Attachment 5

Rehabilitation and Mine Closure

Narrabri Underground Mine Stage 3 Extension Project

Environmental Impact Statement

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A5 REHABILITATION AND MINE CLOSURE

This Attachment describes the approach to rehabilitation and mine closure for the Narrabri Underground Mine Stage 3 Extension Project (the Project).

This Attachment also addresses the following components of the Secretary's Environmental Assessment Requirements (SEARs) for the Project:

> *The EIS must address the following specific issues:*
>
> - ***Rehabilitation and Final Landform*** *– including*
> - *a conceptual final landform design;*
> - *an assessment of the likely impacts of the development on existing landforms and topography, including justification of the final landform design and its long-term geotechnical stability;*
> - *a detailed description of the progressive rehabilitation measures that would be implemented for the development and how this rehabilitation would integrate with the final landform of the mine;*
> - *a detailed description of the proposed rehabilitation and mine closure strategies for the development, including rehabilitation objectives, performance standards and completion criteria;*
> - *decommissioning and management of surface infrastructure; and*
> - *nominated final land uses, having regard to any relevant strategic land use planning or resource management plans or policies; …*

References to Sections 1 to 9 in this Attachment are references to Sections in the Main Report of the Environmental Impact Statement (EIS) for the Project. References to Appendices A to P in this Attachment are references to Appendices of the EIS for the Project. Internal references within this Attachment are prefixed with "A5".

A5.1 EXISTING REHABILITATION AT THE NARRABRI MINE

The approved Mining Operations Plan (SLR Consulting Australia Pty Ltd [SLR], 2020) (MOP), the Rehabilitation Management Plan (Eco Logical Australia Pty Ltd [ELA], 2017) (RMP) and the Mine Closure Plan (SLR, 2016) (MCP) describe the approved Narrabri Mine activities and progress toward rehabilitation outcomes required under Mining Lease (ML) 1609 and Project Approval 08_0144.

A summary of rehabilitation activities undertaken at the Narrabri Mine and relevant rehabilitation monitoring results are documented in the Annual Review.

A summary of the current objectives for rehabilitation, the approved final landform and land use concepts and rehabilitation progress to date for the Narrabri Mine is provided below.

A5.1.1 Rehabilitation Objectives

Condition 1, Schedule 5 of Project Approval 08_0144 and the MOP outline the rehabilitation objectives for the Narrabri Mine.

The rehabilitation objectives outlined in Condition 1, Schedule 5 of Project Approval 08_0144 are reproduced in Table A5-1.

Table A5-1
Narrabri Mine Rehabilitation Objectives

Project Component	Rehabilitation Objective
Surface Facilities Area	▪ Set through RMP
Other Land Affected by the Project	▪ Restore ecosystem function, including maintaining or establishing self-sustaining native ecosystems: – comprised of local native plant species; with – a landform consistent with the surrounding environment
Built Features	▪ Repair/restore to pre-mining condition or equivalent
Community	▪ Minimise the adverse socio-economic effects associated with mine closure including the reduction in local and regional employment ▪ Ensure public safety

The existing rehabilitation objectives of the Narrabri Mine would be reviewed, and where relevant augmented or revised for the Project (Section A5.2).

A5.1.2 Final Landform and Land Use Concepts

The Narrabri Mine final landform will generally approximate the pre-mining landscape with the exception of the reject emplacement area and surface impacts from subsidence in the underground mining area (SLR, 2020).

The following final land uses are approved at the Narrabri Mine (SLR, 2020):

- water management;
- pasture;
- woodland;
- State Forest; and
- biodiversity offset areas (Section A5.1.4).

In addition, surface infrastructure may be retained post-mining where agreed with the relevant regulatory authorities and landholders.

A5.1.3 Rehabilitation Status

Rehabilitation at the Narrabri Mine is undertaken progressively as soon as reasonably practicable as areas become available following mining operations, in accordance with Condition 2, Schedule 5 of Project Approval 08_0144.

Progressive rehabilitation activities have been conducted at the Narrabri Mine since 2008 and the rehabilitation of approximately 130 hectares (ha) of disturbed areas has commenced to date. Rehabilitation has been undertaken in areas that are available for rehabilitation (principally the area above Longwalls 101 to 107) (Narrabri Coal Operations Pty Ltd [NCOPL], 2020) (Figure A5-1).

NCOPL considers that the current rehabilitation performance at the Narrabri Mine indicates good progress towards achieving the relevant rehabilitation objectives and completion criteria with the continued application of adaptive rehabilitation management.

A summary of the current rehabilitation status of key areas at the Narrabri Mine is provided below.

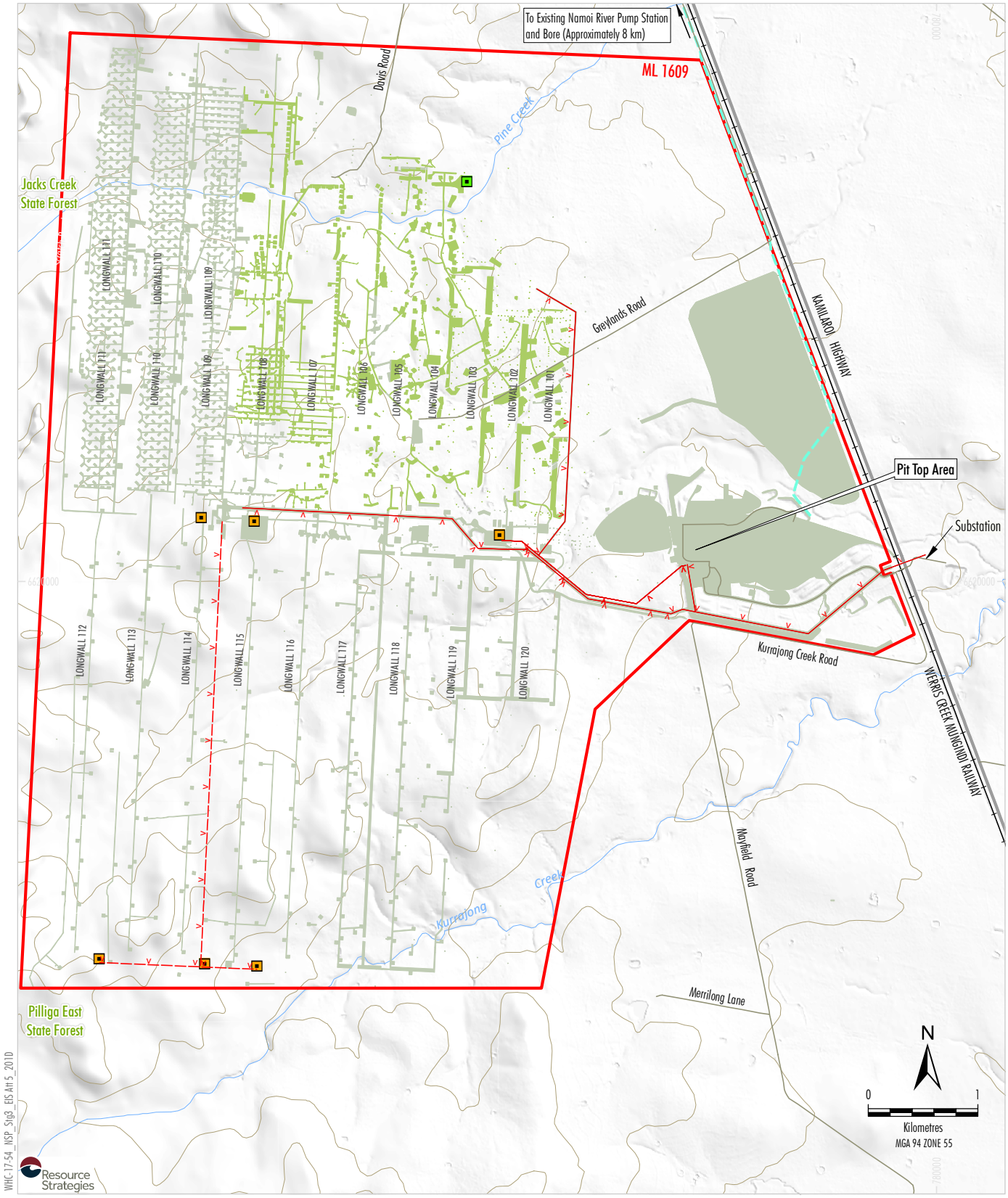
Pit Top Area

Rehabilitation activities in the Pit Top Area have focused on areas that are no longer required for operational activities (e.g. amenity bund) and stabilising operational areas (e.g. water management structures).

