

Ravensworth Ash Disposal Area

Rehabilitation Management Plan





Rehabilitation Management Plan	
Name of mine	Former Ravensworth No.2 Mine (Excluded Area) Ravensworth South Mine
Rehabilitation management plan commencement date	2 July 2022
Rehabilitation management plan revision dates	Version 0 FINAL
Mining leases	Excluded Area (formerly CCL723) ML 1484 (expires 31/07/2024) ML 1485 (expires 17/08/2036)
Name of lease holder	AGL Macquarie Pty Ltd
Submission Date	31 July 2022



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1. Introduction to mining project

1.1. History of operations

The Ravensworth No.2 Mine, was operated by Peabody Resources Ltd under contract to Pacific Power up until 1993 when extraction of the coal resource was completed. Peabody's contractual commitments with respect to the site were completed on 31st December 1993. In accordance with commitments made in the EIS, Pacific Power proposed to complete rehabilitation of the site by filling the final void left after completion of mining with fly ash from Bayswater Power Station. Filling of the void was predicted to take around 30 years from the time of commencement of filling.

In January 1994 with the cancellation of part of the existing coal lease (CCL 723) Pacific Power's commitments for the rehabilitation of the Ravensworth No 2 Mine as required under the *Coal Mines Regulation Act 1982* was incorporated into a legal deed between Pacific Power and the Department of Mineral Resources. This deed is relevant to the whole of Ravensworth No 2 site, including the void areas that contain ash as well as the remaining areas that had been partly revegetated during the period of mining.

In November 1993, the then Department of Mineral Resources (DMR) approved the Ravensworth No. 2 Mine Fly Ash Disposal and Rehabilitation Environmental Management Plan Volume 1 and 2 (Ravensworth No. 2 Mine Fly Ash Disposal and Rehabilitation Environmental Management Plan Volume 1 and 2, 1993) (No.2 EMP) which describes the rehabilitation standard to which the site is to be returned and the rehabilitation methodology to be employed.

An Environmental Impact Statement (EIS) for the ash disposal project and ongoing rehabilitation was subsequently developed with approval subsequently received from Muswellbrook and Singleton Councils under the *Environment Planning and Assessment Act 1979* (EP&A) who at the time were the determining authorities.

In 1996, the Ravensworth South Mine Final Void Rehabilitation Plan (South EMP) (Ravensworth South Mine Final Void Rehabilitation Plan (South EMP), 1996) was first approved. The South EMP was subsequently amended and approved by the then Division of Resources and Energy (DRE) on 20 December 2012 (Ravensworth South Mine Final Void Rehabilitation Plan (South EMP), 20 Dec 2012).

Responsibility for the area that was the subject of the original approval for Ravensworth South Mine (defined by CL 110) has since been redefined and now resides with several owners. This document applies to that part of the previously approved Ravensworth South Mine now owned and managed by AGL Macquarie (ML 1484 and ML 1485). This part of the former open cut coal mine continues to be referred to as Ravensworth South.

The leases for open cut mining down to the Bayswater seam in the area were restricted by depth to around 107 metres. Underground mining of underlying seams commenced with the resultant long wall extraction occurring below the Ravensworth No 2 mine site and partially under Ravensworth South, including the final void areas. Underground mining at Ravensworth Underground Mine (RUM) ceased mining in September 2014 and is currently in care and maintenance with no active mining occurring.

Voids 1 and 2 have been fully filled with ash, capped and rehabilitated. Void 3 was filled with ash and capped in 2014. Due to the nature of its geology, Void 4 is used as a water storage dam due to the localised low point in the underlying bedrock. Water storage capacity in Void 4 is used to manage water for the ash transport system and will continue to do so until the Ravensworth South Void 5 is filled. Void 4 also includes provision for discharge under the site Environment Protection Licence (EPL) in accordance with the Hunter River Salinity Trading. Following completion of ash deposition into Ravensworth South Void 5, ash deposition (subject to electricity demand and generation) would occur into Void 4 with subsequent rehabilitation including capping and revegetation.

Ravensworth South Mine (ML 1484 and ML 1485) includes Final Void 5 and the surrounding formerly rehabilitated areas. Deposition of ash into Void 5 commenced in March 2014 and is expected to be completed sometime after 2030 depending on BPS electricity generation. A dividing wall has been constructed within the Ravensworth South final void to separate the AGLM and Glencore emplacement areas. The western ramp of the final void is now owned by Glencore Ravensworth Underground Mine (RUM) under ML 1349. This ramp was used for tailings emplacement facility prior to being capped and dumped over with mine overburden.

An average of approximately 1.3 million tonnes of fly ash per annum are pumped as an ash slurry from BPS to Void 5.

Mining within Ravensworth No. 2 (Excluded Area) ceased 31 December 1993 whilst mining within Ravensworth South ceased in 2000. As such no mining is proposed under this Rehabilitation Management Plan (RMP). The proposed activities under this RMP include rehabilitation associated activities only.

1.2. Current development consents, leases and licences

1.2.1. Excluded Area

Development consent, for the Fly Ash Disposal in Ravensworth No. 2 Mine Void and Mine Rehabilitation Project, was obtained from Singleton and Muswellbrook Councils on 8 December 1993 and 16 December 1993 respectively. Fly ash disposal to the void was also foreshadowed in the BPS EIS in 1979. On the 17 March 1994, after an application was submitted by Pacific Power, Singleton Council amended Condition 11(b) of the Development Consent to allow construction activities that were identified in the EIS as having an impact above the L90 noise limits, to be extended to between 7 am and 6 pm on Saturdays.

On 31st January 1996 Pacific Power sought approval from Singleton Council to discontinue noise monitoring until future works relating to capping of the ash in the vicinity of Ravensworth Village were carried out. On 20 July 2006 approval was granted by Singleton Council to modify the project consent to duplicate the return water system infrastructure as part of the water management system for ash emplacement.

On 4 January 2007 approval was granted by Singleton Council to modify the project consent to allow Ashton Coal Operations Limited to deposit coal tailings into Void 4 east. On 29 October 2012 approval was granted by Singleton Council to modify the project consent by adding condition 15 and thus

allowing deferment of the filling, capping and rehabilitation of the existing Void 4 and extension of the fly ash delivery pipeline and installation of new water pipelines to facilitate the ash deposition and rehabilitation of Void 5.

The Ravensworth No. 2 area was originally covered by Consolidated Coal Lease 723 (CCL 723). On 11 March 1994 the then Minister for Mines granted cancellation of CCL 723. Prior to the cancellation of CCL 723, Pacific Power entered into a deed of agreement for Ravensworth No. 2 (Excluded Area) that maintains statutory obligations for rehabilitation.

On 25 November 2016 Singleton Council granted Bettergrow consent (DA 140/2016) to construct and operate a composting facility on approximately 50 hectares (ha) of the capped Void 3 area. This development consent was modified twice in 2018 to increase the material limit from 50,000 tonnes to 76,000 tonnes and to allow transport of the composted materials offsite. The Bettergrow facility is operated under EPL 7654.

Details on statutory approvals including consents, authorisations and licenses applicable to this area included in Appendix A. The boundaries for the area are shown in Plan 1A.

1.2.2. Ravensworth South Mine

The Ravensworth South Mine was granted by the then NSW Department of Environment and Planning on 16 December 1986 (DA 86_51). Condition 2 (b) of this consent refers to the use of fly ash from the power stations to fill voids as part of the rehabilitation process. AGLM is currently seeking to modify DA 86_51. The modification aims to amend the operational management of Void 5, amend the final landform of Void 5, establish a borrow pit to win material for capping of the ash deposits and amend the consent boundary so it reflects the ownership boundaries and current operations at Ravensworth Operations and AGL.

