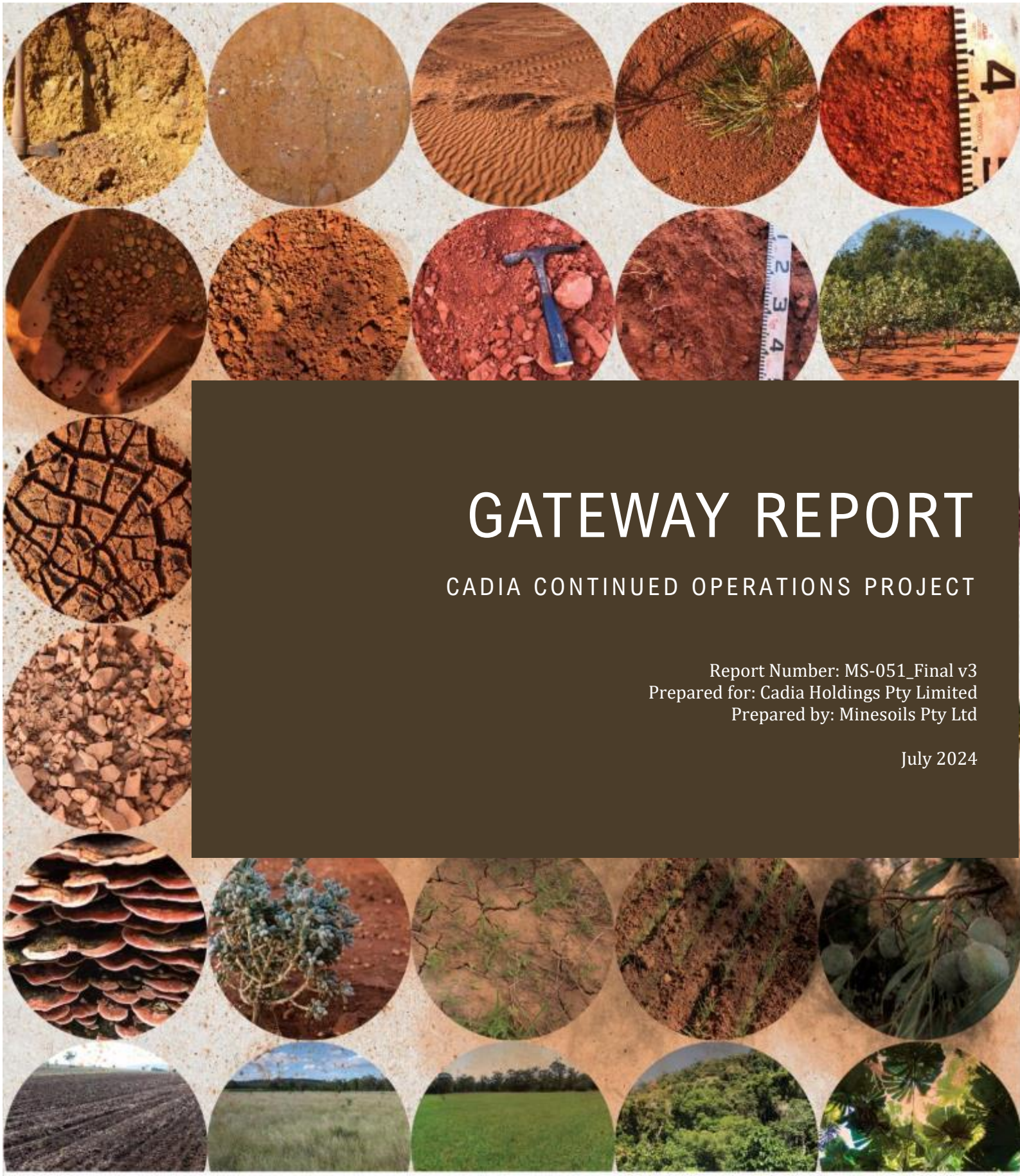

GATEWAY REPORT

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

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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

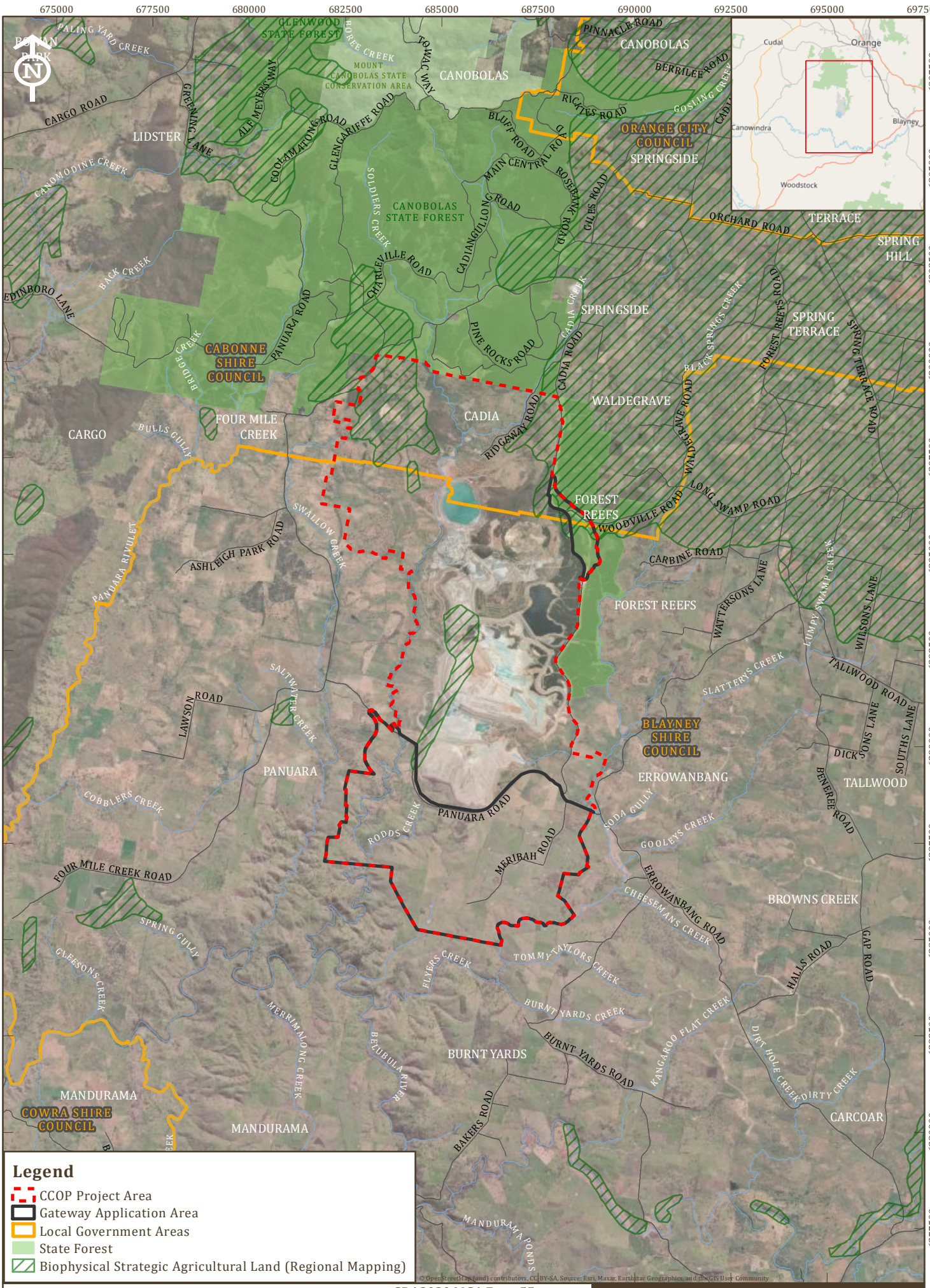
CHPL owns and operates the Cadia mine, located approximately 20 kilometres (km) South-South-West of Orange in the Central Tablelands region of New South Wales (NSW) (refer **Figure 1**). The mining operation traverses two local government areas (LGAs), Blayney Shire Council and Cabonne Council.

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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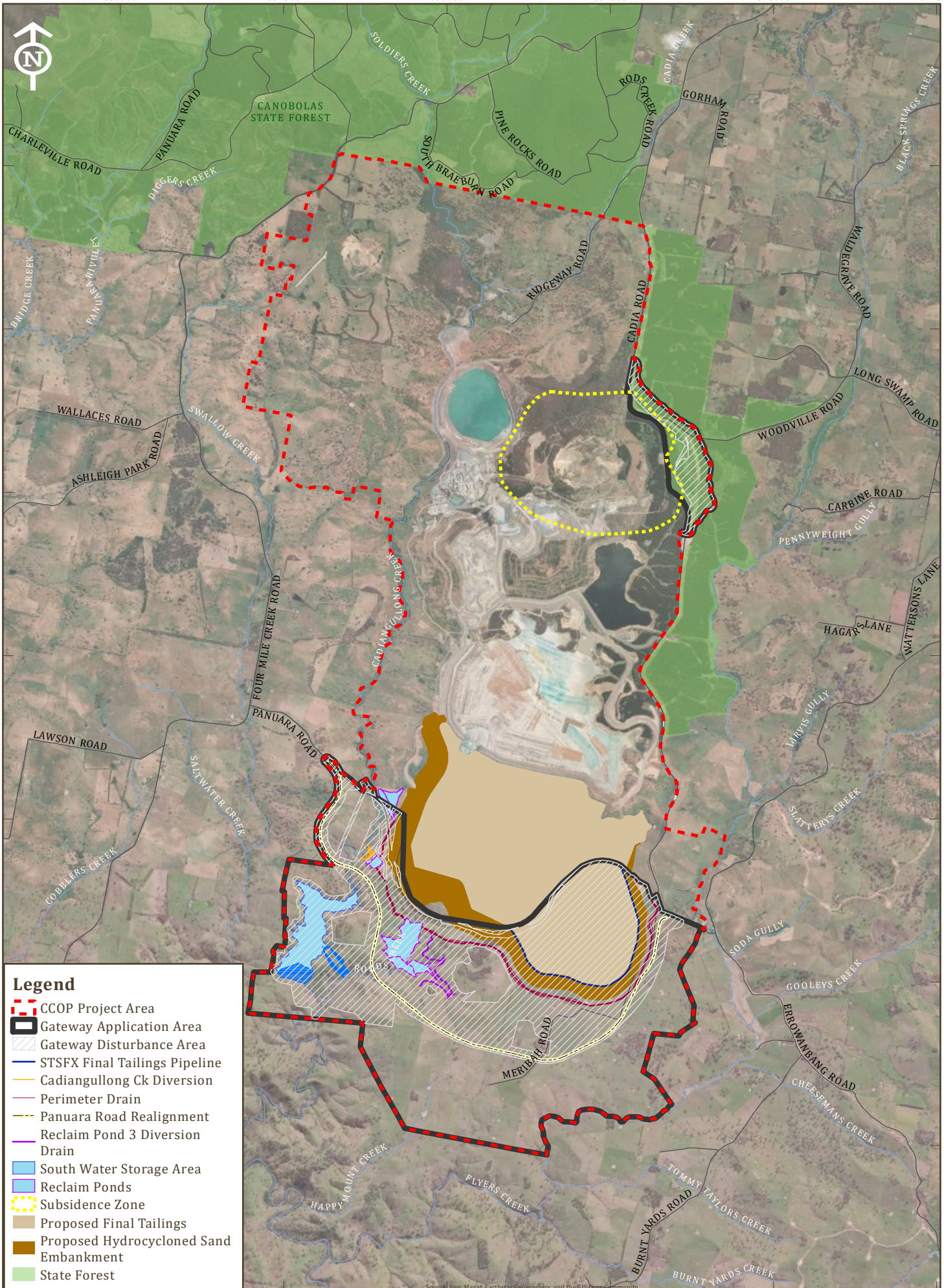