In addition, over 10,000 native woodland species tube stock were planted along the amenity bund and in other key locations to minimise potential visual impacts of the Narrabri Mine (Plate A5-1).

No further rehabilitation activities in the Pit Top Area are planned until mine closure activities commence.

Plate A5-1 Tree Plantings



LEGEND

- Mining Lease (ML 1609)
- Approved Narrabri Mine
- Electricity Transmission Line (Constructed)
- Electricity Transmission Line (Not Yet Constructed)
- Existing Namoi River Pipeline (Buried)
- Ventilation Complex
- Ventilation Complex Decommissioned
- Existing Rehabilitation and Remediation Areas
- Existing/Approved Surface Development

Source: NCOPL (2019) ; NSW Spatial Services (2019)

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NARRABRI STAGE 3 PROJECT

Existing Narrabri Mine Rehabilitation and Remediation Areas

Figure A5-1

Underground Mining Area

Surface infrastructure (e.g. gas management and mine safety pre-conditioning infrastructure areas, exploration areas and associated access tracks) located in the underground mine area that is no longer required has been decommissioned and rehabilitated.

The rehabilitation of these surface infrastructure areas included (NCOPL, 2020):

- decommissioning of surface infrastructure (e.g. drilling sumps; gas management infrastructure and pipelines);
- capping of boreholes in accordance with the *Exploration Code of Practice: Rehabilitation* (Department of Planning and Environment – Division of Resources and Geosciences, 2017) and the *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (Department of Industry – Resources and Energy, 2016);
- re-profiling landforms to be consistent with the surrounding landscape to allow for free-drainage of surface water runoff;
- application of topsoil/subsoil on the re-profiled landform;
- addition of habitat features (e.g. logs) in woodland final land use areas; and
- application of either woodland or pasture seed mix and with fertiliser where natural revegetation did not occur.

Surface infrastructure areas associated with Longwalls 101 to 107 have been rehabilitated to either a pasture area or a woodland final land use. Plate A5-2 shows a pasture rehabilitation area. A rehabilitated woodland area is shown on Plate A5-3.

The remediation of mine subsidence effects has been undertaken where natural processes (e.g. soil movement, wind erosion, water erosion) have not filled surface cracking. Small surface cracks are ripped and/or graded to infill the cracks as required. Larger surface cracks that cannot be filled with ripping and/or grading are filled with stockpiled subsoil material.

Plate A5-2 Progressive Pasture Area Rehabilitation – May 2020

Plate A5-3 Progressive Woodland Area Rehabilitation – May 2020

A5.1.4 Approved Biodiversity Offset Areas

Four biodiversity offset areas have been established at the Narrabri Mine within ML 1609 (Section 6.7).

In accordance with Condition 6, Schedule 5 of Project Approval 08_0144, these approved biodiversity offset areas are managed in accordance with the Biodiversity Offset Strategy (ELA, 2019).

The approved biodiversity offset areas have been managed in accordance with the Biodiversity Offset Strategy (ELA, 2019) (or earlier versions) since 2014 and management activities undertaken to date include weed control, feral animal management and fire management.

A5.2 REHABILITATION OF THE PROJECT

Rehabilitation planning for the Project was informed by existing mine closure and rehabilitation objectives and current rehabilitation practices implemented for the Narrabri Mine. Mine closure and rehabilitation objectives have also been established for the extended underground mining area and new surface facilities that would be developed for the Project.

The following documents were considered during the review and development of the mine closure and rehabilitation objectives:

- *Mine Closure and Completion: Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth Department of Industry, Innovation and Science [DIIS], 2016a);
- *Mine Rehabilitation: Leading Practice Sustainable Development Program for the Mining Industry* (DIIS, 2016b);
- *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia [ANZMEC-MCA], 2000); and
- *ESG3: Mining Operations Plan (MOP) Guidelines*, September 2013 (New South Wales [NSW] Division of Resources and Energy, 2013).

In addition, the Mining Development Rehabilitation Standard SEARs recommended by the Resources Regulator have been considered during rehabilitation planning for the Project.

Where relevant, the proposed rehabilitation and mine closure strategy considers the outcomes of consultation with relevant stakeholders and the relevant EIS technical studies.

NCOPL would continue rehabilitation of the Stage 2 mining areas at the Narrabri Mine as part of the Project.

A5.2.1 General Rehabilitation and Mine Closure Objectives

The Project would require the progressive rehabilitation of approximately 1,617 ha of surface development areas.

In addition, the Project would require the remediation of subsidence impacts in the approximate 6,253 ha[1] underground mine area.

The Project would be rehabilitated to a safe, stable and non-polluting landform of a similar character to surrounding areas. The general rehabilitation and mine closure objectives for the Project would be to:

- comply with relevant or applicable legislative requirements;
- remove Project infrastructure that is no longer required to support post-mining land uses;
- establish rehabilitated areas suitable for post-mining land uses consistent with pre-mining land uses;
- establish Mine Site Ecological Rehabilitation areas in accordance with the NSW Biodiversity Offsets Scheme;
- minimise potential environmental impacts and potential safety issues arising from mine closure; and
- continue to engage with the local community and regulatory stakeholders on key environmental and socio-economic issues during the closure and post-mining phase.

Rehabilitation would be undertaken progressively as soon as reasonably practicable as areas become available following mining operations.

Disturbed Project lands would be considered suitable for relinquishment when the nominated rehabilitation objectives and completion criteria have been met, or if the relevant Minister(s) otherwise accept(s) the rehabilitation status.

A5.2.2 Conceptual Final Landform Design

The Project would not require significant changes to the approved final landform design (Section A5.1.2). The conceptual final landform for the Project would continue to generally approximate the pre-mining landscape with the exception of the reject emplacement area and surface impacts from subsidence in the underground mining area.

[1] Includes the areas of surface development within the remediated underground mine footprint.

Figure A5-2 presents the conceptual final landform design for the Project. The key Project components relevant to the final landform include:

- Pit Top Area surface infrastructure;
- box cut;
- reject emplacement area;
- brine storage area; and
- underground mining area.

Further detail on the final landform is provided below.

Assessment of the potential impacts on existing landforms and topography is provided in Section 6.2.

Pit Top Area Surface Infrastructure

The Pit Top Area surface infrastructure includes:

- Coal Handling and Preparation Plant (CHPP);
- run-of-mine (ROM) coal stockpile and product coal stockpile and associated coal handling infrastructure;
- rail loop and product coal load-out infrastructure;
- site water management infrastructure;
- administration, workshop, store and bathhouse buildings;
- range of service facilities;
- longwall unit assembly area;
- access roads;
- car parking; and
- amenity bunds.

Following the completion of mining, surface infrastructure would be decommissioned (Section A5.3.4), unless otherwise agreed with the relevant regulatory authorities and landholders (Section A5.2.3). Waste generated during decommissioning would be removed from site by an appropriately licensed waste contractor.

The decommissioned surface infrastructure areas would then be re-profiled to be consistent with the surrounding landscape (Figure A5-2).

Box Cut

Following the completion of mining, mine entrances in the box cut would be sealed in accordance with the requirements of *MDG6001 Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams* (NSW Trade and Investment, 2012).

Consistent with the approved final landform, the box cut would then be backfilled with material recovered from the amenity bund and other areas on-site before being re-profiled to be consistent with the surrounding landscape (Figure A5-2).

Reject Emplacement Area

The reject emplacement design has been reviewed and updated by ATC Williams (2019) based on the expected quantity and geochemical characterisation of reject and exploration waste to be disposed for the Project. ATC Williams (2019) adopted an agricultural (pasture) final land use for its review of the reject emplacement design.