Included in the Ravensworth South area are AGLM's share of ML 1484 and ML 1485. These MLs are jointly owned by AGLM and Glencore with the ownership defined by land ownership

On 3 February 2017 Singleton Council granted consent (173/2016) for the construction and operation of the composting facility adjacent to Void 5. The composting facility is operated by a third party under DA 173/2016 and EPL

Details on statutory approvals including consents, authorisations and licenses applicable to the Excluded Area and ML 1484 and ML 1485 are included in Appendix A. The boundaries for the Excluded Area, ML1484 and 1485 are shown in Plan 1.

1.2.3. Environment Protection Licence

The Ravensworth No. 2 area and Ravensworth South area is operated under EPL 779. This EPL was established for the operation of BPS and extends to cover the ash deposition from BPS into the voids 1 to 4 at Ravensworth No. 2 and Void 5 at Ravensworth South.

1.2.4. Tailings emplacement approvals

AGLM also has an agreement (in the name of Macquarie Generation) in place Ashton Coal Operations Pty Limited (ACOL) relating to the disposal of tailings into the eastern part of the void 4. The approvals related to this agreement and the ongoing management, rehabilitation and monitoring of this area remain the responsibility of ACOL. The footprint of land aligned to this Agreement is not covered in this RMP.

1.2.5. Prescribed dams

Prescribed dams are listed in Schedule 1 of the *Dam Safety Act 1978*. Ravensworth No 2 Voids 3 and 4 and Ravensworth South Void 5 are listed as prescribed dams in Schedule 1.

1.2.6. Notification zones

Notification areas are defined by the Dam Safety NSW (DS NSW) under Section 369 of the *Mining Act 1992* by an order published in the Government Gazette.

Before granting coal leases over these areas the Minister will seek the recommendations of the DS NSW. DS NSW will normally recommend the condition be included in the lease requiring the mining company to make special application before mining within the Notification Area. The size of the Notification Areas relates to the nature of the storage, local geology and potential mining operations possible.

Void 5 was gazetted as a notification area on 8 April 2011 and is included in May 2011 listing of notification areas provided on the DS NSW website.

1.3. Land ownership and land use

During 2013 and prior to the sale of Macquarie Generation (Macgen) to AGL, a large portion of the Ravensworth No. 2 site and a smaller portion of the Ravensworth South Mine site (western portions of ML 1484 and 1485) were sold to Glencore. These areas were generally the western aspects of the sites. The current AGLM property boundaries are shown in Plan 1. This plan also shows the boundary between the Excluded Area and Ravensworth South. The consent boundaries for DA 144/93 and DA 86/51 were subsequently aligned to the Macgen property boundaries prior to the sale of Macgen to AGL. The land that was sold to Glencore now forms part of the Ravensworth Operations Project approved work under DA 09_0176 as modified and has been used for infrastructure such as coal conveyors, raw coal stockpiles, equipment lay down and out of pit overburden emplacement.

The holding area covers approximately 849.4 ha (refer Plan 1A). The Excluded Area has a total area of approximately 475.6 ha, whilst Ravensworth South has a total area of approximately 373.8 ha (including the area to the northeast of ML 1485).

Prior to mining operations the area has had a long history of clearing and agricultural or pastoral land use which has resulted in considerable modification to native vegetation and faunal habitat. Clearing resulted in both grasslands being devoid of trees and artificially induced open woodland with scattered mature trees dominating the current landscape.

The land surrounding the project site is highly disturbed, with the predominant land use being mining, power generation, rail and road transportation and some agricultural activities. The former

Ravensthorpe village is immediately north of the site and Camberwell is about five kilometres to the east of the project site.

The pre mining environment was generally described as degraded grazing land, with Land and Soil capability classes V- VIII. The mined areas surrounding Ravensthorpe South have been progressively rehabilitated to form a landscape similar to the pre mining landscape. Pre-mining surface drainage comprised intermittent water courses that flowed to Bowmans Creek in the east and Bayswater Creek in the west. (Aurecon, 2015)

Soils prior to mining were described as typical of those occurring on similar Permian parent materials in the Hunter, comprising red duplex, and yellow duplex and red gradational soils. The Ravensthorpe South Mine EIS examined the suitability of soils and overburden material for rehabilitation. Both were indicated to be suitable but required improvement for successful rehabilitation.

From 1st March 1996 as a result of the *Energy Services Corporations Act 1995*, Pacific Power no longer retained ownership of BPS. From that date the power station was owned and operated by the newly formed Macquarie Generation although ownership of Ravensthorpe No. 2 remained with Pacific Power. The responsibilities for rehabilitation and environmental management at the site were therefore retained by Pacific Power. As a result of this restructuring process a separation of responsibilities for compliance with the Development Consent conditions issued by the two councils was necessary. As the Ravensthorpe No. 2 Site does not lie within the Muswellbrook Council area, the Muswellbrook Council Development Consent conditions were considered to be the sole responsibility of Macquarie Generation. For the Singleton Council Development Consent conditions, Macquarie Generation was responsible for compliance with conditions relating to ash disposal and water management while Pacific Power remained responsible for those activities relating to rehabilitation and management of the ash disposal site.

On 13th March 1998 the *Energy Services Corporations (Further Amendment of Transfer of Pacific Power's Assets) Order 1998* transferred ownership of the Ravensthorpe No. 2 site to Macquarie Generation. From that date Macquarie Generation assumed total responsibility for all aspects of the project until ownership of Macquarie Generation was transferred to AGL Macquarie (AGLM) on 2 September 2014.