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Gateway Application Area and Gateway Disturbance Area

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**).

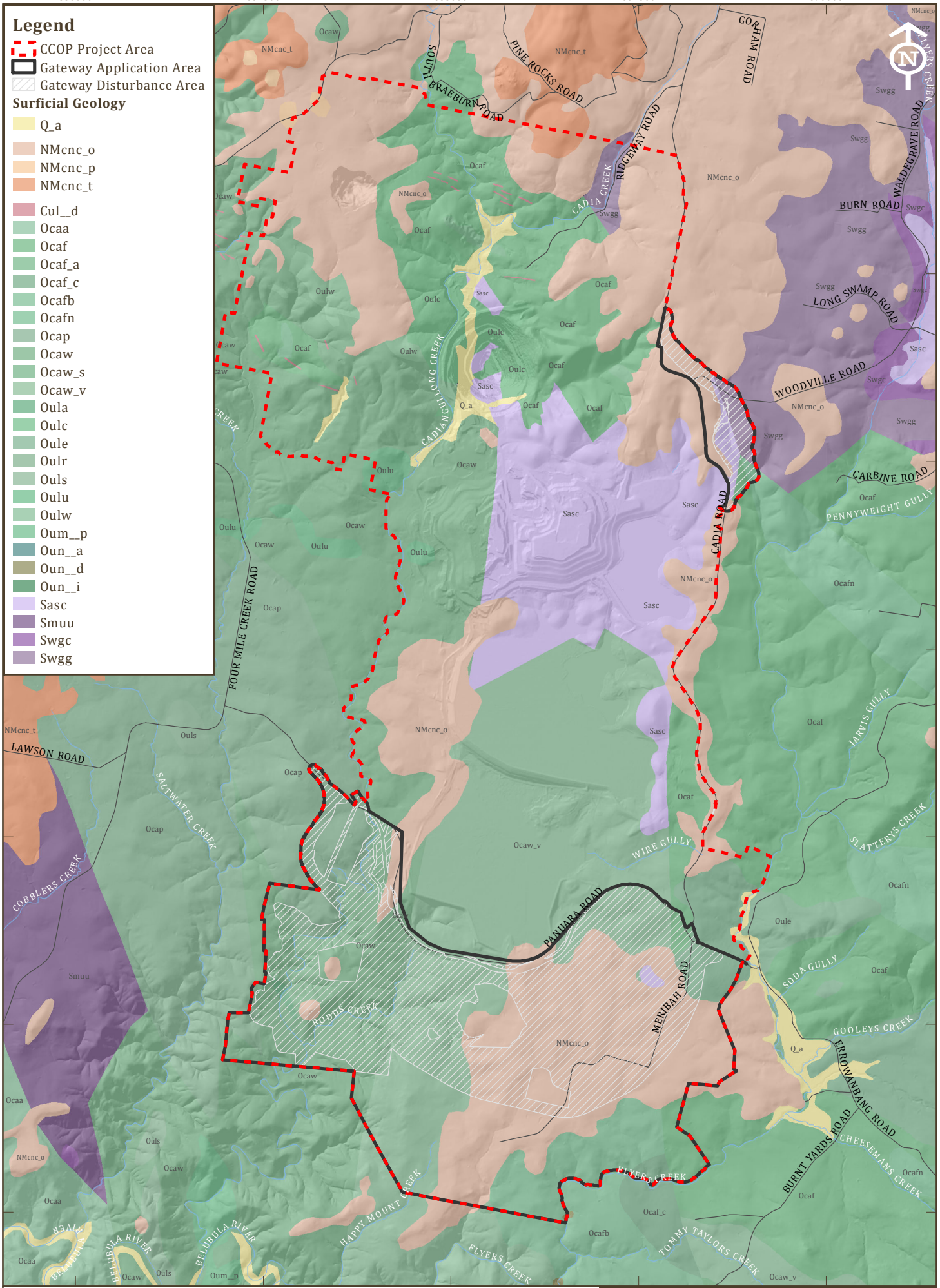
Groundwater resources within the region are generally associated with three geological formations; the Tertiary Basalt, Ordovician Volcanics and Silurian Sediments formations. A summary of characteristics of these groundwater resources is provided below, as described by Advisian (2023):

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**.