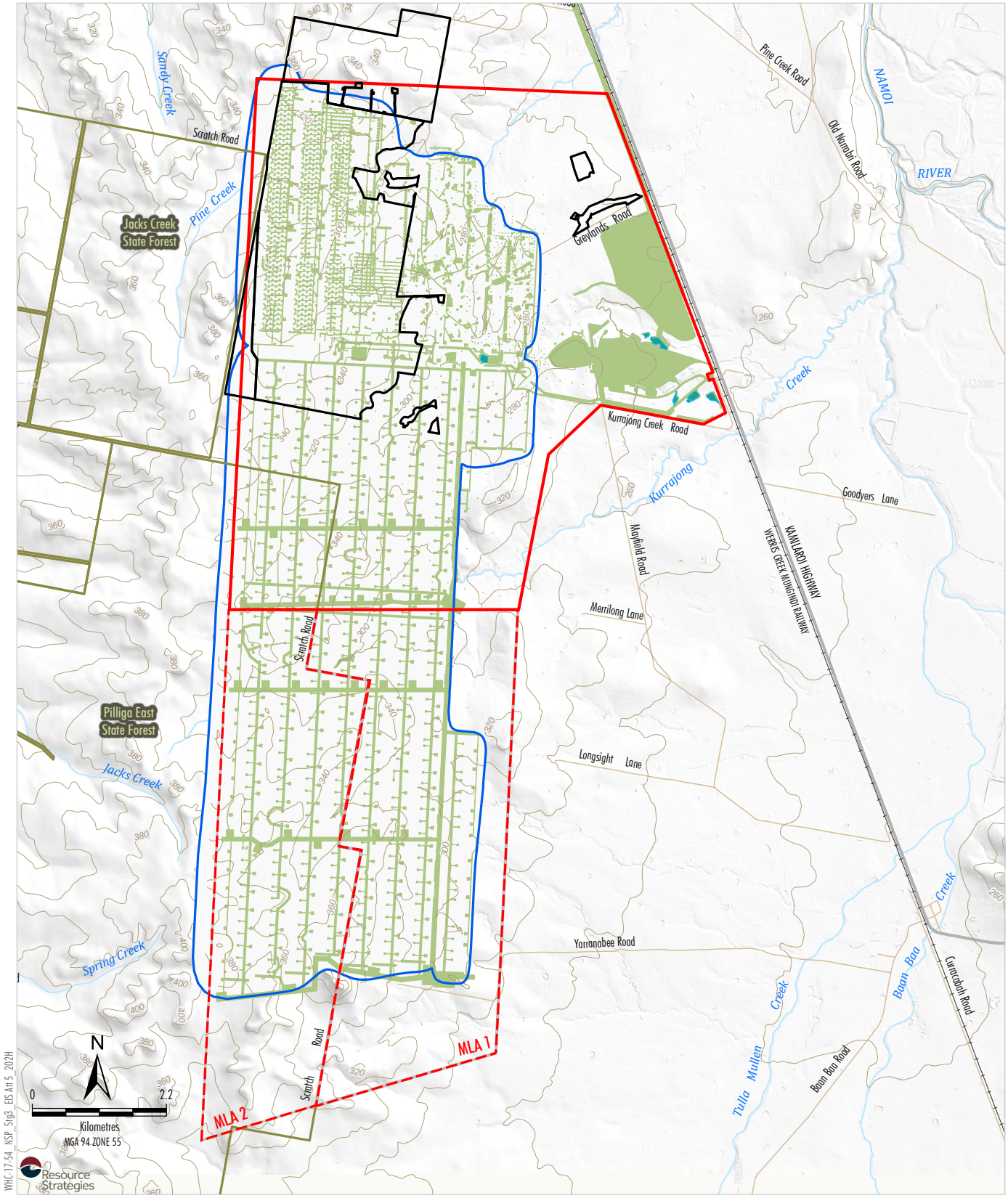
Progressive rehabilitation of completed sections of the reject emplacement area would be conducted as each emplacement section reaches capacity.

The rehabilitated reject emplacement area would be approximately 15 metres (m) high with batter slopes of generally 1(Vertical [V]):5(Horizontal [H]) with a maximum grade of 1(V):4(H) on the north-east batter. An approximate 400 millimetre (mm) clay capping layer would be placed over the final landform prior to revegetation (ATC Williams, 2019). Figure A5-3 provides a cross-section of the conceptual final landform of the reject emplacement area.

A review of geotechnical stability for the reject emplacement design indicated that a very low risk of global batter failure or displacement exists. As such, this exposure pathway (i.e. geotechnical failure of the emplacement) is of low risk (ATC Williams, 2019).

Brine Storage Area

Brine generated at the Project would be stored in brine storage ponds. Consistent with the current post-mining water management strategy, brine would be re-injected into the longwall goaf through the disused goaf gas drainage holes or via the underground infrastructure towards the completion of mining.



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LEGEND

- Mining Lease (ML 1609)
- Provisional Mining Lease Application Area
- Approved Biodiversity Offset Area
- Remediated Underground Mining Area
- Rehabilitation Area
- Water Management Area

Land Use

- State Forest

Source: NCOPL (2019) ; NSW Spatial Services (2019); Ditton Geotechnical Services (2020)

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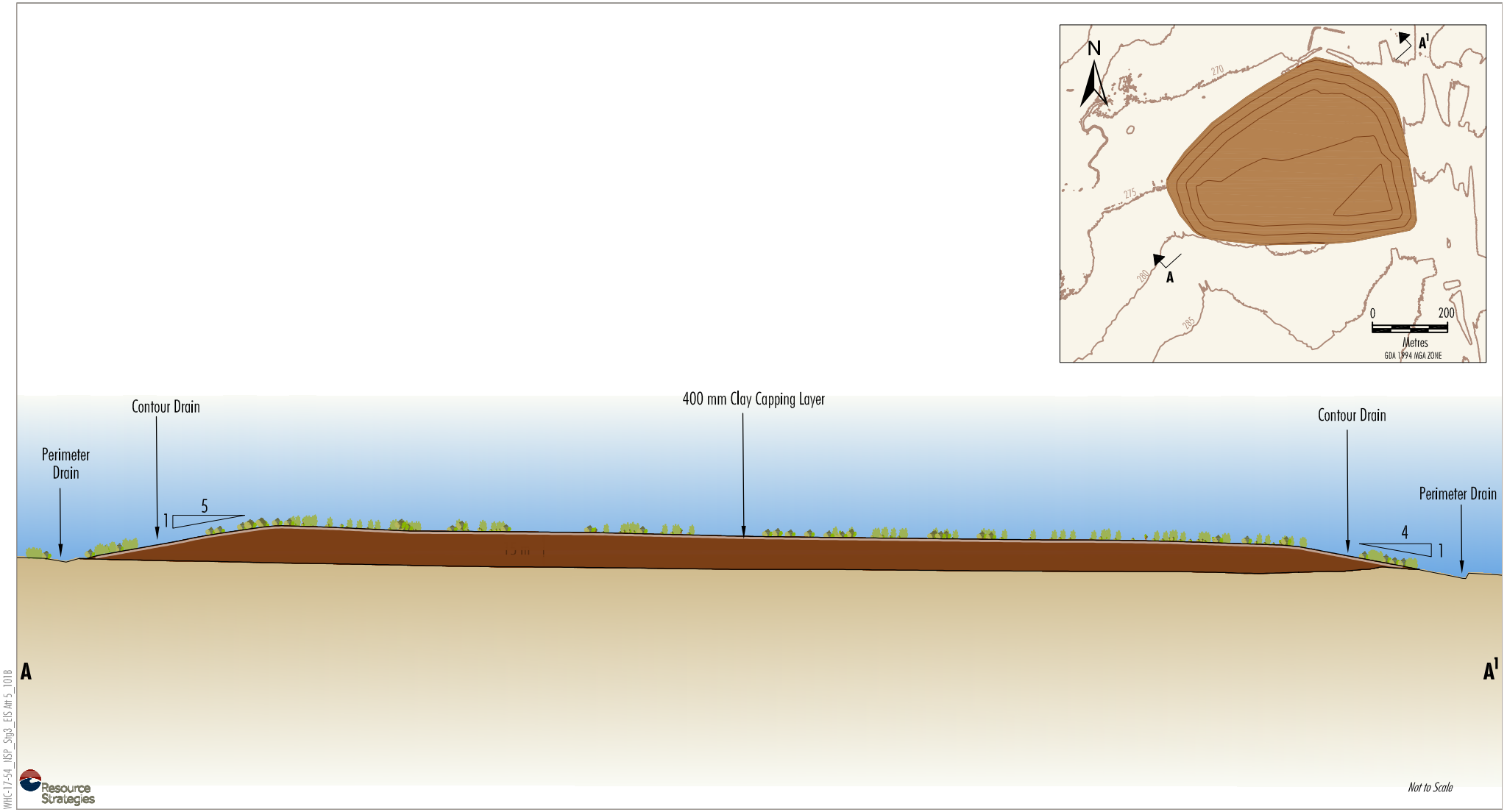
Conceptual Final Landform