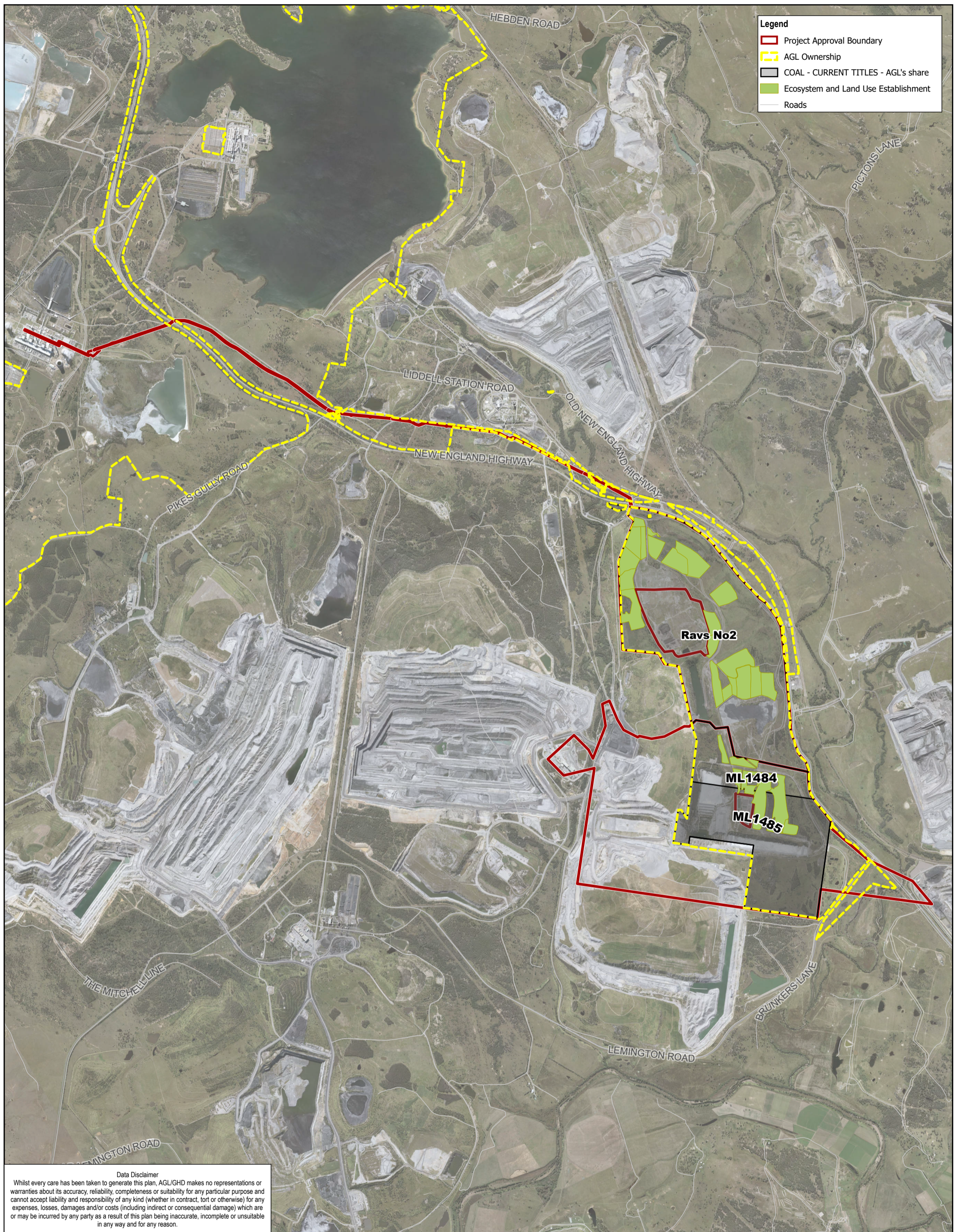
The land covered by the Excluded Area, ML1484 and ML1485 is owned entirely by AGLM. The property title details for the land holdings are included in Table 3. Land ownership is shown in Plan 1A.

Table 1 Details of Land Title and Ownership

Lot	DP	Landowner	LGA
7	1188289	AGLM	Singleton

1.3.1. Land ownership and land use figure

AGLM own 100% of the Ravensthorpe Site land (Excluded Area and Ravensthorpe South). As previously discussed, portions of the Ravensthorpe No. 2 and Ravensthorpe South Mine areas were sold to Glencore in 2013 prior to acquisition of Macquarie Generation by AGL in September 2014. Refer to Plan 1A which shows the current status of land ownership.



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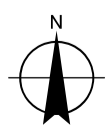
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- AGL Ownership
- COAL - CURRENT TITLES - AGL's share
- Ecosystem and Land Use Establishment
- Roads

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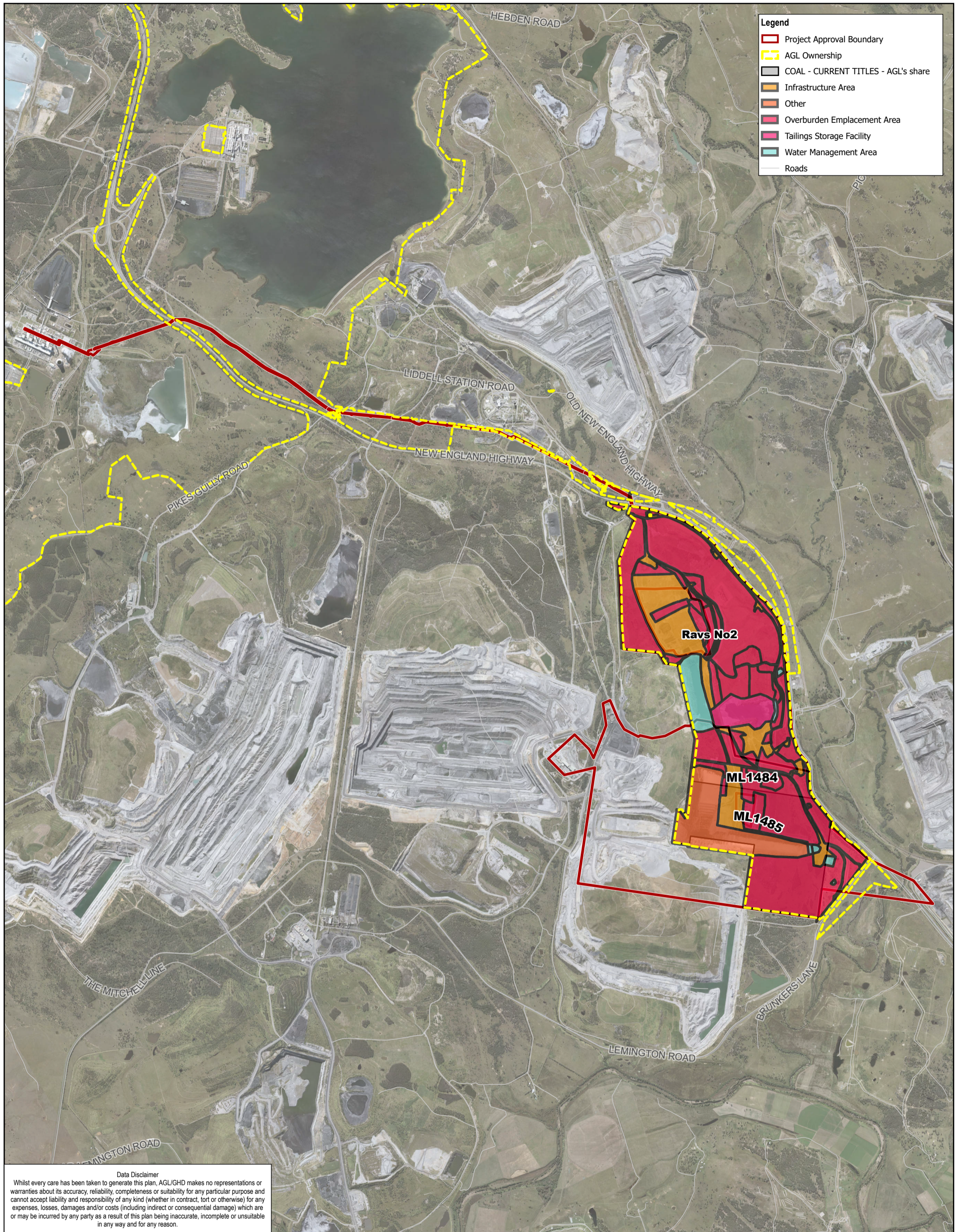


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 Ravensworth

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 Date **29/07/2022**

**Plan 1A
 Rehabilitation**

PLAN 1A.1



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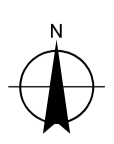
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- COAL - CURRENT TITLES - AGL's share
- Infrastructure Area
- Other
- Overburden Emplacement Area
- Tailings Storage Facility
- Water Management Area
- Roads