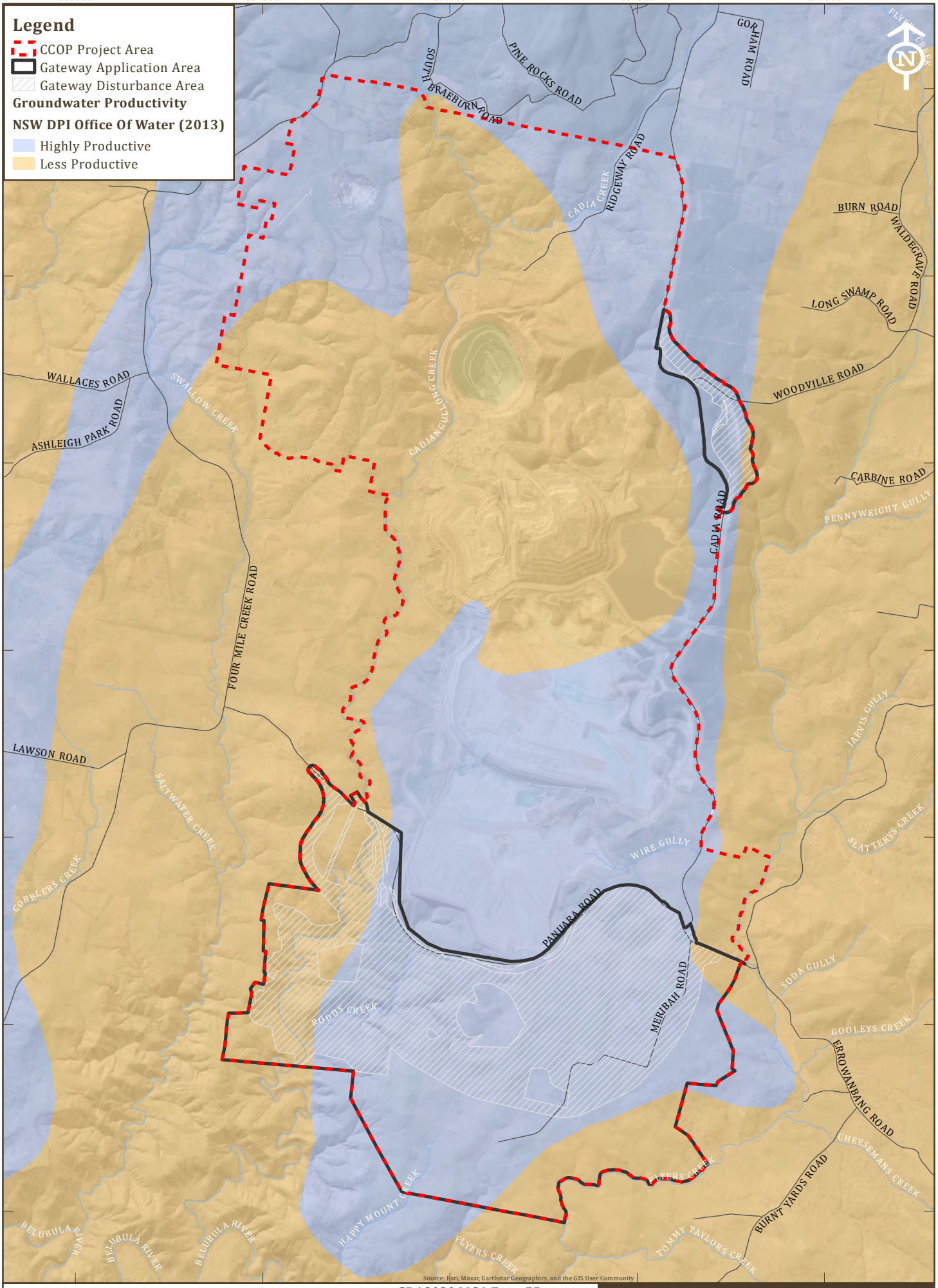
Detailed groundwater modelling and impact assessments are currently being prepared to inform the CCOP EIS. These studies will include a review of the adequacy of the existing groundwater monitoring network and if necessary, recommend rationalisation and / or additional bores be installed as part of this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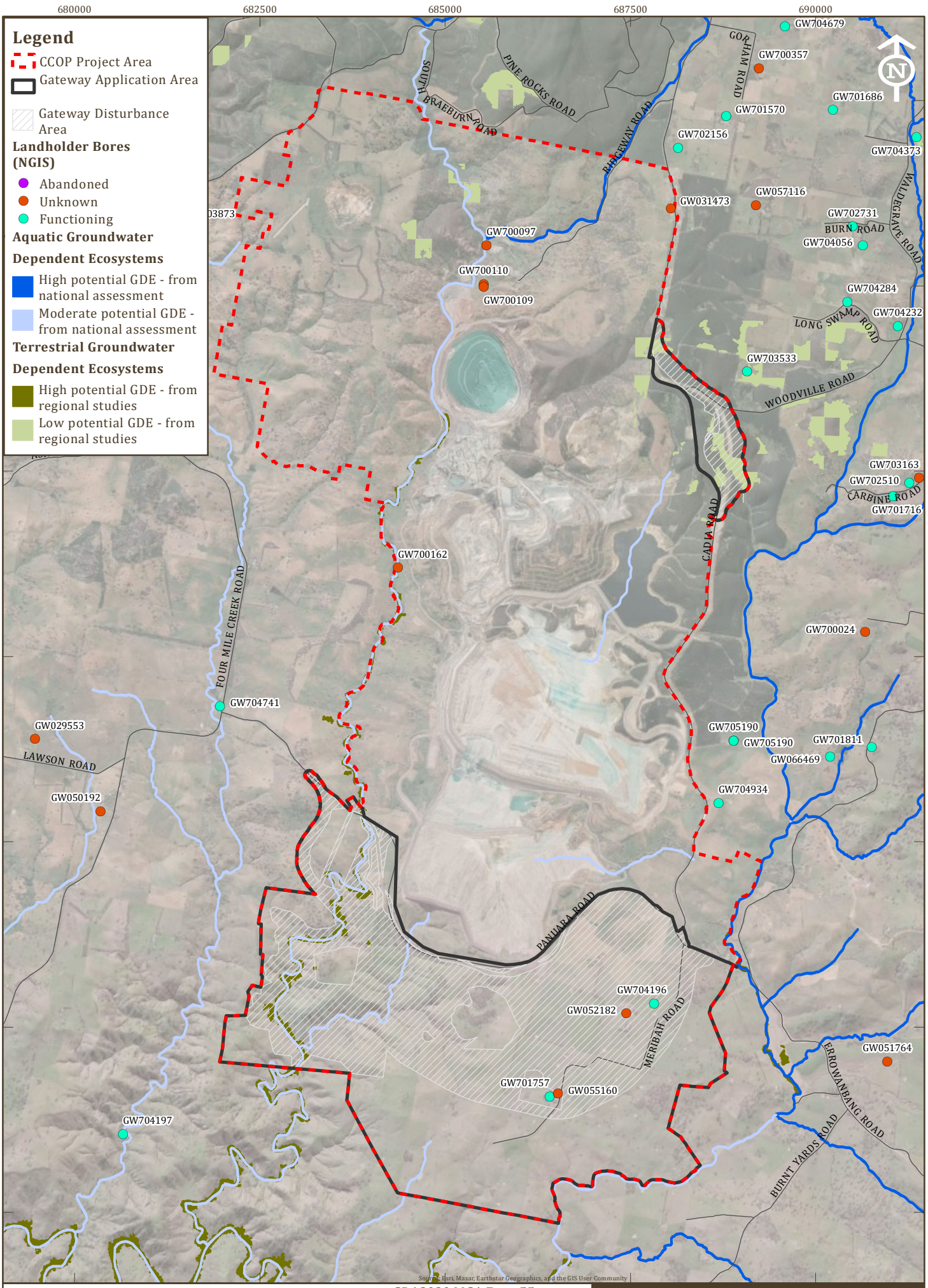

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Groundwater Users

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

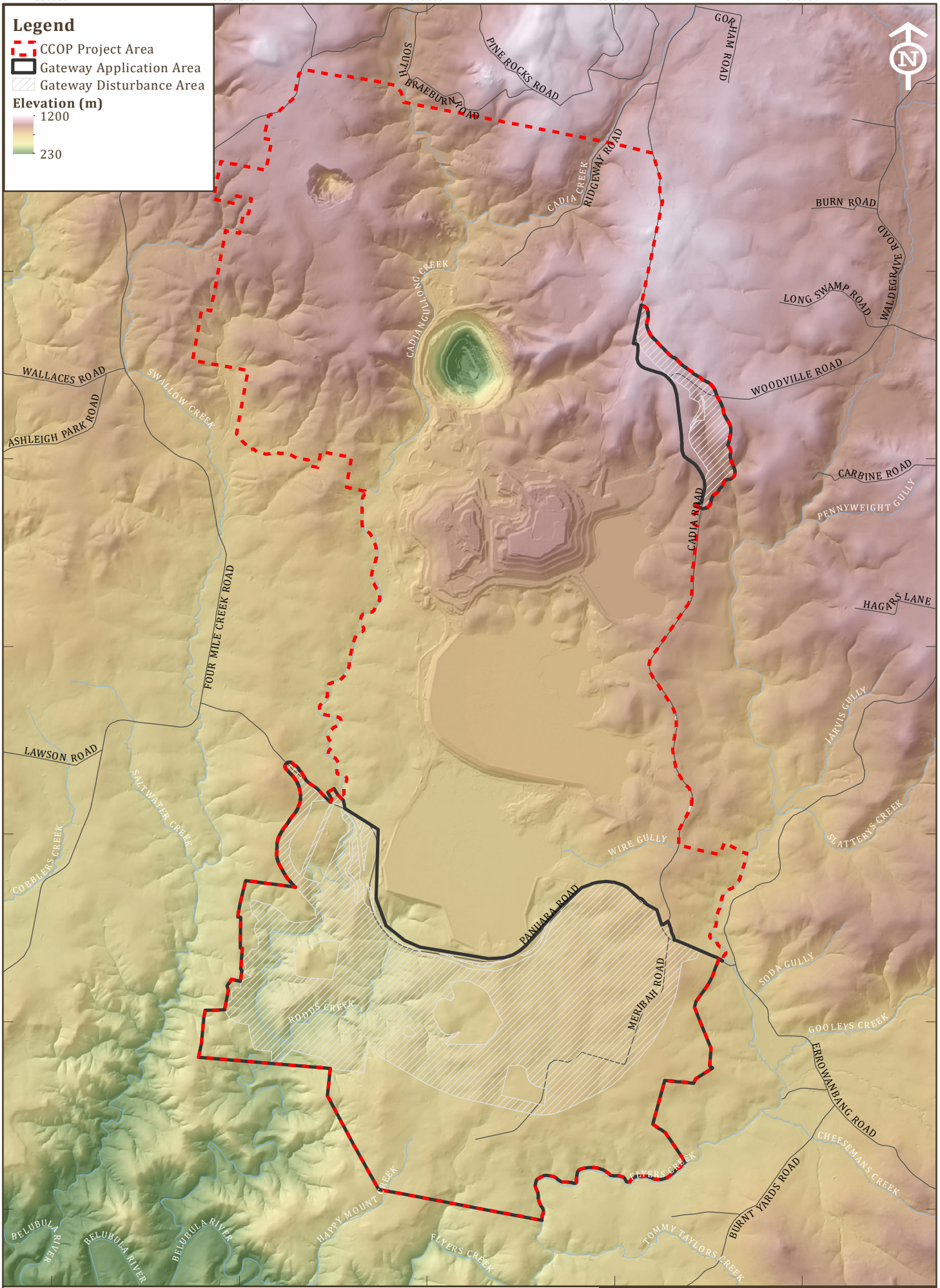
Undulating low hills to rolling hills, 500 –965 m above sea level. Local relief is usually between 100–120 m, although it can be as low as 60 m for undulating slopes around Panuara. Slopes vary from 5–8% but are up to 15% in the steeper terrain. Slope lengths vary from 500–800 m. Drainage lines run west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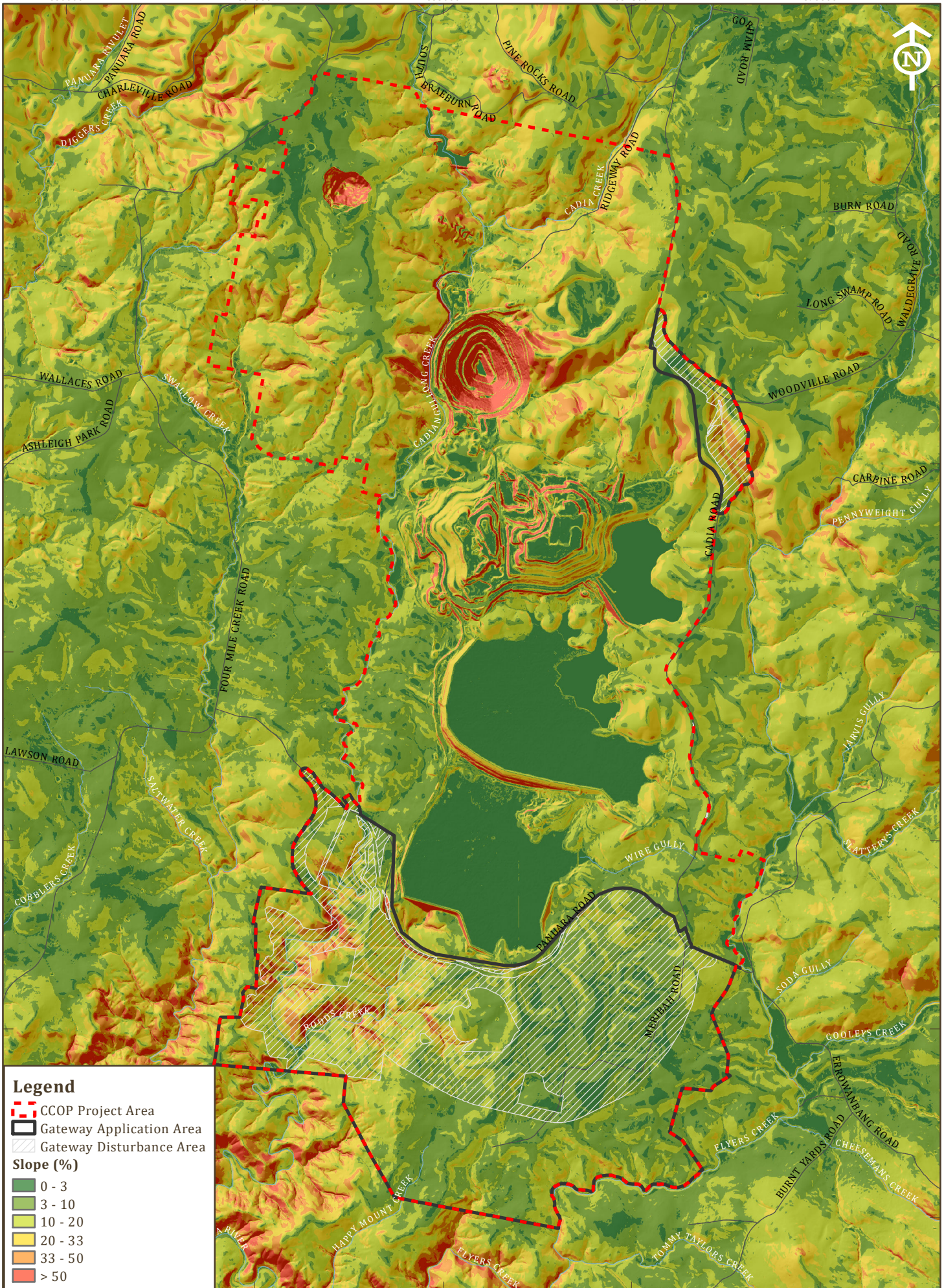