Figure A5-2



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Resource Strategies

Source: Whitehaven (2019); ATC Williams (2019)

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NARRABRI STAGE 3 PROJECT

Conceptual Cross Section of Reject Emplacement Area

Figure A5-3

Following the dewatering of the brine storage ponds, accumulated salts would be removed from the brine storage pond floor and walls and placed in the box cut. Brine storage pond liners would be removed from site by an appropriately licensed waste contractor. The brine storage pond walls would then be pushed in and re-profiled to be consistent with the surrounding landscape (Figure A5-2).

Underground Mining Area

Following the completion of each longwall panel, surface infrastructure associated with the completed longwall panel (except for selected gas drainage boreholes and associated access tracks) would be decommissioned. The disused gas drainage boreholes may be required to re-inject brine or inert gases to manage spontaneous combustion events within the goaf. The gas drainage boreholes would be decommissioned following the completion of the adjacent longwall panel.

Following the completion of mining, remaining surface infrastructure in the underground mining area would be decommissioned (Section A5.3.4).

The decommissioned surface infrastructure areas would then be re-profiled to be consistent with the surrounding landscape (Figure A5-2).

Landform changes would occur as a result of subsidence in the underground mining area. Surface impacts from subsidence would be progressively remediated in accordance with the procedures referenced in Section A5.3.7. Post-mining subsidence monitoring would continue for a period of time detailed within the Extraction Plans, and any observed surface impacts would continue to be remediated by NCOPL in accordance with the Extraction Plan.

A5.2.3 Post-mining Land Use

NCOPL has considered post-mining land uses (e.g. native vegetation, agriculture, forestry), taking into account strategic land use objectives in the vicinity of the Project. The potential benefits of the post-mining land use to the environment, future landholders and the community have also been considered.

For the purposes of rehabilitation and mine closure planning for the Project, NCOPL proposes the post-mining land use of the Project would continue to comprise a combination of native vegetation (Mine Site Ecological Rehabilitation/other woodland areas/biodiversity offset areas), agricultural (pasture) and forestry (State Forest) land uses.

Project infrastructure outside of the Mine Site Ecological Rehabilitation areas (e.g. rail loop, site access roads, water storages) may be retained for alternate post-mining uses (where agreed with relevant regulatory authorities and landholders).

The proposed post-mining land uses would be consistent with the approved Narrabri Mine post-mining land uses (Section A5.1.2) and the surrounding existing land uses (Section 6.6).

The post-mining land uses would also be generally consistent with the aims of the *Narrabri Local Environmental Plan 2012* (Attachment 7).

A5.2.4 Rehabilitation Domains and Conceptual Objectives

Rehabilitation domains for the Narrabri Mine are described in the approved MOP. These rehabilitation domains were developed following an assessment of potential post-mining land uses, taking into account relevant strategic land use objectives in the region and the potential benefits of the post-mining land use to the environment, future landholders and the community. The existing rehabilitation domains have been augmented to incorporate the Project.

The provisional primary and secondary rehabilitation domains for the Project are summarised in Table A5-2. The primary domains would develop over time into the proposed secondary domains shown on Figure A5-4.

These provisional rehabilitation domains would be incorporated into an updated MOP (Section A5.4).

Conceptual mine closure and rehabilitation objectives were determined for the primary and secondary domains and are summarised in Table A5-3.

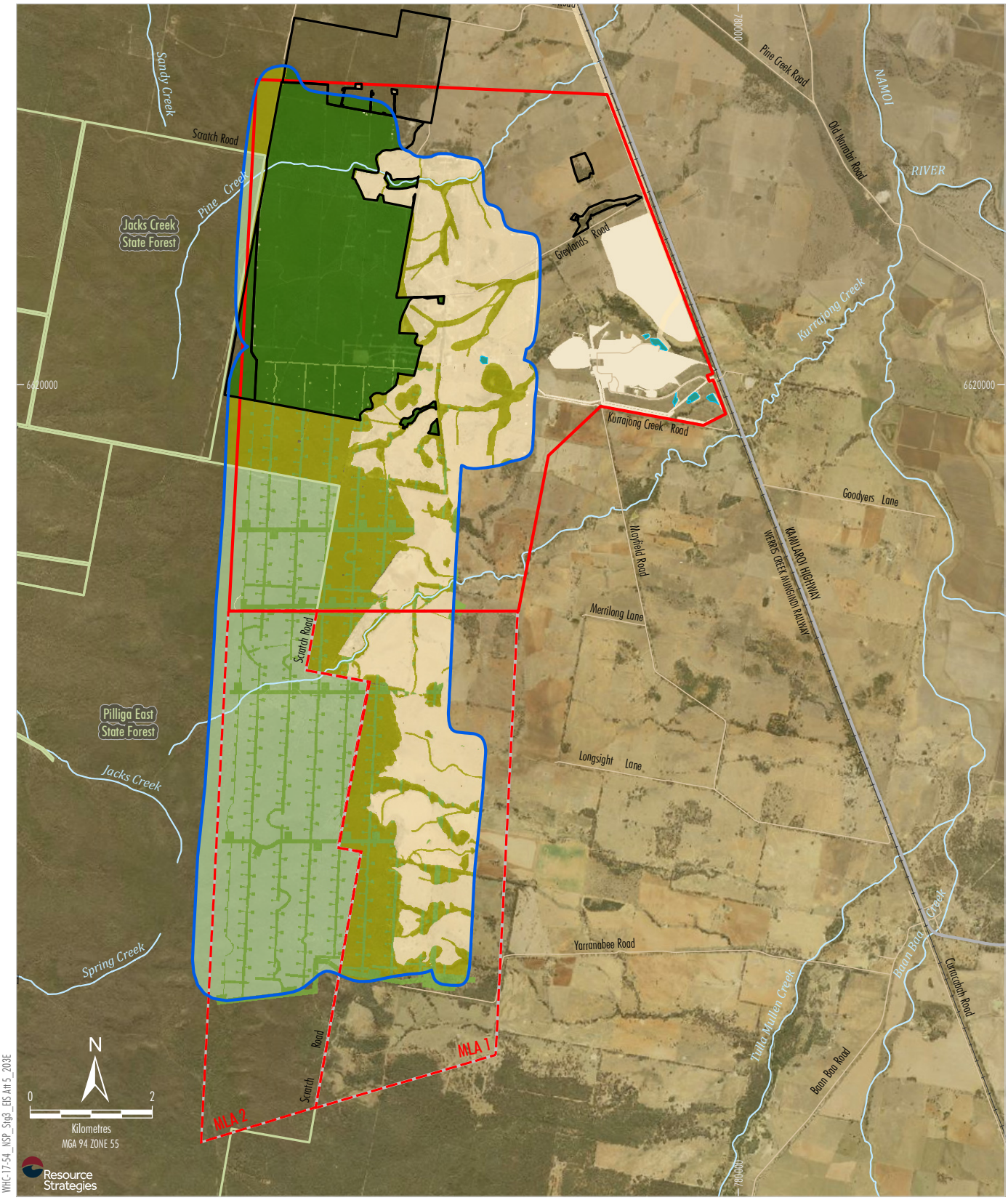
Table A5-2
Primary and Secondary Rehabilitation Domains