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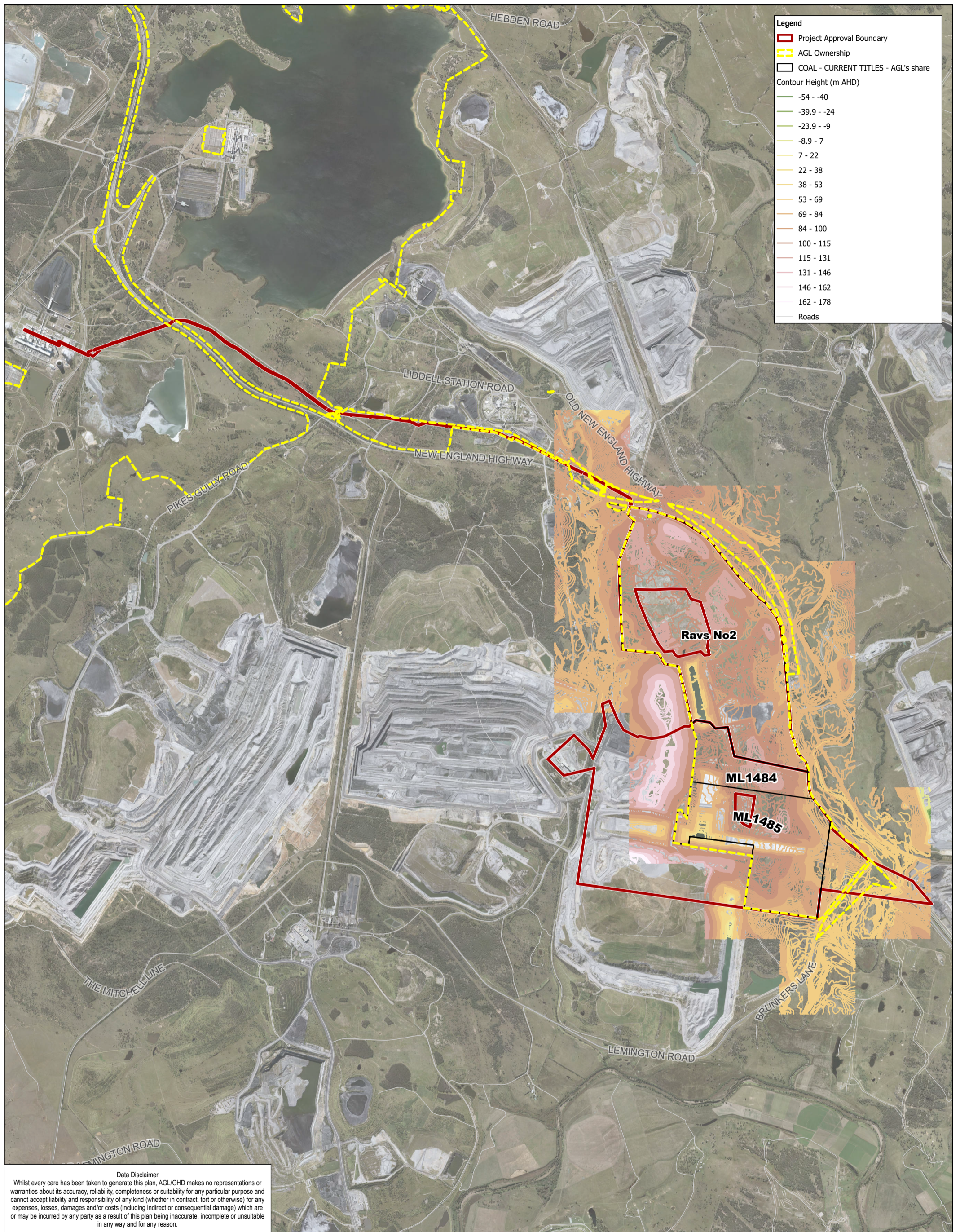


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**Plan 1A
 Disturbance**

PLAN 1A.2



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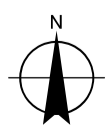
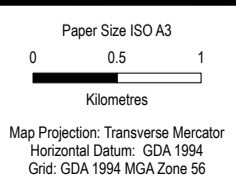
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- AGL Ownership
- COAL - CURRENT TITLES - AGL's share

Contour Height (m AHD)

- 54 - -40
- 39.9 - -24
- 23.9 - -9
- 8.9 - 7
- 7 - 22
- 22 - 38
- 38 - 53
- 53 - 69
- 69 - 84
- 84 - 100
- 100 - 115
- 115 - 131
- 131 - 146
- 146 - 162
- 162 - 178
- Roads

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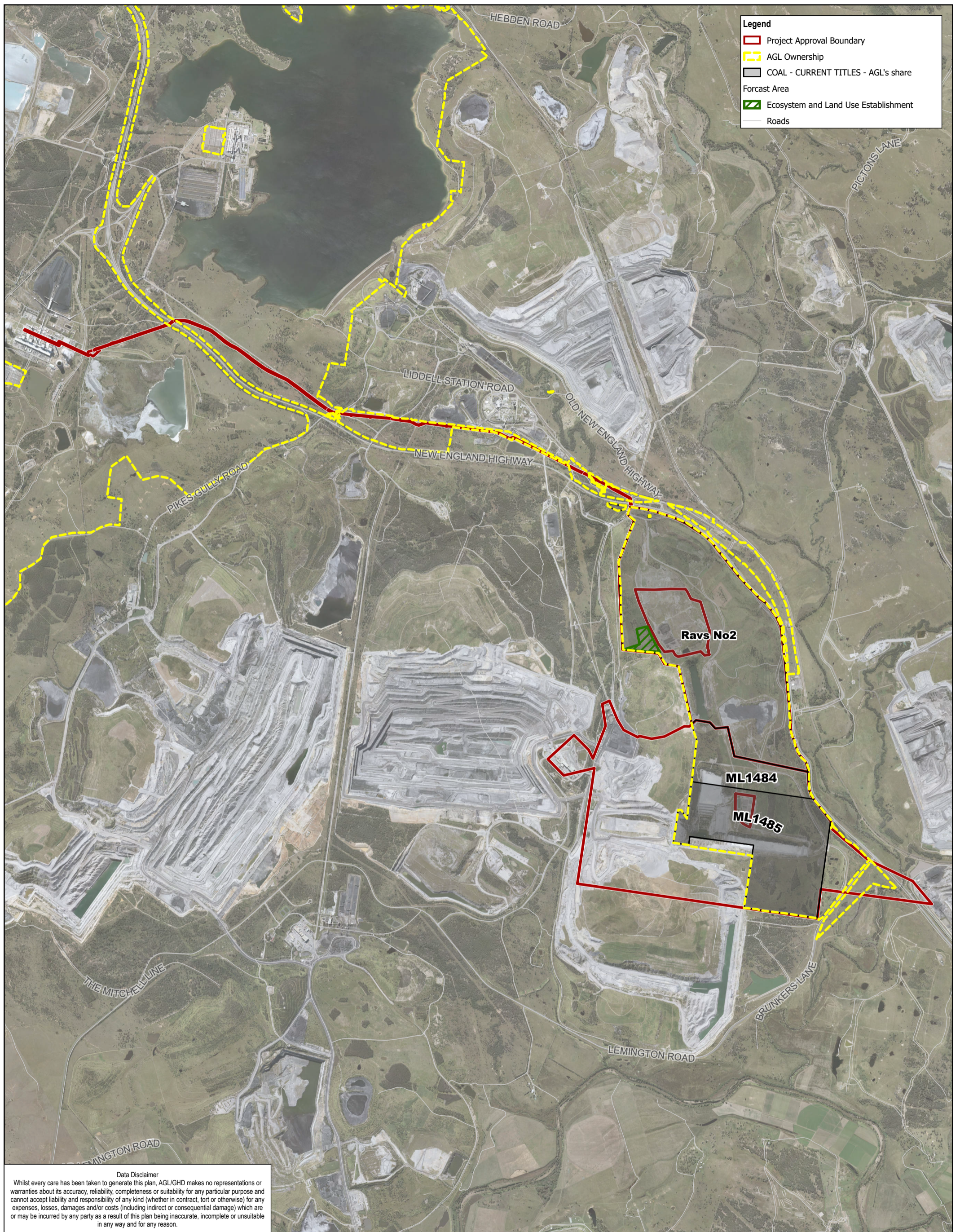