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Slope Analysis

FIGURE 7

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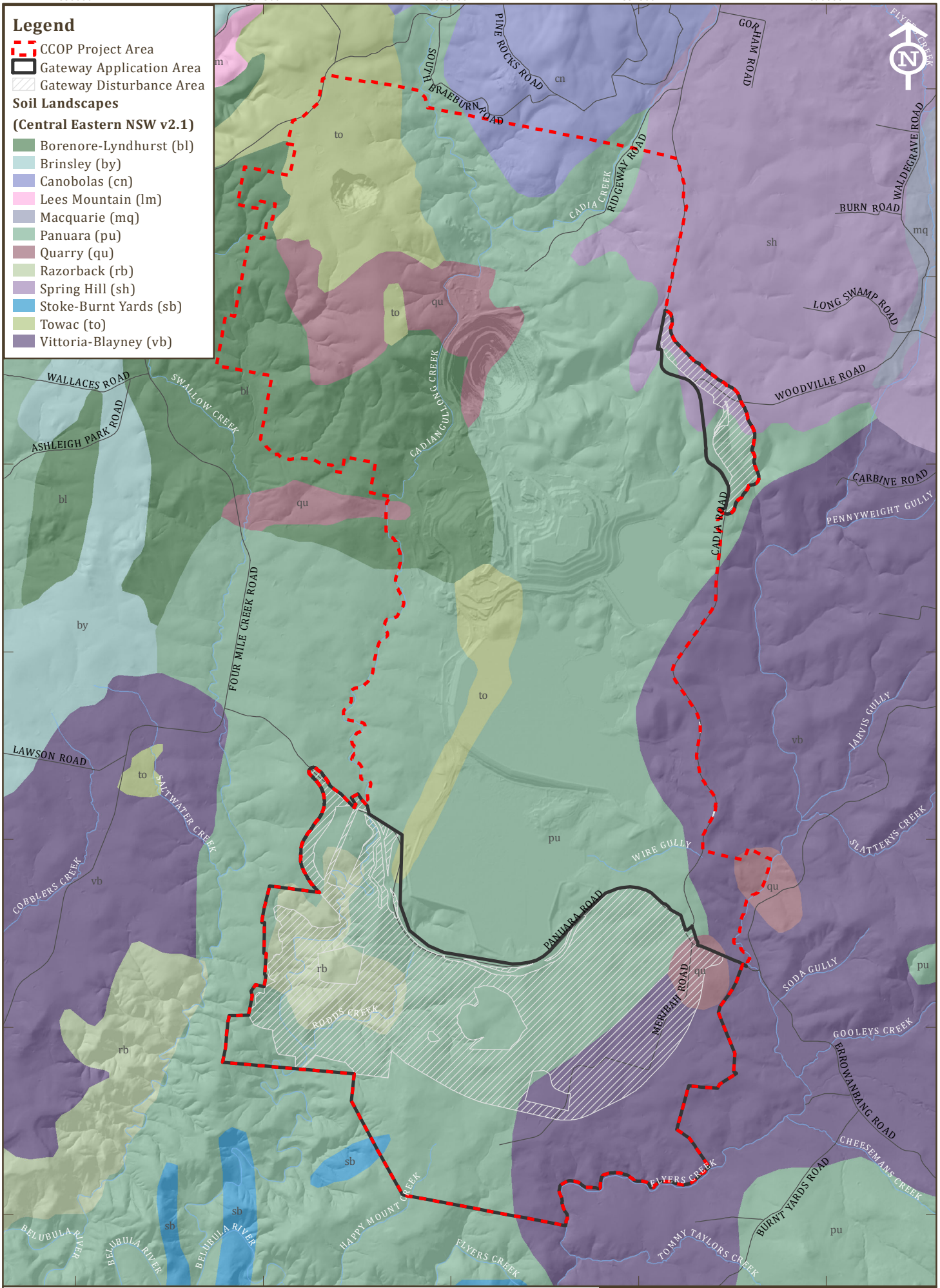

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Regionally Mapped Soil Landscapes

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.