Primary Domain[1]	Secondary Domain (Final Land Use)[2]
Infrastructure Area (1) *(Pit Top Area [excluding water management components], underground mine surface infrastructure [e.g. ventilation shafts, gas management and mine safety pre-conditioning infrastructure areas, exploration areas and associated access tracks], Namoi River pump station, alluvial production bore and pipeline)*	▪ Pasture (B) ▪ Woodland (C) ▪ State Forest (D) ▪ Mine Site Ecological Rehabilitation (E) ▪ Biodiversity Offset (F)
Water Management Area (3) *(All key components of the site water management system)*	▪ Water Management (A) ▪ Pasture (B) ▪ Woodland (C) ▪ Mine Site Ecological Rehabilitation (E)
Reject Emplacement Area (4) *(Reject emplacement area)*	▪ Pasture (B)[3]
Stockpiled Material (5) *(Soil stockpiles and amenity bund)*	▪ Pasture (B)
Underground Mining Area (8) *(All areas subject to subsidence)*	▪ Water Management (A) ▪ Pasture (B) ▪ Woodland (C) ▪ State Forest (D) ▪ Mine Site Ecological Rehabilitation (E) ▪ Biodiversity Offset (F)
Approved Biodiversity Offset (9) *(Approved Narrabri Mine On-site Biodiversity Offset Areas)*	▪ Biodiversity Offset (F)

1 Primary domain numbering is consistent with the approved MOP.

2 Project infrastructure outside of the Mine Site Ecological Rehabilitation areas (e.g. rail loop, site access roads, water storages) may be retained for alternate post-mining uses (where agreed with relevant regulatory authorities and landholders) (Section A5.2.3). If Project infrastructure is retained, additional secondary rehabilitation domains would be incorporated into an updated MOP (Section A5.4).

3 Pasture is consistent with the final land use adopted by ATC Williams (2019) for its review of the reject emplacement final landform design (Section A5.2.2).



LEGEND

- Mining Lease (ML 1609)
- Provisional Mining Lease Application Area
- State Forest
- Approved Biodiversity Offset Area
- Remediated Underground Mining Area

Secondary Domains

- Water Management (A)
- Pasture (B)
- Woodland (C)
- State Forest (D)
- Mine Site Ecological Rehabilitation (E)
- Biodiversity Offset (F)

Source: NCOPL (2019); NSW Spatial Services (2019)

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NARRABRI STAGE 3 PROJECT

Conceptual Rehabilitation Domains

Figure A5-4

Table A5-3
Rehabilitation Objectives

Rehabilitation Domain	Domain Rehabilitation Objective
Primary Domains	
Infrastructure Area (1)	▪ Infrastructure with no alternate post-mining use (where agreed with relevant regulatory authorities and landholders) would be decommissioned and removed. ▪ Ventilation shafts would be backfilled with material recovered from the amenity bund, southern mine water storage and/or the stockpiles located at the ventilation complexes. ▪ Mine entrances and ventilation shafts would be sealed in accordance with the requirements of *MDG6001 Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams* (NSW Trade and Investment, 2012). ▪ Boreholes would be capped in accordance with the *Exploration Code of Practice: Rehabilitation* (Department of Planning and Environment – Division of Resources and Geosciences, 2017) and the *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (Department of Industry – Resources and Energy, 2016). ▪ Hydrocarbons (petrol, diesel, oils, greases, degreasers and kerosene), chemicals, and liquid and non-liquid wastes unused at the completion of mining would be returned to the supplier in accordance with relevant safety and handling procedures. ▪ Potentially contaminated soils would be identified and remediated in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*. ▪ The landform would be re-profiled to be consistent with the surrounding landscape to allow for free drainage of surface water runoff. ▪ Following rehabilitation, pasture, woodland, Mine Site Ecological Rehabilitation, State Forest and biodiversity offset areas land uses would be established.
Water Management Area (3)	▪ Water management structures and sediment control structures would either be retained as water sources for future land uses or decommissioned and rehabilitated. ▪ Potentially contaminated soils would be identified and remediated in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*. ▪ Where water management structures are decommissioned, the landform would be re-profiled to be consistent with the surrounding landscape to allow for free drainage of surface water runoff. ▪ Following rehabilitation, pasture, woodland, Mine Site Ecological Rehabilitation and water management land uses would be established.
Reject Emplacement Area (4)	▪ The rehabilitated reject emplacement area would be constructed with a compacted floor with a permeability of less than $1x10^{-9}$ metres per second. ▪ The rehabilitated reject emplacement area would be approximately 15 m high with batter slopes of generally 1(V):5(H) with a maximum grade of 1(V):4(H). ▪ An approximate 400 mm capping layer would be placed over the final landform prior to revegetation. ▪ Erosion control structures including batter contour drains; swale drains; perimeter drain would be constructed. ▪ Potentially contaminated soils would be identified and remediated in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*. ▪ Following rehabilitation, pasture land use would be established.
Stockpiled Material (5)	▪ Stockpiled material would be removed and used in rehabilitation activities. ▪ Potentially contaminated soils would be identified and remediated in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*. ▪ Following the removal of the stockpiled material, the landform would be re-profiled to be consistent with the surrounding landscape to allow for free drainage of surface water runoff. ▪ Following rehabilitation, pasture land use would be established.
Underground Mining Area (8)	▪ Subsidence remediation measures would be implemented. ▪ Potentially contaminated soils would be identified and remediated in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*. ▪ Following rehabilitation, pasture, woodland, State Forest and biodiversity offset areas land uses would be established.
Approved Biodiversity Offset (9)	▪ Managed in accordance with the Biodiversity Offset Strategy (Section A5.1.4).

Table A5-3 (Continued)
Rehabilitation Objectives

Rehabilitation Domain	Domain Rehabilitation Objective
Secondary Domains	
Water Management (A)	▪ Retained water management structures would support the post-mining land use (e.g. agriculture). ▪ Retained water management structures would be appropriately licensed in accordance with the NSW *Water Management Act 2000* (if required).
Pasture (B)	▪ Pasture areas would be revegetated to include a mixture of pasture species. ▪ Pasture areas would be suitable for light intensity grazing.
Woodland (C)	▪ Woodland areas would be revegetated to include endemic woodland species and to enhance the habitat values and biodiversity values. ▪ Rehabilitated woodland areas would be self-sustaining and have comparable flora and fauna values of surrounding remnant vegetation.
State Forest (D)	▪ State Forest areas would be revegetated to include endemic woodland species and to enhance the habitat values and biodiversity values. ▪ Rehabilitated State Forest areas would be self-sustaining and have comparable flora and fauna values of surrounding remnant vegetation.
Mine Site Ecological Rehabilitation (E)	▪ Refer to Table A5-4.
Biodiversity Offset (F)	▪ Managed in accordance with the Biodiversity Offset Strategy (Section A5.1.4).

A5.2.5 Mine Site Ecological Rehabilitation Areas

NCOPL would establish Mine Site Ecological Rehabilitation areas in accordance with the NSW Biodiversity Offsets Scheme as part of the Project (Figure A5-4).

Mine Site Ecological Rehabilitation aims to re-create a functioning native ecosystem (habitat) at the site of disturbance. This can have a greater benefit to local flora and fauna than mine site rehabilitation that is not targeted towards re-creating habitats (Appendix D).

The Mine Site Ecological Rehabilitation areas would contribute a portion of the overall biodiversity offset credits for the Project (land-based offset areas would also be required) (Appendix D).

Recognisable and self-sustaining plant community types are required to be re-established as part of Mine Site Ecological Rehabilitation. NCOPL would aim to re-establish the same plant community types in similar locations to those cleared for the Project (Appendix D). The plant community types that would be re-established in the Mine Site Ecological Rehabilitation areas are listed in Table A5-4.

In addition, the Mine Site Ecological Rehabilitation areas would provide habitat for threatened species potentially impacted by the Project. The threatened species habitat that would be re-established in the Mine Site Ecological Rehabilitation areas are listed in Table A5-4.

The rehabilitation objectives and the biodiversity offset credits for the plant community types and threatened species habitat that would be re-established in the Mine Site Ecological Rehabilitation areas are listed in Table A5-4.