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Plan 1B
Current Landform Contours

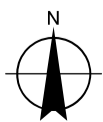
PLAN 1B



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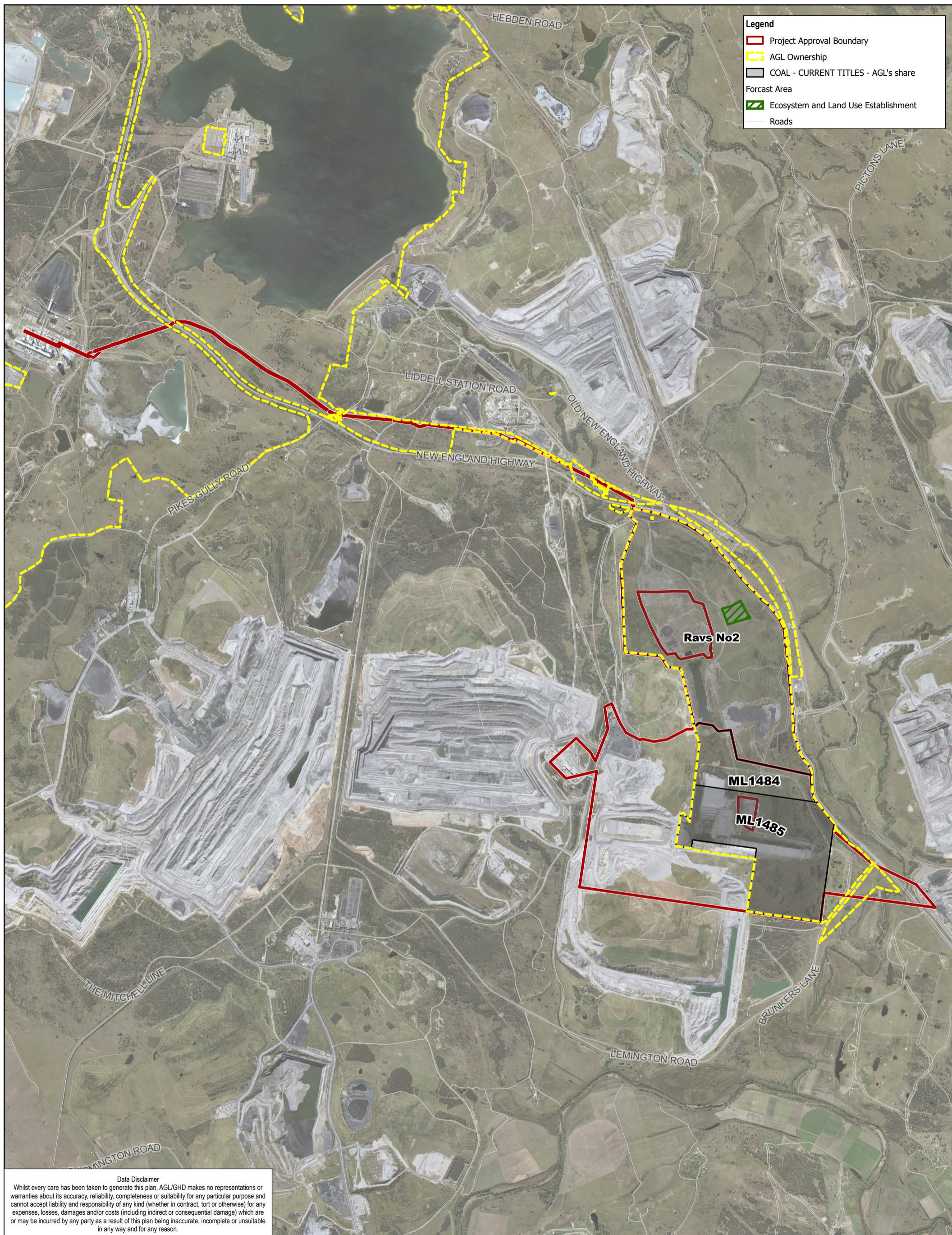


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Plan 2A
Mining and Rehabilitation
Year 1 (2023)

Project No. **12583536**
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PLAN 2A



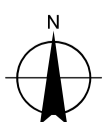
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- Project Approval Boundary
- AGL Ownership
- COAL - CURRENT TITLES - AGL's share
- Forecast Area
- Ecosystem and Land Use Establishment
- Roads

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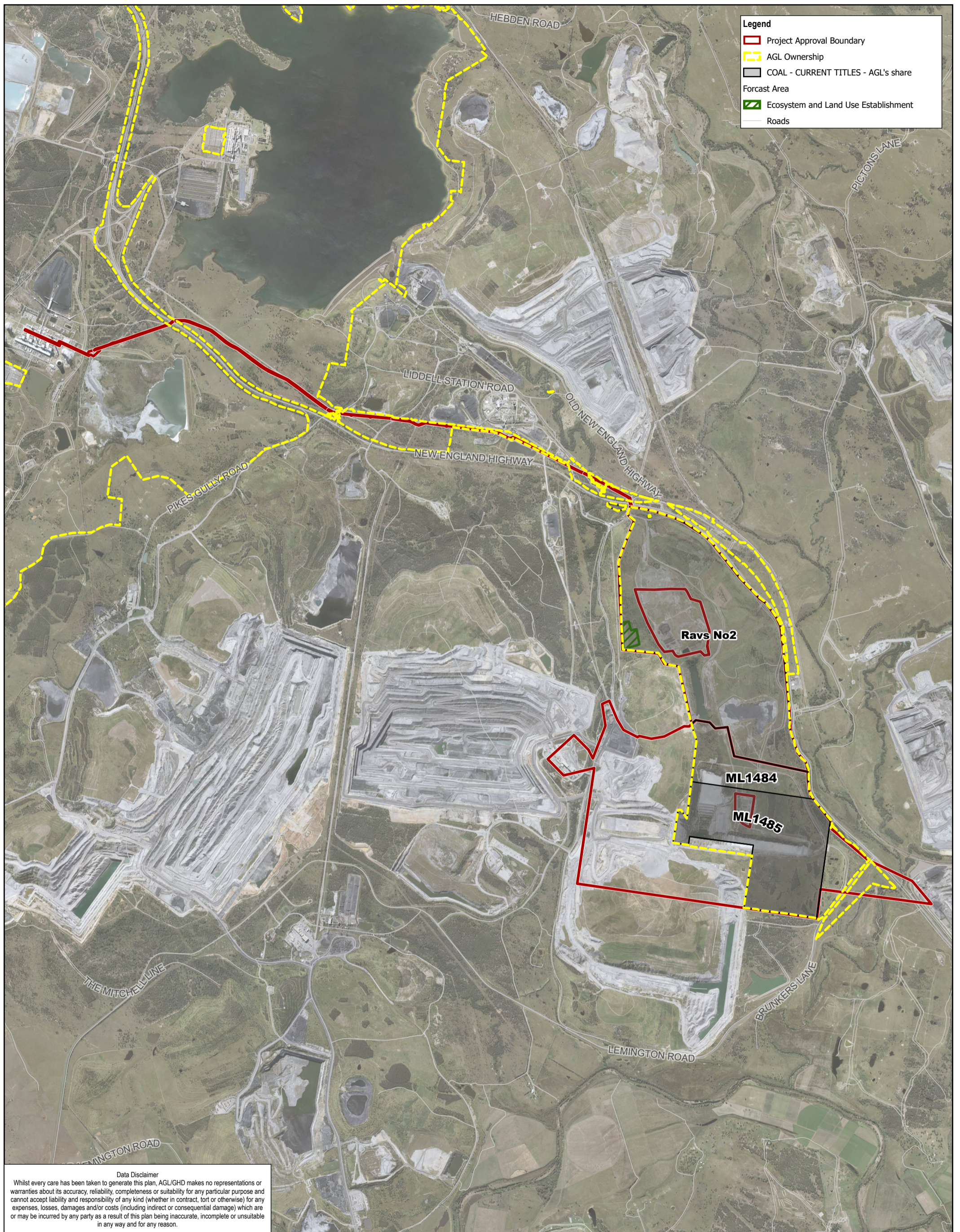
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Plan 2B
Mining and Rehabilitation
Year 2 (2024)