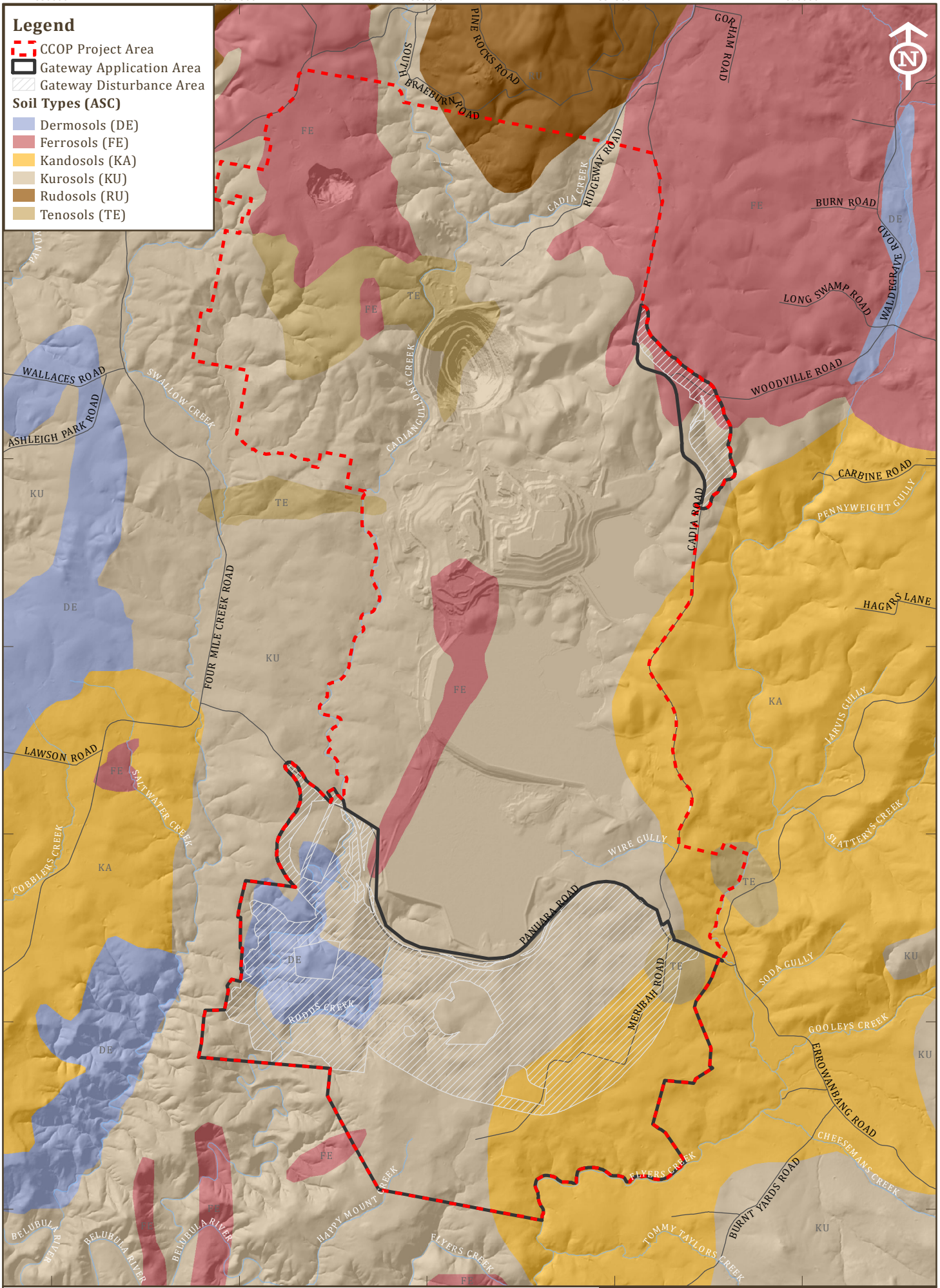
Kandosols

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

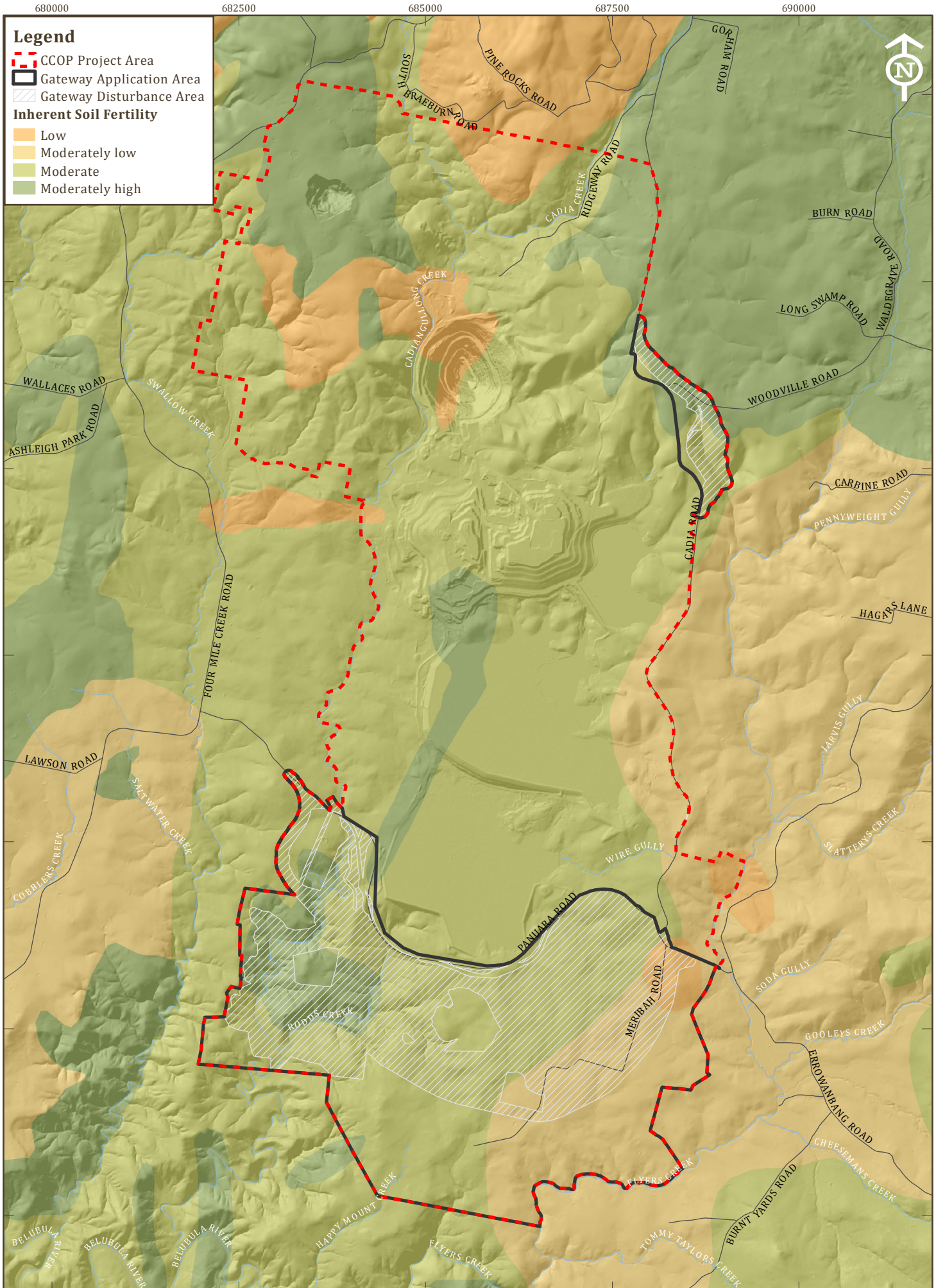
Land and Soil Capability (LSC) Mapping uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations. Regional mapping indicates the 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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Meters
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Scale 1:65000 at A4

Regionally Mapped Inherent Soil Fertility

FIGURE 10

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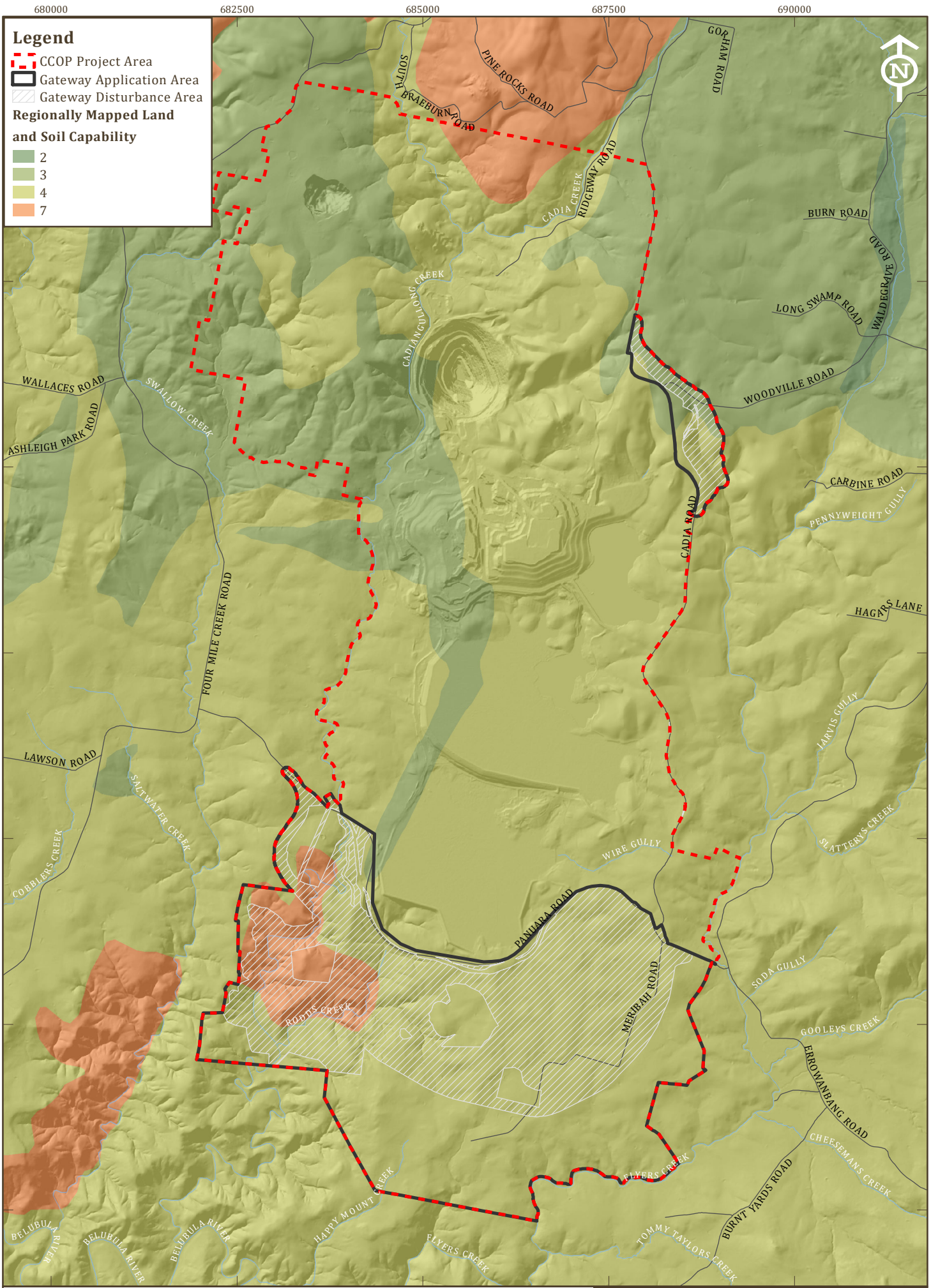

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Regionally Mapped Land and Soil Capability

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.