Detailed rehabilitation objectives, performance indicators, completion criteria and credit value estimate for the Mine Site Ecological Rehabilitation areas developed in accordance with the draft *Ancillary Rules for Use of Mine Site Ecological Rehabilitation as an Offset* (Department of Planning, Industry and Environment, 2019) are provided in the Biodiversity Development Assessment Report (Appendix D).

The Mine Site Ecological Rehabilitation areas would be rehabilitated consistent with the rehabilitation strategy for the Woodland secondary domain if the rehabilitation objectives, performance indicators and completion criteria for the Mine Site Ecological Rehabilitation areas are not able to be satisfied.

A5.2.6 Approved Biodiversity Offset Areas

The biodiversity offset areas established at the Narrabri Mine (Section A5.1.4) would be included in the Project rehabilitation strategy as shown on Figure A5-4.

Details of the proposed biodiversity offset strategy for the Project are provided in Section 6.7.

A5.2.7 Key Rehabilitation Performance Measures and Completion Criteria

Performance measures[2] are objective target levels or values assigned to a variety of indicators (e.g. slope, species diversity, percent groundcover), which can be measured to demonstrate progress and ultimate success of rehabilitation. Completion criteria provide a defined end point, at which point in time rehabilitation can be deemed successful and the mining lease relinquishment process can proceed.

Detailed performance indicators (measures) and completion criteria for the Mine Site Ecological Rehabilitation areas developed in accordance with the draft *Ancillary Rules for Use of Mine Site Ecological Rehabilitation as an Offset* (Department of Planning, Industry and Environment, 2019) are provided in the Biodiversity Development Assessment Report (Appendix D).

Key rehabilitation performance measures and completion criteria have been developed for the other Project rehabilitation areas with regard to the *Mine Closure and Completion: Leading Practice Sustainable Development Program for the Mining Industry* (DIIS, 2016a). It is appropriate that these rehabilitation performance measures and completion criteria described remain at the strategic level for this EIS.

[2] Also known as “performance standards”.

Table A5-4
Mine Site Ecological Rehabilitation Overview

Plant Community Type/Species		Area[1] (ha)	Rehabilitation Objective	Credit Value
Ecosystem Credits				
55	Belah Woodland	7	▪ Objective 1: The vegetation composition of the rehabilitation is recognisable as a plant community type contained within the BioNet Vegetation Classification. ▪ Objective 2: The vegetation structure of the rehabilitation is recognisable as, or is trending towards, a plant community type contained within the BioNet Vegetation Classification. ▪ Objective 3: Levels of ecosystem function have been established that demonstrate the rehabilitation is self-sustainable.	16
88	Pilliga Box – Buloke Woodland	35		101
206	Dirty Gum – White Cypress Woodland on Sand Monkeys	1.5		3
244	Poplar Box Grassy Woodland	6.5		13
399	Red Gum – Tea Tree Creek Woodland	12		32
401	Rough-barked Apple Sand Flat Woodland	3		5
404	Red Ironbark – White Bloodwood +/- Burrows Wattle Shrubby Woodland	205		359
405	White Bloodwood – Red Ironbark – Black Cypress Woodland	99.5		177
406	White Bloodwood – Motherumbah – Red Ironbark Shrubby Woodland	38		62
435	White Box – White Cypress Woodland	27.5		48
Species Credits				
Koala (*Phascolarctos cinereus*)		435	▪ Objective 4: Achieve the restoration target value used to calculate the credit value for the area of habitat for the target flora species. ▪ Objective 5: Achieve the restoration target value used to calculate the credit value for the area of habitat suitability for the target fauna species. ▪ Objective 6: Threatened fauna species for which species credits have been calculated are present on the rehabilitation site and form part of a self-sustaining population.	816
Eastern Pygmy-possum (*Cercartetus nanus*)		394		739
Squirrel Glider (*Petaurus norfolcensis*)		428		800
Large-eared Pied Bat (*Chalinolobus dwyeri*)		345.5		647
Eastern Cave Bat (*Vespadelus troughtoni*)		324		599

Source: After Appendix D.

[1] Refer to Figure A5-4 for location.

A MOP would be developed for the Project that would describe the rehabilitation performance measures and completion criteria, including more detailed and quantified criteria where applicable (based on the Development Consent conditions for the Project). The rehabilitation performance measures and completion criteria included in the MOP would be specific, measurable, realistic and time-bound in accordance with *ESG3: Mining Operations Plan (MOP) Guidelines*, September 2013 (NSW Division of Resources and Energy, 2013).

Over the life of the Project, rehabilitation performance measures and completion criteria would, periodically, be updated and refined in consultation with relevant regulatory authorities and stakeholders to reflect evolving mine site rehabilitation practices and standards.

The key rehabilitation performance measures and strategic completion criteria for the other Project rehabilitation areas as related to each rehabilitation phase are described below.

Decommissioning

- Project infrastructure (e.g. CHPP, ROM coal stockpile and product coal stockpile, rail loop, buildings) is to be decommissioned in accordance with the MOP to the satisfaction of the relevant regulatory authorities, unless otherwise agreed with the relevant regulatory authorities and landholders.
- Mine entrances and ventilation shafts decommissioned and sealed in accordance with the MOP and NSW Resources Regulator requirements.
- Any potentially contaminated areas are to be tested and where required, remediated, in accordance with the NSW *Land Contamination Management Act 1997* following infrastructure decommissioning.

Landform Establishment

- Each domain re-profiled to the final landform design in accordance with the MOP, to be confirmed by survey of slopes and elevations.
- Surface water management infrastructure designed and implemented in line with the approved Water Management Plan.

Growth Medium Development

- Application of a growth medium (e.g. suitable topsoil/subsoil) to bare or stripped areas in accordance with the MOP.
- Soil application depths, amelioration requirements and soil application equipment on rehabilitated landforms are to be in accordance with the MOP.
- Suitable soil preparation on final landforms (e.g. ripping on contour or tilling) is to be undertaken prior to establishment of vegetation.

Ecosystem and Land Use Establishment

- Salvaged habitat features placed on rehabilitated landforms in accordance with the MOP.
- Re-profiled landforms stabilised by use of a cover crop (i.e. minimal erosion).
- Natural revegetation allowed to establish, however if rehabilitation monitoring determines this is not successful, additional management measures would be developed (e.g. seeding using suitable woodland or pasture species in accordance with the nominated post-mining land use) and further rehabilitation monitoring would be undertaken.
- After revegetation establishment in a domain, representative rehabilitation monitoring sites would be established in that domain and in corresponding representative control sites in accordance with the requirements of the MOP.

Ecosystem and Land Use Sustainability

- Adequate species diversity, succession and habitat development that meets applicable benchmark levels, as confirmed by survey.
- Satisfies the post-mining land use objective, as agreed with relevant regulatory authorities and stakeholders. Followed by lease relinquishment where applicable.

A5.3 GENERAL REHABILITATION PRACTICES AND MEASURES

The following sub-sections summarise the general rehabilitation practices and measures that would be implemented for the Project.

The success of progressive rehabilitation activities would be regularly evaluated throughout the Project life and the results would be used to inform future rehabilitation initiatives.

A5.3.1 Vegetation Clearing

The clearance of vegetation would be undertaken progressively, with the area of vegetation cleared at any particular time generally being no greater than that required to accommodate projected development activities for the subsequent 12 months.

In existing cleared areas (i.e. pasture areas), vegetation clearance in surface development areas may be able to be limited to slashing when conditions are suitable (i.e. during dry weather) for certain applications. As the primary method of revegetation would be through natural regeneration (through seed bank in the topsoil or seed from surrounding vegetation) (Section A5.3.6), it is expected that minimising the disturbance of the soil profile would improve rehabilitation outcomes.

Vegetation clearance protocols would be documented in the MOP and the Biodiversity Management Plan. Key components of the vegetation clearance protocols would include aspects such as the delineation of vegetation areas to be cleared, clearing inspections and salvage of habitat features.