Project No. **12583536**
 Revision No. **0**
 Date **29/07/2022**

PLAN 2B



Legend

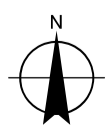
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Theme Submission ID: **2813**
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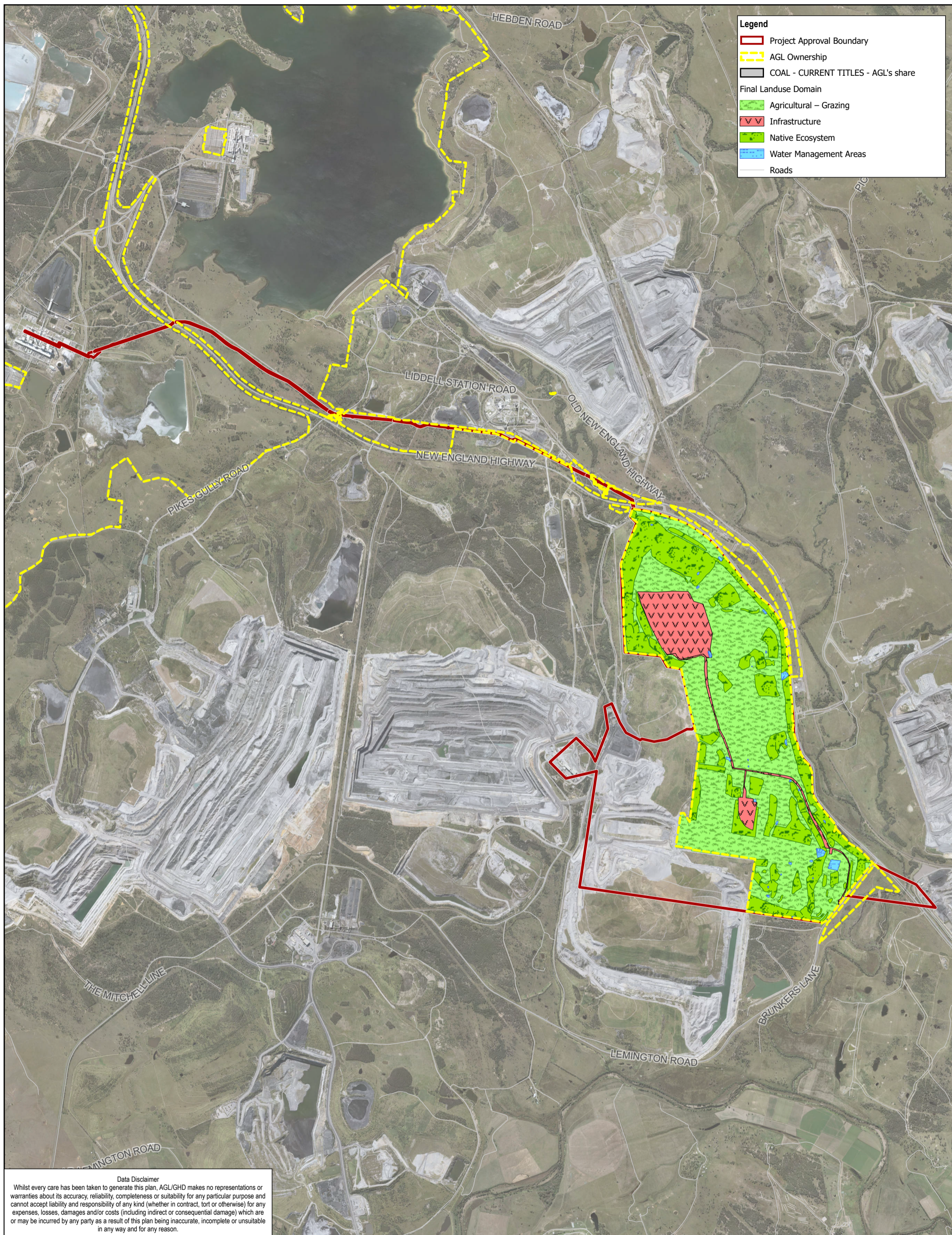


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Plan 2C
Mining and Rehabilitation
Year 3 (2025)

Project No. **12583536**
 Revision No. **0**
 Date **29/07/2022**

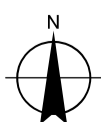
PLAN 2C



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Theme Submission ID: **2814**
 Annual Reporting Period: **2022**