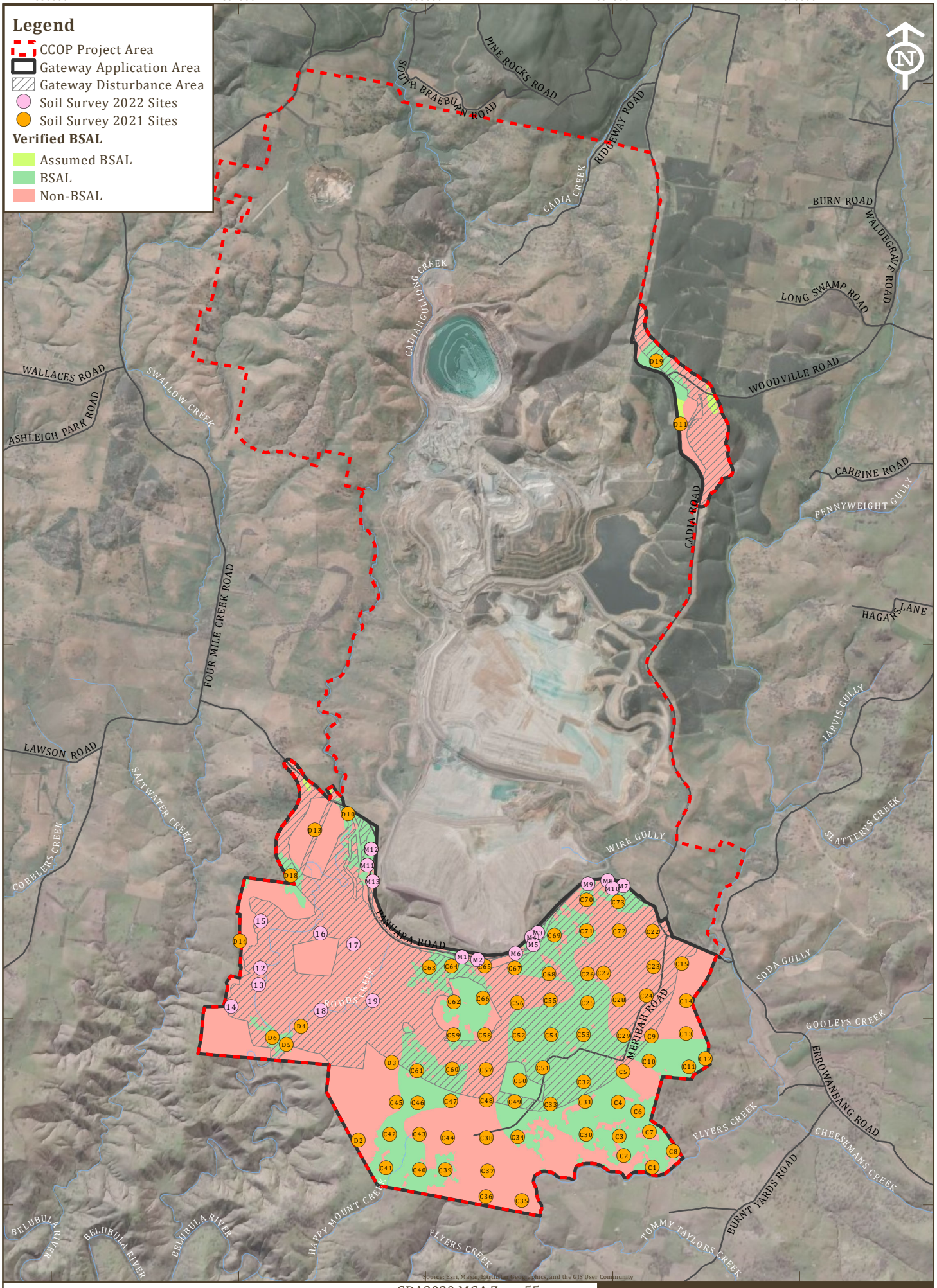
Following the identification of verified BSAL, CHPL initiated a range of further refinements to the CCOP to relocate key infrastructure assets and further reduce the total impact on verified BSAL, where possible. While some areas of verified BSAL have now been omitted from the GAA, some areas of potential 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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Meters
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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.

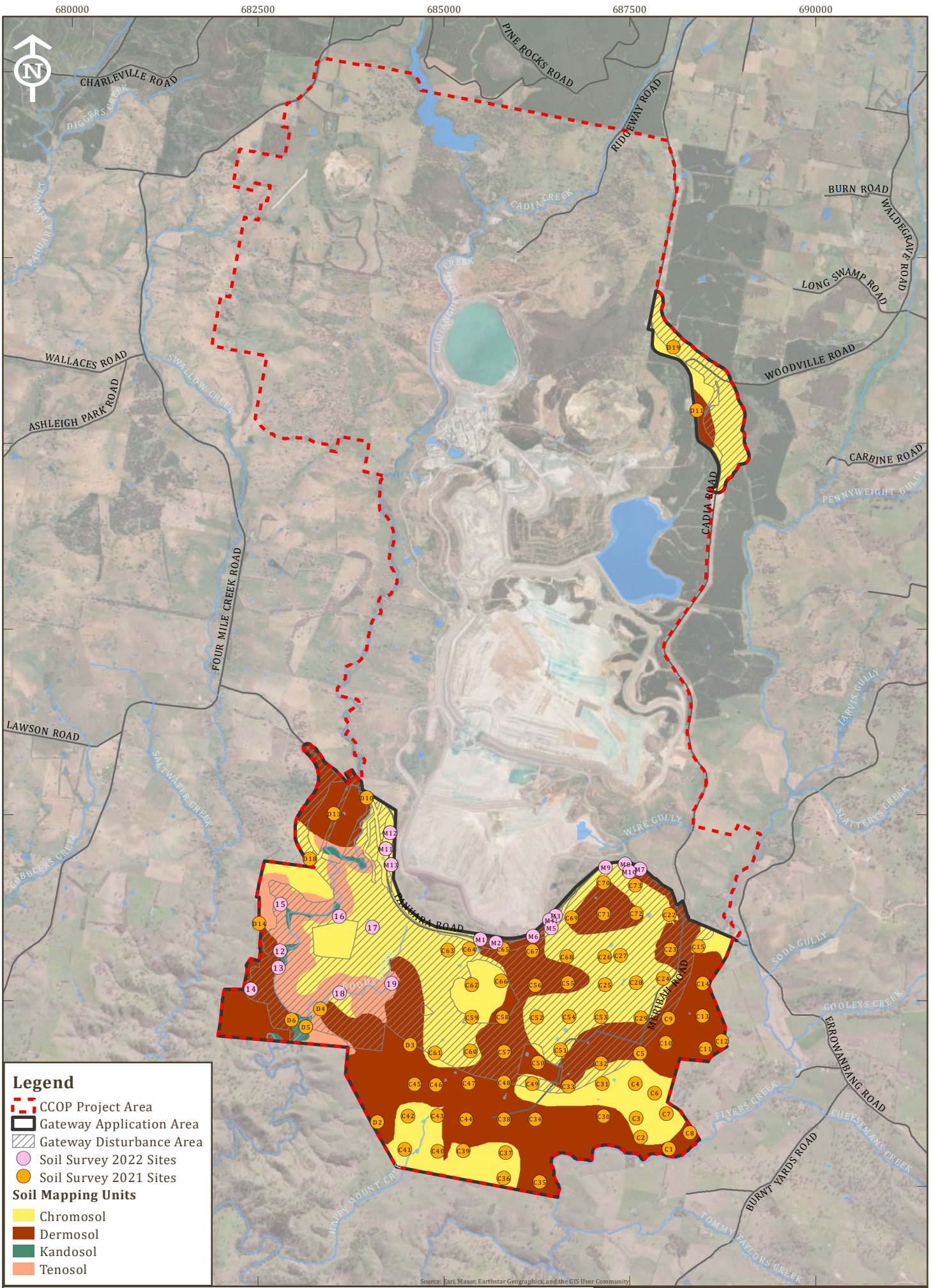
For the purpose of this assessment, the soil survey information relevant to the GAA (2,265 ha) includes 99 soil investigation sites, which equates to approximately 1 site per 23 ha. Soil survey assessment sites relevant to the GAA were collected over two periods, as shown on **Figure 13**:

- 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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Meters
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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**.

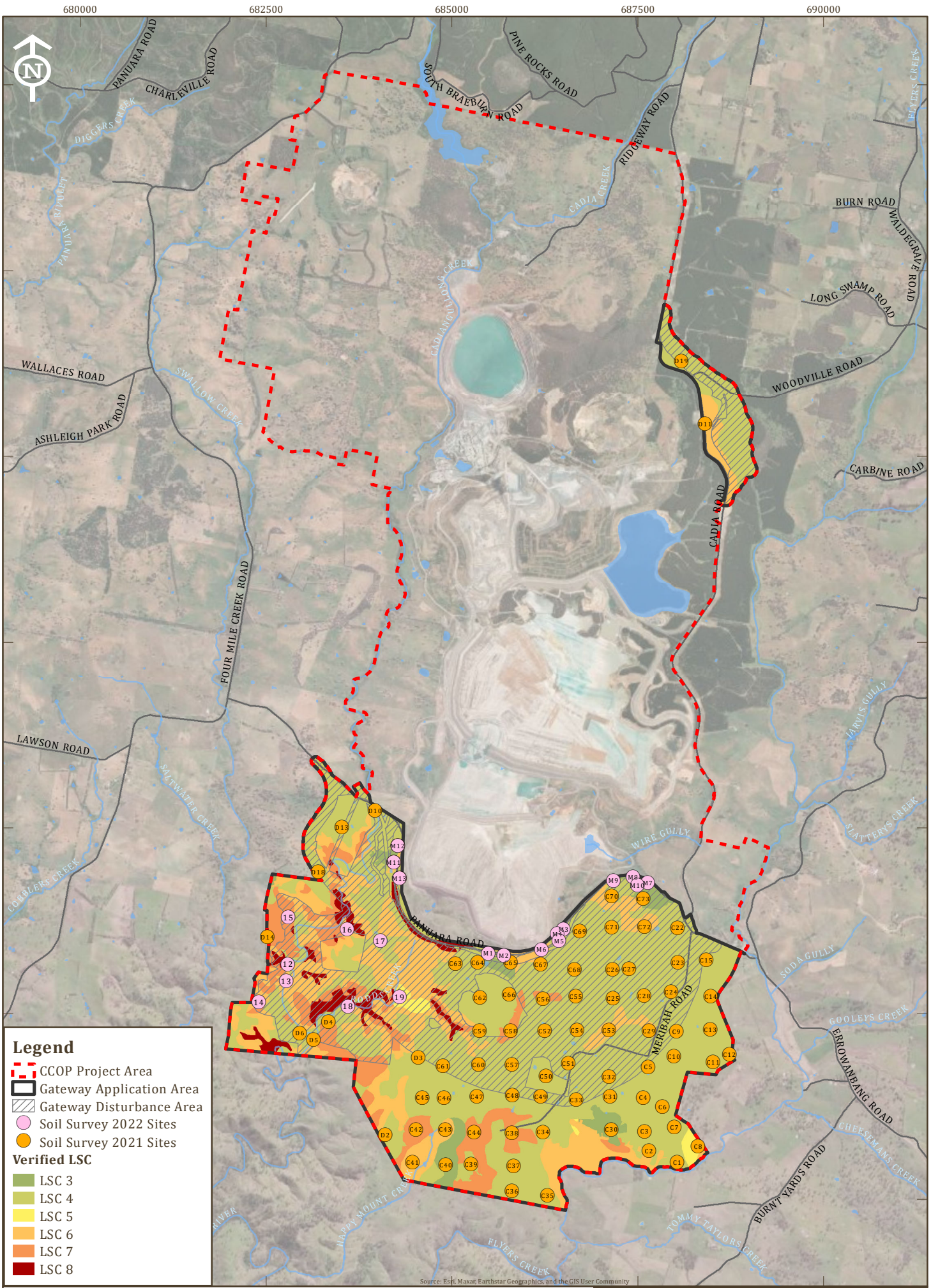
The limitations associated with each land class are discussed below:

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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Verified Land and Soil Capability

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.