Key habitat features would be salvaged during vegetation clearance activities and stockpiled for relocation to rehabilitation areas. When relocated, these features are likely to provide habitat resources for a range of invertebrate and ground-dwelling fauna.

Further details on management of potential impacts on terrestrial ecology during clearing is provided in Section 6.7.

A5.3.2 Soil Stripping and Handling

Recovered soil resources would be used in the rehabilitation of the Project or stockpiled for later use in rehabilitation.

As the primary method of revegetation would be through natural regeneration (through seed bank in the topsoil or seed from surrounding vegetation) (Section A5.3.6), soil resources would be stockpiled by the plant community type present before soil stripping, so the soils (and associated plant community type seed bank) can be reapplied consistent with the plant community type being targeted in the Mine Site Ecological Rehabilitation areas.

The following management measures would be implemented during the stripping of soils:

- Areas of disturbance requiring soil stripping would be clearly defined.
- Soil stripping during periods of high soil moisture content (i.e. following heavy rain) would be avoided where practicable to reduce the likelihood of damage to soil structure.
- Where ameliorants (e.g. lime, gypsum and fertiliser) are determined to be necessary to improve the condition of the soil, they would be applied to the soil prior to rehabilitation.
- In preference to stockpiling, wherever practicable, stripped soil would be directly replaced on completed sections of the final landforms.

Any long-term soil stockpiles would be managed to maintain long-term soil viability through the implementation of the following management practices as listed below:

- Soil stockpiles would be retained at a height of 2 m (where existing disturbance areas allow and does not require the need for additional disturbance) and with slopes no greater than 1(V):2(H) with a slightly roughened surface and a flat top to minimise erosion, where practicable.
- All soil stockpiles would be protected with a non-persistent cover crop to reduce erosion potential as soon as practicable after completion of stockpiling.
- Soil stockpiles would be located in positions to avoid surface water flows and where required sediment control fencing would be placed immediately down-slope of stockpiles until stable vegetation cover has established.

- No vehicle access on soil stockpiles would be allowed.
- Weed control programs would be implemented on soil stockpiles if monitoring indicates weed control is required.
- An inventory of soil resources (available and stripped) would be maintained and regularly reconciled with rehabilitation requirements.

The MOP would describe the soil resource management measures that would be used during the Project life.

A5.3.3 Geotechnical Stability

Existing geotechnical stability management and monitoring measures conducted at the Narrabri Mine would continue to be applied for the Project (e.g. regular geotechnical monitoring of box cut, water storages, reject emplacement). The Project would not result in any material additional geotechnical issues with the continued implementation of the management and monitoring measures.

A review of geotechnical stability for the reject emplacement design indicated that a very low risk of global batter failure or displacement exists. As such, this exposure pathway (i.e. geotechnical failure of the emplacement) is of low risk (ATC Williams, 2019).

A5.3.4 Decommissioning of Surface Infrastructure

Subject to the agreed final land use, decommissioning of surface infrastructure would include, but not be limited to, the following actions:

- de-energising equipment (e.g. removing connections to power, water, gas, compressed air and sewerage) and isolation of power to the site (if appropriate);
- removal of underground infrastructure, such as mining equipment and service infrastructure;
- mine entrances would be sealed in accordance with the requirements of *MDG6001 Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams* (NSW Trade and Investment, 2012);
- boreholes would be capped in accordance with the *Exploration Code of Practice: Rehabilitation* (Department of Planning and Environment – Division of Resources and Geosciences, 2017) and the *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (Department of Industry – Resources and Energy, 2016);
- demolition and removal of buildings and other surface infrastructure (such as the CHPP, conveyors and train load-out facilities);
- removal of roadways, concrete footings, drainage structures, hardstand and foundations, if not required for the post-mining land use;
- removal of rail line, sleepers and ballast, if not required for the post-mining land use;
- removal of the Namoi River pump station, alluvial production bore and pipeline;
- removal of waste generated during decommissioning from site by an appropriately licensed waste contractor; and
- removal and disposal of any hazardous materials such as fuel, lubricants, chemicals or other substances of concern.

As part of mine closure planning, NCOPL would assess whether Project surface infrastructure (e.g. conveyor belt, building materials, cement pads/footings, poly pipe) could be disposed of on-site (e.g. in backfilled box cut or underground).

A5.3.5 Selection of Native Plant Species for Revegetation

The Mine Site Ecological Rehabilitation areas would be revegetated with species consistent with the plant community types listed in Table A5-4.

Natural revegetation would be allowed to establish, however if rehabilitation monitoring determines this is not successful, additional management measures would be developed (e.g. seeding using suitable woodland species endemic to adjacent remnant vegetation) and further rehabilitation monitoring would be undertaken.

The seed mix would be specific to the plant community type being targeted in the Mine Site Ecological Rehabilitation areas.

For woodland and biodiversity offset areas, natural revegetation would also be allowed to establish, however if rehabilitation monitoring determines this is not successful, additional management measures would be developed (e.g. seeding using suitable woodland species endemic to adjacent remnant vegetation) and further rehabilitation monitoring would be undertaken.

Native plant species to be planted in woodland and biodiversity offset areas would be selected on a site-by-site basis, depending on nearby remnant vegetation associations, soil types, aspect and site conditions.

Pasture areas would be sown with a native pasture seed mix relevant to the season of planting.

The list of suitable native plant species to be used in the revegetation of disturbance areas would be documented in the MOP.

A5.3.6 Establishment of Agricultural Land

The rehabilitated Project would include pasture areas similar to surrounding areas that would be suitable for light intensity grazing.

Appropriate management and amelioration measures would be implemented so that rehabilitated pasture areas would be comparable in productivity to pre-mining pasture conditions (Section 6.6). This may include the application of gypsum and fertiliser to topsoil in order to address potential acidity, organic carbon and/or nutrient deficiency constraints, and enhance rapid establishment of a sustainable vegetation growth.

Approximately 2,063 ha of surface development areas and remediated underground mine areas would be re-established as agricultural land (pasture) following the closure of the Project.

A5.3.7 Remediation of Subsidence Impacts

Ditton Geotechnical Services Pty Ltd (2020) has undertaken a review of potential subsidence impacts of the Project and the consequences for land overlying the underground mining area (Section 6.3 and Appendix A).

Remediation measures for potential subsidence consequences (e.g. increased ponding on drainage lines and surface cracking) are discussed in Section 6.3 and Appendices A, C, D and G.

A5.3.8 Erosion and Sediment Control Measures

Erosion and sediment control measures would be progressively developed and approved as part of the Water Management Plan (Section 6.5.4). Sediment and erosion controls would be periodically updated and regularly reviewed.

Operational sediment and erosion control works would be maintained during the establishment of revegetation. However, once self-sustaining stable final landforms have been achieved within an area, key elements of the operational sediment control structures would be either left as passive water control storages or removed to allow the area to become free-draining.

A5.3.9 Approved Biodiversity Offset Areas

The biodiversity offset areas established at the Narrabri Mine (Section A5.1.4) would be included in the Project rehabilitation strategy (Figure A5-4).

Details of the proposed biodiversity offset strategy for the Project are provided in Section 6.7.

A5.3.10 Land Contamination Measures

Investigations would be undertaken at mine closure to identify and remediate any contaminated soil that may exist (e.g. in infrastructure areas), in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*. Contaminated land would be remediated by removal and disposal at an appropriately licensed facility, encapsulation or appropriate remediation treatment on-site.

At mine closure, a preliminary contaminated site analysis would be implemented to determine whether an assessment should be conducted. Where required, an assessment of contamination in the area would be undertaken by a suitably qualified consultant. This would quantify the amount of contaminated material that would need to be bio-remediated on site.

A5.3.11 Weed and Pest Control

Weed control is an important factor in the success or failure of revegetation and is a large component of long-term management in rehabilitation.

Weed control measures include a combination of herbicide application, biological controls and manual weeding. Weed species are controlled on an ongoing basis as needed.

Weed outbreaks in rehabilitation areas would be monitored, and control measures undertaken would be reported in the Annual Reviews.

NCOPL would minimise rubbish on-site to discourage scavenging and reduce the potential for colonisation of Project rehabilitation areas by non-endemic fauna. Humane control methods would be implemented for all animal pest species.

