 2.31(4)(a)(vi) Reduction in the area of BSAL*

31. The Gateway Panel finds that the Application will result in a permanent 378 ha reduction in the area of verified/assumed BSAL land.

32. The Gateway Panel recommends that the EIS addresses the matters identified in section 2.31(4)(a)(i) and (ii) and (iv).

### *Section 2.31(5)(a) Duration of any impacts*

33. The Gateway Panel finds that the impacts on BSAL:
    - will be permanent and severe in the STSFx area to the south of the existing mine; and
    - will be permanent in the area to the north-east of the existing mine, and while they are unlikely to substantially alter the forestry production system, they will very likely permanently impact the highly productive Orange Basalt Groundwater Source, as mapped by the former NSW Department of Primary Industries (Office of Water) in Groundwater Productivity in NSW – 2013.

34. The Gateway Panel recommends that the EIS addresses the matters identified in section 2.31(4)(a)(i) and (ii) and (iv).

### *Section 2.31(5)(b) Proposed mitigation measures in respect of any impacts*

35. No mitigation measures are proposed for the STSFx area. In other areas soil stripping and reuse will be implemented to mitigate impacts.

36. The Gateway Panel recommends that the EIS:
    - includes a management plan to ensure that the land proposed to be temporarily disturbed by the Application is rehabilitated to a Land and Soil Capability (LSC) class appropriate for agriculture at the end of the Project.
    - includes management/mitigation plans for groundwater and connected surface water systems consistent with AIP requirements.

# 8. Consideration of impacts on Critical Industry Cluster land

37. The Gateway Panel has considered the proposed development's impact on Critical Industry Cluster land, as well as the duration of impact and proposed mitigation measures in respect of any such impact in accordance with sub-sections 2.31(4) and (5) of the Resources SEPP.

38. The Gateway Application Report states that there is no Critical Industry Cluster land within the Gateway Application Area. The Gateway Panel accepts this finding and therefore finds that the proposed development will not have a significant impact on any critical industry based on its consideration of the following:

### *Section 2.31 (4)(b)(i) Any impacts on the land through surface area disturbance and subsidence*

39. Nil impacts.

### *Section 2.31 (4)(b)(ii) Reduced access to, or impacts on, water resources and agricultural resources*

40. Nil impacts.

### *Section 2.31 (4)(b)(iii) Reduced access to support services and infrastructure*

41. Nil impacts.

### *Section 2.31 (4)(b)(iv) Reduced access to transport routes*

42. Nil impacts.

### *Section 2.31 (4)(b)(v) The loss of scenic and landscape values*

43. Nil impacts.

### *Section 2.31 (5)(a) Duration of any impacts*

44. Not applicable.

### *Section 2.31 (5)(b) Proposed mitigation measures in respect of any impacts*

45. Not applicable.

# 9. Determination

46. The Gateway Panel has assessed the Gateway Application against the relevant criteria set out in section 2.31 of the Resources SEPP and has had regard to the duration of potential impacts and any proposed avoidance, mitigation, offset or rehabilitation measures.

47. Based on its consideration of the Material, the Gateway Panel is of the opinion that the proposed development:

- does not meet the following relevant criteria and therefore may significantly reduce the agricultural productivity of the impacted BSAL in relation to those criteria:
  - section 2.31(4)(a)(i)
  - section 2.31(4)(a)(ii)
  - section 2.31(4)(a)(iii)
  - section 2.31(4)(a)(iv)
  - section 2.31(4)(a)(vi)
- meets the following relevant criterion in relation to the fragmentation of agricultural land uses:
  - section 2.31(4)(a)(v)
- meets the following relevant criteria and therefore will not have a significant impact on a Critical Industry:
  - section 2.31(4)(b)(i)
  - section 2.31(4)(b)(ii)
  - section 2.31(4)(b)(iii)
  - section 2.31(4)(b)(iv)
  - section 2.31(4)(b)(v)
  - section 2.31(4)(b)(vi)

48. Overall, the Gateway Panel is of the opinion that the proposed development does not meet all of the relevant criteria set out above and has therefore determined the application by issuing a conditional Gateway Certificate in accordance with section 2.31 of the Resources SEPP.

49. The reasons for the formation of this opinion are set out in sections 7 and 8 of this report.

Neal Menzies (Chair)
Member of the Mining and Petroleum Gateway Panel

Clinton Foster
Member of the Mining and Petroleum Gateway Panel

Hugh Middlemis
Member of the Mining and Petroleum Gateway Panel

New South Wales Government
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