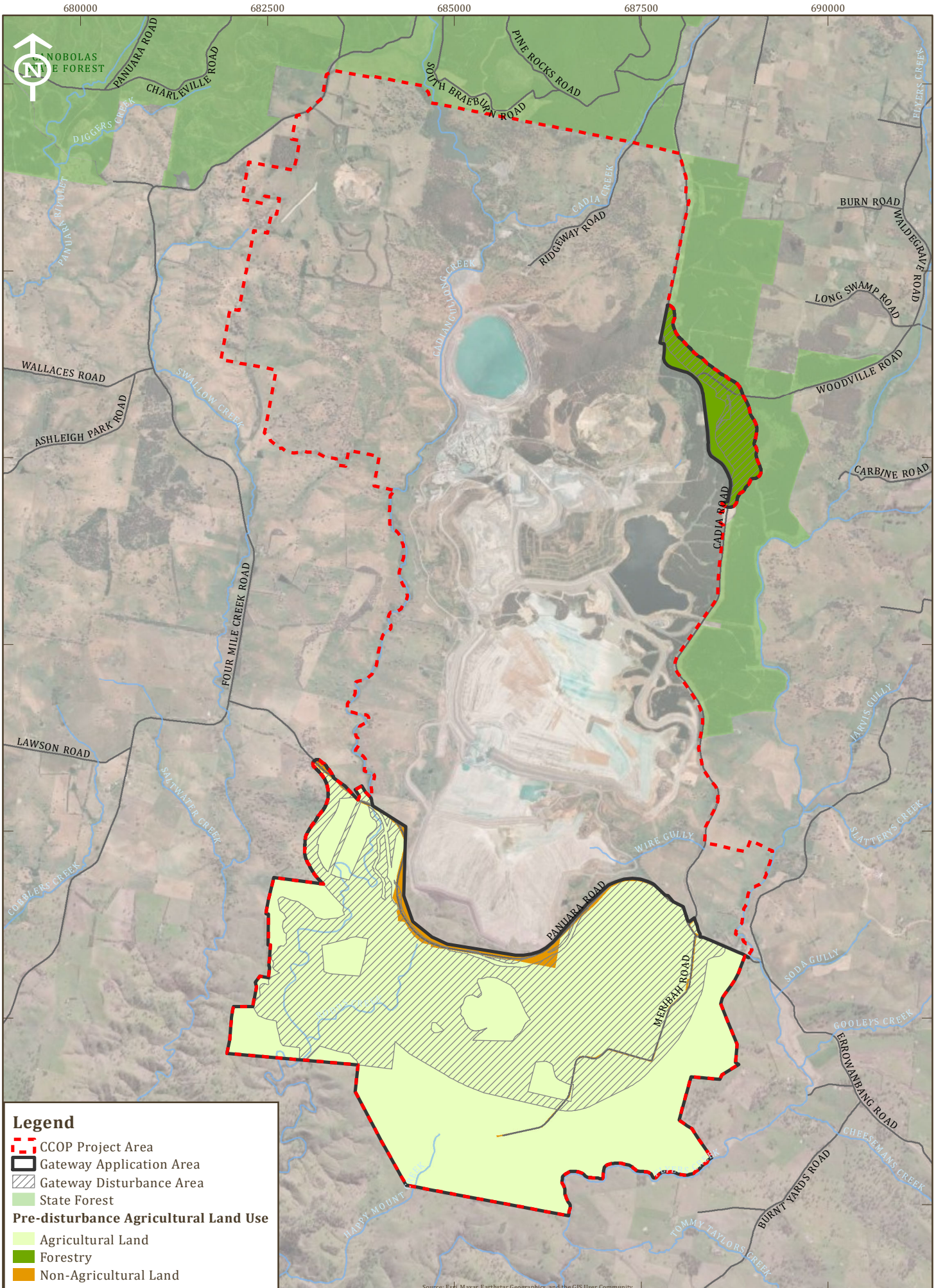
Plate 1: Cattle being sold at the Central Tablelands Livestock Exchange, located 15km from the GAA. (Photo Source: Central Western Daily, 2018)

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.

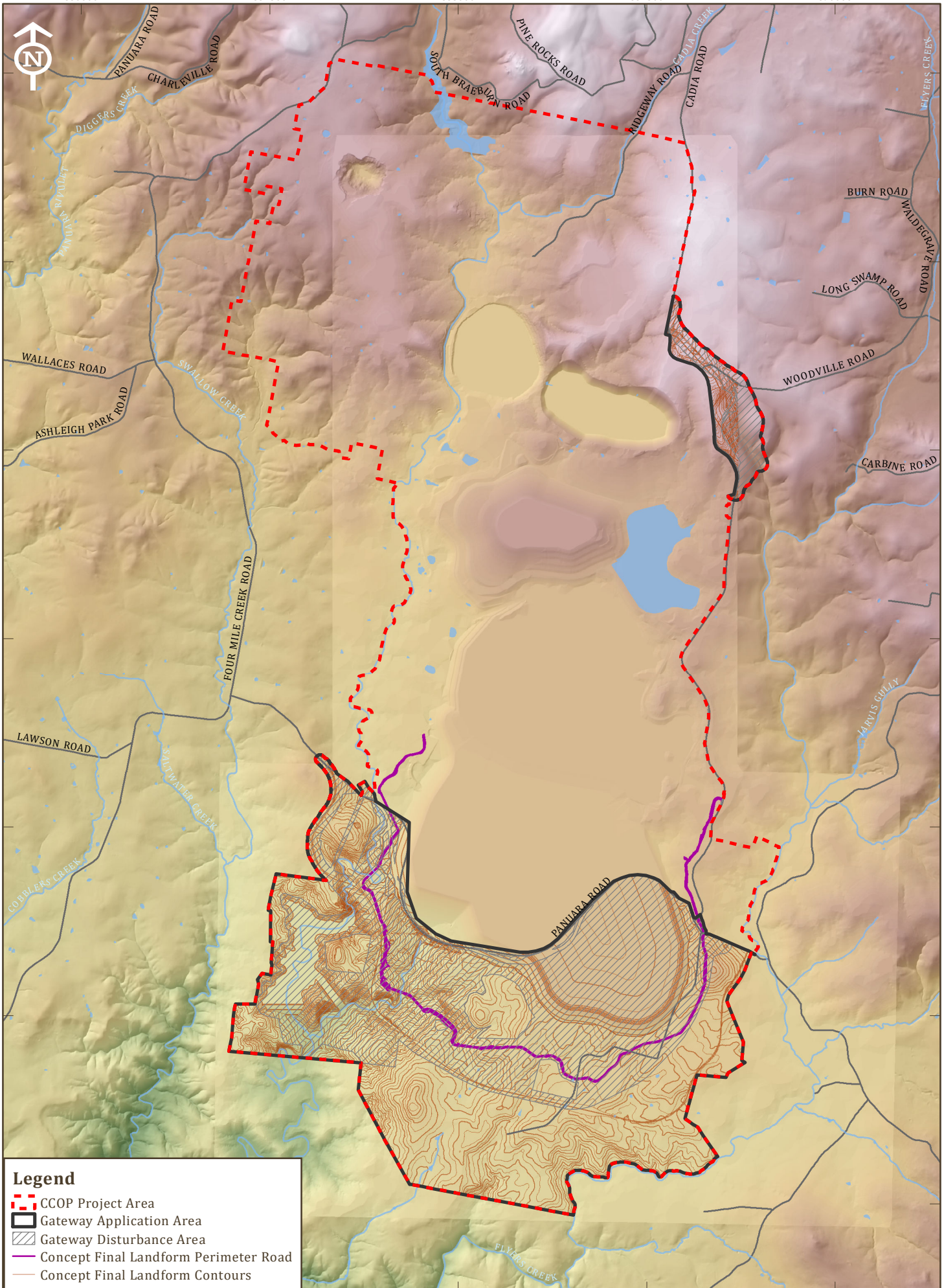
There will be no direct or indirect impacts to the soil resources of the Project locality outside of the existing consented disturbance areas and the GAA.

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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Conceptual Final Landform