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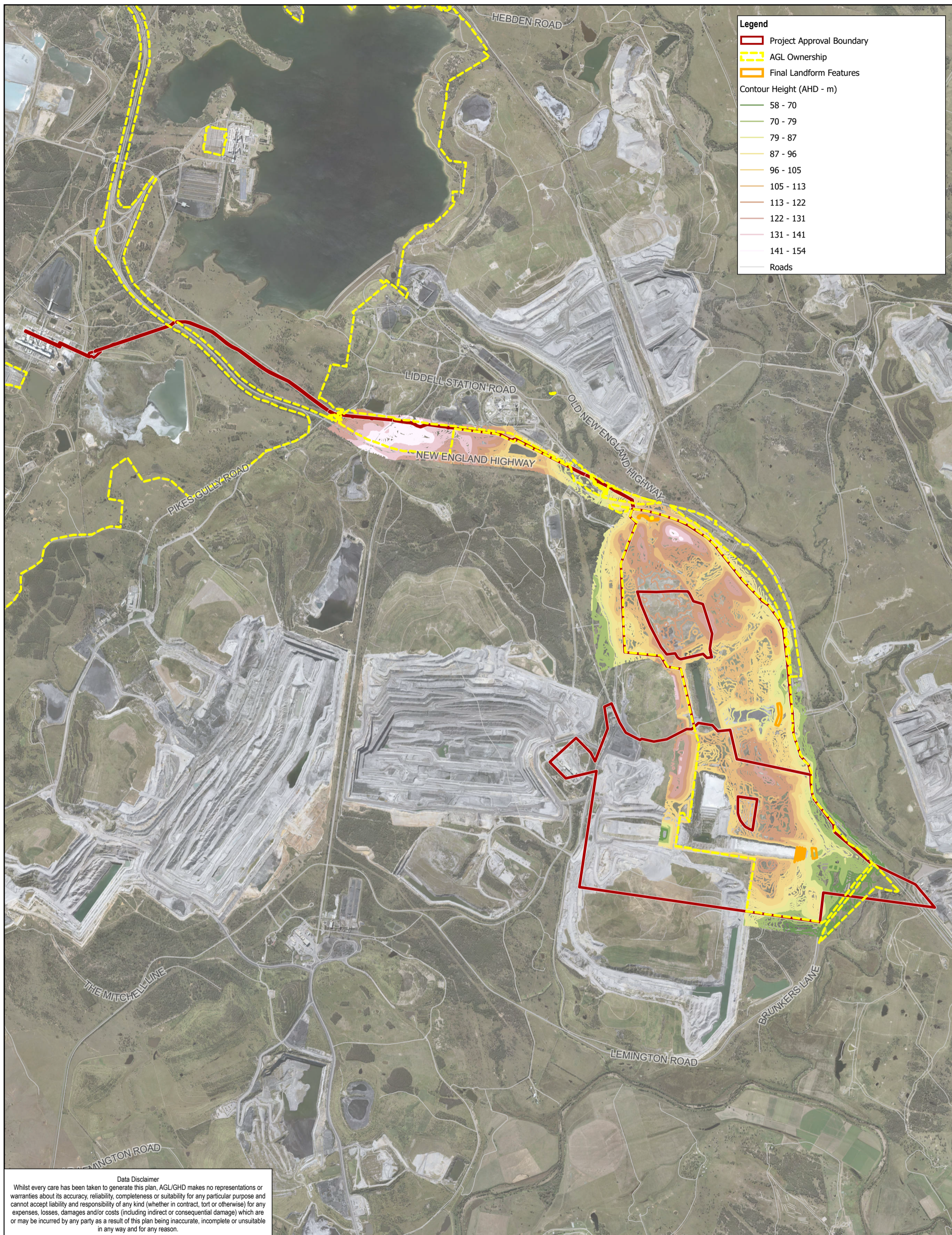


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 Date **29/07/2022**

Plan 3
Final Landuse

PLAN 3



Legend

- Project Approval Boundary
- AGL Ownership
- Final Landform Features

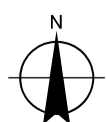
Contour Height (AHD - m)

- 58 - 70
- 70 - 79
- 79 - 87
- 87 - 96
- 96 - 105
- 105 - 113
- 113 - 122
- 122 - 131
- 131 - 141
- 141 - 154
- Roads

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Theme Submission ID: **2817**
 Annual Reporting Period: **2022**

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 Kilometres
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 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



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Plan 4
Final Landform

PLAN 4

2. Final land use

2.1. Regulatory requirements for rehabilitation

The regulatory requirements specific to post mining land use and rehabilitation outcomes across the project area are summarised in Table 2.

Table 2 Regulatory requirements - Post mining land use, landscape and rehabilitation outcomes

RMP Section	Section/Condition	Area	Requirement	Timeline
Project Approval				
Section 0	No. 2 EMP V1 and No. 2 EMP V2 (Ravensworth No. 2 Mine Fly Ash Disposal and Rehabilitation Environmental Management Plan Volume 1 and 2, 1993)	Excluded Area	Minimum standard for the majority of the site following the completion of ash disposal and rehabilitation activities is a Class 6 Land Capability Class ¹ according to the Land Capability Land Assessment Scheme (NSW Office of Environment & Heritage, Oct 2012)	Ongoing
Section 4.1	No. 2 EMP V1		Coverage of 70% pasture and 30% trees	Ongoing
Section 0	RSFVRP for ML 1484 and ML 1485	ML 1484 and ML 1485	Class 4 Land Capability	Ongoing
Section 0			Class 7 on land subjected to spontaneous combustion	Ongoing

The final land use was previously approved by the Resources Regulator on 29 June 2016 when the Ravensworth Mining Operations Plan for Ravensworth Ash Disposal Area (Rehabilitation Management Plan) (MOP) dated 20 June 2016 was approved. The land use specified in this approved plan is consistent with the requirements specified in Table 2.

The following goals underpin the post mining land use and landscape goal:

- Land will be rehabilitated in accordance with the relevant standards applicable at the time of rehabilitation;

- Rehabilitated land will represent a minimal source of offsite environmental impacts, such as dust, water pollution, visual amenity and weeds;
- Rehabilitated land will require ongoing management inputs no greater than similar adjacent land;
- To reinstate a viable drainage network on the site which is hydrologically stable and incorporates erosion controls and sediment collection dams which isolate effectively the rehabilitated area from adjoining area;
- Successful design and rehabilitation of landforms to ensure structural stability, revegetation success and containment of wastes; and
- Post-mining land use compatible with surrounding land uses, that provides optimal environmental, economic and community benefits.

2.2. Final land use options assessment

2.2.1. Final Land Use Assessment for the Excluded Area

According to Land and Soil Capability (NSW Office of Environment & Heritage, Oct 2012) system a Class 6 capability is suitable for grazing, forestry and nature conservation but requires careful management to prevent severe land and environmental degradation.

A Class 6 classification is warranted given the high risk of degradation if cultivation were to occur as per Class 1 to 3 and due to the sodic and saline nature of the soils creating the requirement for careful land management practices more consistent with Class 6. Cultivation would also bring the rock present in the overburden to the surface creating problems for equipment.

An additional consideration in using the Class 6 classification is the climatic conditions of the area. Review of the climatic data for the area shows that the rainfall is highly variable with an unreliable pattern that would create a significant risk if cultivation were to occur due to failure from reduced rainfall and erosion risk associated with bare ground.

There is a small area to the north of the site that is only suitable to nature conservation due to the steep topography and presence of mining infrastructure and therefore has been given a Class 8 rating. A Class 8 Land Capability is incapable of agricultural land use with limitations so severe the land cannot sustain anything other than nature conservation.

The final land use options are included in Table 3.

2.2.2. Final Land Use Assessment for ML 1484 and ML 1485

The sections of ML 1484 and ML 1485 that have been or are subjected to spontaneous combustion have been re-classified as Class 7 due to the significant vegetation mortality and are therefore not suitable for grazing until rectification works have been undertaken. Class 7 Land Capability is land generally incapable of agricultural land use with severe limitations that restrict most land uses aside from selective forestry and nature conservation.

The areas of Class 7 Land Capability may be altered to a higher capability dependent on soil testing and the ability for the land to support and sustain productive land uses such as grazing.

Final land use options are shown in Table 3, with Land and Soil Capability (LSC) classes noted in accordance with Land and Soil Capability (NSW Office of Environment & Heritage, Oct 2012).