A5.3.12 Bushfire Management

Potential bushfire risk and proposed management measures for the Project are discussed in Section 6.18.

A5.3.13 Post-closure Maintenance

The management and maintenance of rehabilitation areas post-closure would be determined in consultation with relevant government authorities and stakeholders, and would be outlined in the MOP and MCP (Sections A5.4 and A5.7).

A5.4 MINING OPERATIONS PLAN

The MOP describes how rehabilitation is undertaken, provides rehabilitation performance and completion criteria and addresses aspects of rehabilitation including mine closure, final landforms and final land use.

Preliminary rehabilitation objectives, performance indicators and completion criteria for the Project would be reviewed as part of an update to the MOP for the Project, which would be undertaken in consultation with relevant regulatory authorities, and in accordance with the relevant NSW rehabilitation and mine closure guidelines.

A5.5 MONITORING, INVESTIGATIONS AND TRIALS

A5.5.1 Rehabilitation Monitoring

Post-closure monitoring of rehabilitation areas at the Project would be conducted to assess the:

- progress of rehabilitation areas; and
- the effectiveness of the rehabilitation techniques being used to determine the need for any maintenance and/or contingency measures.

A rehabilitation monitoring program would be developed for the Project that, along with the application of adaptive management, would allow the desired outcomes to be achieved. It is expected that the rehabilitation monitoring would include (subject to final land use agreement):

- Documentation of all rehabilitation activities undertaken.
- Baseline monitoring to determine conditions pre-mining and during mining:
  - recording pasture establishment success and progression towards control sites;
  - monitoring drains and rehabilitated mine landforms for localised failures or rilling and loss of topsoil after rainfall events;
  - identifying potential threats to rehabilitated woodland and pasture areas (e.g. weed invasion, pest species, erosion);
  - monitoring the stability of rehabilitated mine landforms; and
  - recording key rehabilitation information (e.g. taking photographic records).
- Initial monitoring for a period of one to two years post-closure and comparison with control sites.
- Ongoing monitoring (less frequently) from two years post-mining until lease relinquishment.
- Post-lease relinquishment monitoring (to be negotiated with future landholders).
- Use of adaptive management techniques and facilitation of research trials where appropriate.

Monitoring measures specific to individual domains would be outlined within the RMP and/or MOP.

Annual surveys of rehabilitation areas would be undertaken to review the progress of rehabilitation and to identify any additional measures required to achieve ongoing progression towards achieving rehabilitation criteria. A monitoring report would be prepared annually that includes a summary of previous monitoring results, results of the current year's monitoring and any planned remedial works, if required. The monitoring results would be summarised in the Annual Review.

Subsidence monitoring would be conducted before and after longwall mining. Timeframes for subsidence monitoring would be detailed within the Extraction Plans specific to the Project.

A5.5.2 Rehabilitation Investigations and Trials

NCOPL would continue to undertake rehabilitation and subsidence remediation trials and investigations over the life of the Project to allow for continued improvements in rehabilitation and remediation practice.

It is anticipated that these trials and investigations by NCOPL would focus on:

- Coolabah Bertya translocation techniques and processes (Section 6.7);
- rehabilitation practices implemented at the reject emplacement and at decommissioned surface facility sites; and
- techniques and processes for remediation of subsidence impacts.

The results of the rehabilitation and subsidence remediation trials would be summarised in the Annual Review.

A5.6 POTENTIAL BARRIERS AND LIMITATIONS TO EFFECTIVE REHABILITATION

Rehabilitation planning for the Project was informed by existing mine closure and rehabilitation objectives and current rehabilitation practices implemented for the Narrabri Mine.

Table A5-5 outlines potential barriers and limitations to rehabilitation success that would be monitored and, where relevant, addressed by further trials and investigations and suitable mitigation measures throughout the life of the Project.

A5.7 MINE CLOSURE PLAN AND LEASE RELINQUISHMENT

The existing MCP would be updated for the Project in consultation with relevant regulatory authorities and community stakeholders. The MCP would be developed over the Project life, with more detailed measures developed closer to Project completion.

The MCP would include consideration of amelioration of potential adverse socio-economic effects due to the reduction in employment at Project closure (Sections 6.15 and 6.16).

Upon cessation of mining operations, it would be expected that tenure of the mining leases would be maintained by NCOPL until such time as mining lease and other statutory approval relinquishment criteria were satisfied. These criteria would be formulated and prescribed in consultation with relevant regulatory authorities and stakeholders. NCOPL would transfer to the relevant regulators any documents required to preserve the history of the site, once closed, to facilitate future land use planning.

The *Strategic Framework for Mine Closure* published by the ANZMEC-MCA (2000) (or its contemporary version) and *Leading Practice Sustainable Development Program for the Mining Industry – Mine Closure* (DIIS, 2016b) would be used as a guide for mine closure.

Table A5-5
Identification of Potential Key Barriers and Limitations to Effective Rehabilitation and Management Strategies

Key Barrier/Limitation	Potential Causes/Issues	Key Mitigation Strategies
Community objection to proposed final land use	▪ Evolving post-mining land use preferences. ▪ Poor community consultation. ▪ Perceived negative environmental impacts.	▪ Community consultation throughout the Project life, increasing prior to mine closure. ▪ Ongoing consideration of future land use alternatives.
Unauthorised access to site	▪ Personal injury. ▪ Property damage. ▪ Environmental damage.	▪ Installation of appropriate fencing for the stage of the Project. ▪ Security of all buildings and structures. ▪ Provision of signage.
Security and inappropriate disposal of dangerous goods and hazardous substances	▪ Dangerous goods/hazardous substances remain on-site after closure. ▪ Deterioration. ▪ Theft. ▪ Unauthorised access.	▪ Audits of dangerous goods and hazardous substances. ▪ Management and storage of chemicals in accordance with prescribed management procedures, Australian Standards and Codes.
Unplanned delay in commencement/execution	▪ Inadequate planning process. ▪ Delays in approvals. ▪ Inadequate resources. ▪ Environmental damage.	▪ MOP process and ongoing mine closure planning and review.
Contamination greater than expected	▪ Unidentified previous uses. ▪ Inadequate studies.	▪ Contaminated land assessments. ▪ Remediation of contaminated land by removal and disposal at an appropriately licensed facility, encapsulation or land-farming on-site.
Failure to fully provide for closure costs	▪ Inadequate planning process. ▪ Inadequate resources. ▪ Change in scope. ▪ Change in legislation. ▪ Financial loss/delay.	▪ MOP process, financial securities and ongoing mine closure planning and review.
Inadequate soil resources for rehabilitation	▪ Inadequate planning process. ▪ Poor existing soil quality. ▪ Poor soil resource management. ▪ Inadequate resources. ▪ Change in scope.	▪ MOP process and ongoing mine closure planning and review. ▪ Rehabilitation trials and investigations.
Reject emplacement landform instability	▪ Poor implementation of the landform design. ▪ Poor emplacement technique.	▪ Rehabilitation trials and investigations. ▪ Geotechnical investigations and engineering design prior to final rehabilitation of the reject emplacement.
Failure to establish suitable plant species/communities	▪ Inadequate planning process. ▪ Poor species selection. ▪ Climatic/environmental events (e.g. drought, bushfire). ▪ Weed/pest invasion.	▪ Rehabilitation trials and investigations. ▪ Monitoring and maintenance. ▪ Weeds and pest control.
Failure to establish productive agricultural land	▪ Inadequate planning process. ▪ Poor species selection. ▪ Climatic/environmental events (e.g. drought, bushfire). ▪ Weed/pest invasion.	▪ Rehabilitation trials and investigations. ▪ Monitoring and maintenance. ▪ Weeds and pest control.
Failure of subsidence remediation techniques	▪ Inadequate planning process. ▪ Inadequate resources, including monitoring. ▪ Climatic/environmental events (e.g. drought, bushfire). ▪ Difficulty in accessing due to vegetation cover/terrain.	▪ Extraction Plan approval process. ▪ Subsidence impact performance measures. ▪ Rehabilitation trials and investigations. ▪ Monitoring and maintenance.

A5.8 REFERENCES

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