FIGURE 16

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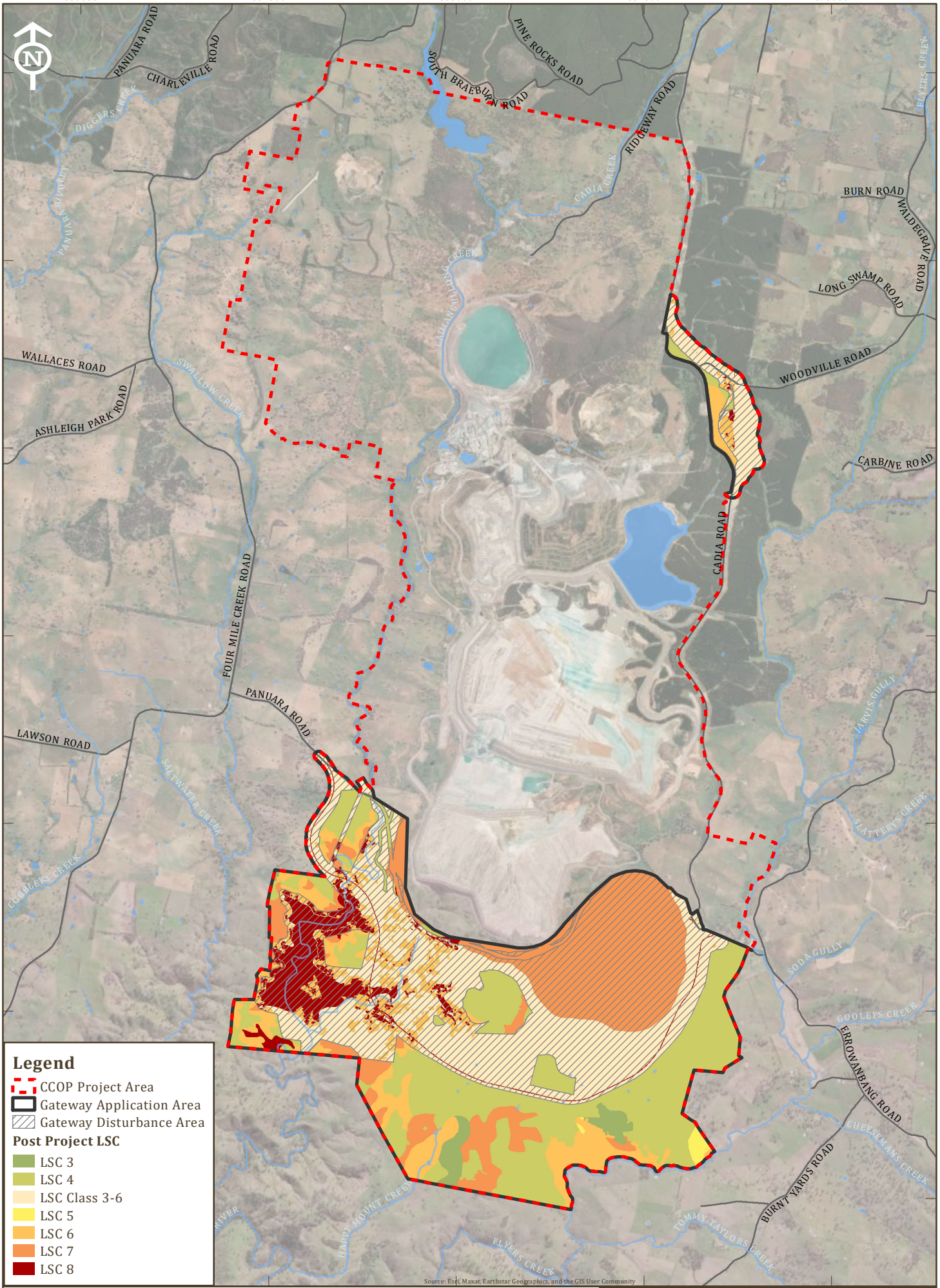

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Conceptual Post Project Land and Soil Capability

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).

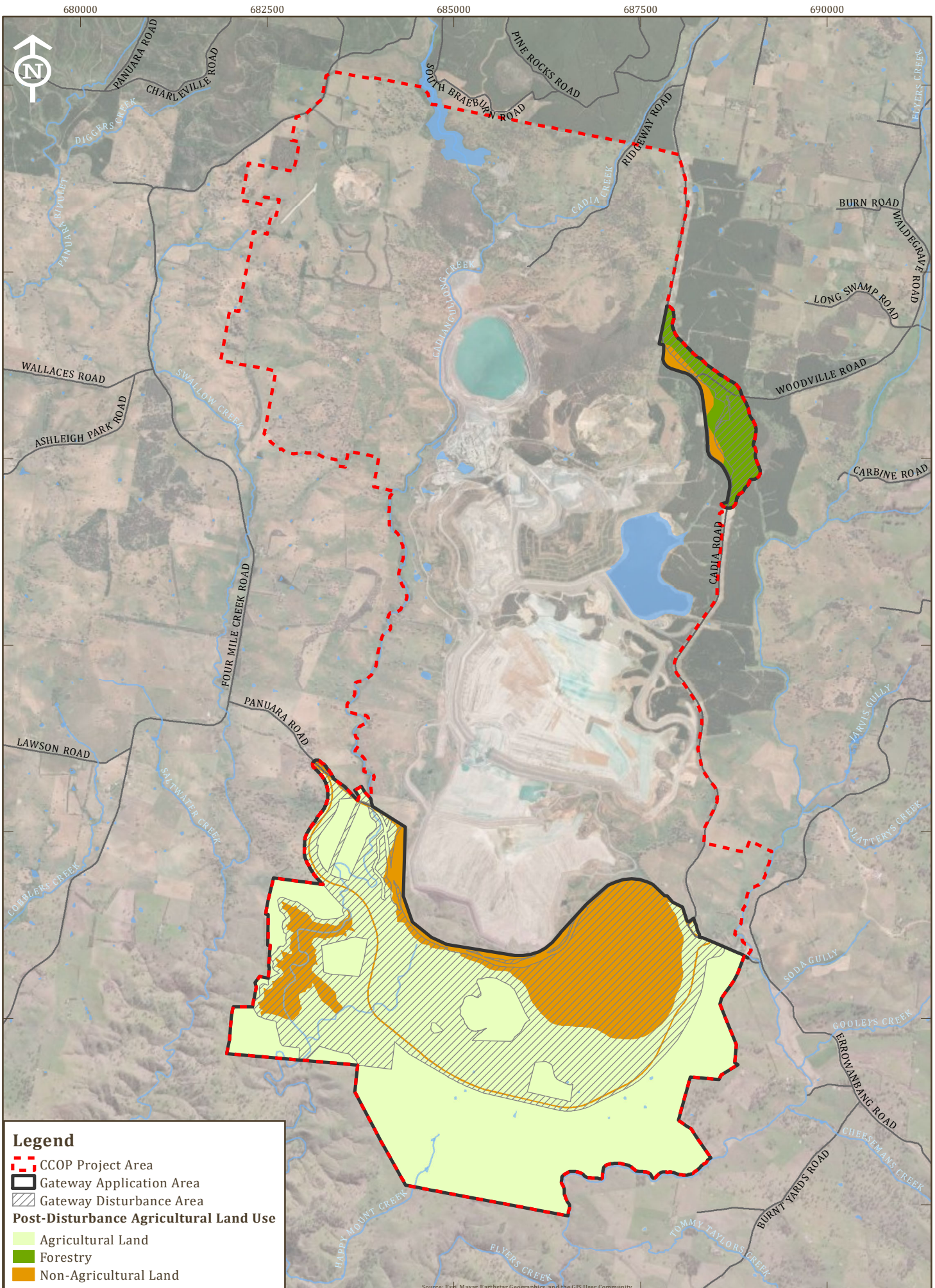
Further work is being undertaken as part of the EIS process to identify opportunities to maximise the extent of land to be returned to agriculture post mining. These outcomes will be detailed further in the Rehabilitation Strategy and Agricultural Impact Statement for the Project.

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**.



Legend

- CCOP Project Area
- Gateway Application Area
- Gateway Disturbance Area

Post-Disturbance Agricultural Land Use

- Agricultural Land
- Forestry
- Non-Agricultural Land

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Scale 1:65000 at A4

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

8 REFERENCES

Advisian Pty Ltd (2023) *Cadia Modification 15 – Groundwater Impact Assessment*

AGE (2021a*) Cadia Groundwater Model Update 2021* (G1383Y)

Australian Bureau of Statistics (2022a), Agricultural Commodities, Australia. Year 2020-2021. https://www.abs.gov.au/statistics/industry/agriculture/agricultural-commodities-australia

Australian Bureau of Statistics (2022b), Value of Agricultural Commodities Produced, Australia. Year 2020–2021 https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia

Bureau of Meteorology (2024) Climate Data Online Website: http://www.bom.gov.au/climate/data Date Accessed: January 2024.

Central Western Daily (2018) *CTLX sales hit a high due to region's drought* CTLX sales hit a high due to region's drought | Central Western Daily | Orange, NSW

Charman P.E.V and Murphy B.W. (Eds) (2007) *Soils - Their Properties and Management - A Soil Conservation Handbook for New South Wales: second edition* (New South Wales Printing Office, Sydney).

CSIRO (2006). *Australian Soil Fertility Manual Third Edition.*

Hazelton, P. and Murphy, B. (2016). *Interpreting Soil Test Results – What do all the numbers mean?* CSIRO Publishing

Isbell, R. F. (2021) *The Australian Soil Classification Third Edition* (CSIRO Publication, Australia).

Isbell R.F., McDonald W.S. and L.J. Ashton (1997) *Concepts and Rationale of the Australian Soil Classification* (CSIRO Publishing, Australia).

Kovac M., Murphy B.W. and Lawrie J.A., 2010, *Soil Landscapes of the Bathurst 1:250,000 Sheet* map, edition 2, Department of Environment, Climate Change and Water NSW, Sydney.

Murphy BW, Eldridge DJ, Chapman GA, McKane DJ (2007) Soils of New South Wales. In '*Soils their properties and management (3rd edn).*' (Eds PEV Charman, BW Murphy). (Oxford University Press: Melbourne).

NCST (2009) *Australian Soil and Land Survey Field Handbook, 3rd edition* (CSIRO Publishing, Australia).

Newcrest Mining Limited (2022) *Cadia Rehabilitation Management Plan* 710-005-EN-PLA-0026

NSW Department of Planning, Industry and Environment (2019). *Murray–Darling Basin Fractured Rock Water Resource Plan Water quality management plan.*

NSW Department of Planning, Industry and Environment (2022) Retrieved of following layers: soil landscapes, soil types, inherent soil fertility, land and soil capability. espade.environment.nsw.gov.au

NSW Department of Primary industries (2013) *Agricultural Impact Statement: Technical Notes.*

NSW Department of Primary Industries (2013) *Agricultural Impact Statement technical notes - A companion to the Agricultural Impact Statement guideline.*

NSW Department of Industry (2016) *The Contribution of Primary Industries to the NSW Economy* Key Data 2016

NSW Office of Environment and Heritage and DPI-OAS&FS (2013). *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land.*

NSW Office of Environment and Heritage (2012). *The land and soil capability assessment scheme: second approximation – A general rural land evaluation system for NSW.*

NSW Department of Primary Industries (2023) *NSW Biosecurity and Food Safety Stagey 2022 - 2030*

NSW Department of Primary Industries (2023) *Farm Enterprise Budget Series - Summary of gross margins for NSW beef enterprises*

Umwelt Pty Ltd (2021) *Cadia Valley Operations Stage 1 – Baseline Review* Cadia Document No. 730-17062-EN-REP-2038