Table 3 Final land use options

Area	Key considerations	LSC Class	Land use
Excluded area	<p>High risk of degradation if cultivation were to occur</p> <p>Sodic and saline nature of the soils</p> <p>Cultivation would bring the rock present in the overburden to the surface creating problems for equipment</p> <p>Climatic data for the area shows that the rainfall is highly variable with an unreliable pattern that would create a significant risk if cultivation were to occur due to failure from reduced rainfall and erosion risk associated with bare ground</p>	6	<p>Suitable for grazing, forestry and nature conservation</p> <p>Management required to prevent severe land and environmental degradation</p>
North of site	<p>Steep topography</p> <p>Presence of mining infrastructure</p>	8	Only suitable to nature conservation
Void 3	Suitable for construction and use for the composting facility.	-	<p>Composting facility</p> <p>Generating organic material for use in AGLM's rehabilitation of the Ravensworth sites, rehabilitation of other AGLM sites and sale to third parties</p> <p>The composting facility was approved in 2016 under DA 140/2016. The development consent was modified in 2018.</p> <p>AGLM will seek modification to the approved final land use under the <i>Mining Act 1992</i> to allow the composting facility to remain in place following completion of rehabilitation activities.</p>
ML 1484 and ML 1485	Moderate to high limitation for high-impact land uses such as cropping, high-intensity grazing and horticulture.	4	Suitable for grazing, forestry and nature conservation

Area	Key considerations	LSC Class	Land use
			Requires ongoing specialised management.
Ravensworth South Compost Facility	Suitable for construction and use for the composting facility.	-	<p>Composting facility</p> <p>Generating organic material for use in AGLM's rehabilitation of the Ravensworth sites, rehabilitation of other AGLM sites and sale to third parties</p> <p>The composting facility was approved in 2017 under DA 173/2016. The development consent was modified in 2019.</p> <p>AGLM will seek modification to the approved final land use under the <i>Mining Act 1992</i> to allow the composting facility to remain in place following completion of rehabilitation activities.</p>
ML 1484 and ML 1485 areas affected by spontaneous combustion	<p>Significant vegetation mortality</p> <p>Not suitable for grazing until rectification works have been undertaken</p>	7	<p>Incapable of agricultural land use</p> <p>May be altered to a higher capability dependent on soil testing and the ability for the land to support and sustain productive land uses such as grazing</p>

2.3. Final land use statement

The final land use and rehabilitation objectives for the Excluded Area and Ravensworth South Mine are outlined in No. 2 EMP V1, No. 2 EMP V2 and RSFVRP for ML 1484 and ML1485, and requires AGLM to rehabilitate the site to the satisfaction of the NSW Resources Regulator and therefore in accordance with the conditions imposed on the mining lease under the *Mining Act 1992*. The final land use of the Excluded Area and Ravensworth South Mine are Agriculture -Grazing (Pasture), Native Ecosystem (Grassland) and Native Ecosystem (Woodland).

2.4. Final land use and mining domains

Final land use and mining domains have been defined in accordance with the NSW Resources Regulator. The domains have a unique operational and functional purpose and therefore similar geophysical characteristics.

2.4.1. Final land use domains

The final land use domains are detailed in Table 4.

Table 4 Final land use domains

Final land use domains	Description
Water Management Area	<p>All large permanent dams and associated drainage lines and structures that have been made safe and stable and designed to fit into the final landform</p> <p>Provide water for grazing stock and habitat for aquatic ecology</p> <p>Locations aligned to requirements of daily movement of cattle (fencing, holding yards, paddock configuration)</p>
Native Ecosystem (Grassland)	Dam walls to the east of Void 4 and east of Void 5
Native Ecosystem (Woodland)	<p>Areas classed as woodland in the 30% trees as stated in the Rehabilitation Management Plan for Ravensworth No. 2 and Ravensworth South Final Void Plan for Ravensworth South</p> <p>Areas of woodland to be interconnected to form wildlife refuges and linkages across the site for arboreal and avian fauna</p> <p>Mid and overstorey woodland species provide refuge for cattle</p>
Agricultural – Grazing (Pasture)	<p>All pasture areas including capped ash emplacements and tailings</p> <p>Approximately 70% of the Ravensworth No. 2 and Ravensworth South sites</p>
Infrastructure	Waste organics handling, storage and processing areas with an access road from Lemington Road

2.4.2. Mining domains

The site has been split into mining domains for the purpose of rehabilitation. These domains are described in Table 5.

Table 5 Mining domains

Mining domains	Description
Other- Ash Emplacement Area	<p>Areas where active ash emplacement is occurring</p> <p>Void 5 predicted to be complete by 2032</p> <p>Void 4 to be filled from completion of Void 5, until end of station life</p> <p>Once completed, capping will occur and revegetation to pasture will occur</p>
Tailings Storage Facility	<p>Void 4 east where Ashton Coal are depositing tailings. This domain will remain in place until the tailings dam has been capped and rehabilitated by Ashton Coal to the satisfaction of AGLM (Ashton Coal and Macquarie Generation, 2006). At this stage disposal of tailings into Void 4 east is planned for completion in 2026 with rehabilitation works planned to commence in 2028 and relinquishment in 2034.</p>
Infrastructure area	<p>Roads, hardstand areas, Glencore's Gas drainage facilities, composting facilities on the Capped Void 3 area and east of Void 5 and the access road and exempt waste handing areas, tailings lines and pipelines</p>
Water Management Area	<p>Constructed walls to the east of Void 4 and Void 5. Walls will be revegetated to create a safe and stable landform resistant to erosion that satisfies the requirements of the Dam Safety Committee. Fence to isolate from livestock.</p> <p>Allows for containment of ash impacted water in Void 4, sediment containment and long term water supply for grazing cattle</p>
Overburden emplacement area	<p>This domain includes areas impacted by spontaneous combustion either historically or currently. These areas will undergo monitoring and remediation towards a final land use domain.</p> <p>This domain also includes formally rehabilitation areas that are undergoing rehabilitation management works.</p>

3. Rehabilitation risk assessment

In accordance with Form and Way: Rehabilitation Management Plans for Large Mines guideline (NSW Resources Regulator, 2021) a Rehabilitation Risk Assessment (RRA) was conducted to evaluate the environmental issues associated with the mining operations. The aim of the RRA is to identify and present effective management protocols for environmental risks to rehabilitation. The following specific aims and objectives have been established for the RRA are:

- To identify the activities, aspects and possible impacts to rehabilitation throughout the rehabilitation phases.
- To identify the current controls (that are already in place) to mitigate or minimise the potential for the impacts in order to reduce the risk to as low as reasonably practicable.
- To identify potential controls that may assist to either eliminate or mitigate other likely impacts.
- Determine the residual risk and ensure that it is appropriately low enough given the sensitivities of the project location.
- To identify where each risk and associated risk control is addressed in the RMP

3.1. Rehabilitation risk assessment methodology

A bowtie risk assessment process was followed utilising the existing RRA to update and meet the requirements for NSW Resources Regulator. The bowtie was developed using BowtieXP (version 11.0.1) software and was pre-populated prior to the workshop with the knowledge from the previous RRA and the guidance material provided by the regulator. The bowtie was then reviewed in a workshop held on the 1st June 2022.

The workshop was facilitated by an independent risk advisor and used the experience of those in attendance to demonstrate site knowledge and experience.

3.2. Risk workshop outcomes

3.2.1. Scope

The center of the bowtie (i.e. hazard) was defined as: Failure to relinquish site and successfully rehabilitate.

In scope:

- Mine Lease areas of Ravensworth South (AGL owned land) and the excluded areas (former Ravensworth No. 2 AGL owned land).
- Ash pipes.
- Ashton's tailings site.

Out of scope:

- Non AGL land (i.e. Glencore owned).
- Glencore operations including the gas drained infrastructure.
- Compost facilities (one located in the excluded area and the other in the Mine Lease area).
- Ausgrid assets (powerlines and switchyard subject to formal easements)
- Transgrid formalised easements.

3.2.2. Causes

Causes were grouped into pathways based on the stage of rehabilitation. The stages were taken from the Guideline for Rehabilitation Risk Assessment (Version 1) by the NSW Resource Regulator, Table 1. A total of 21 causes were identified.

3.2.3. Controls

A total of 52 controls were identified. This included both existing and potential future controls (these were marked with an orange band on top of the control).

The effectiveness of each control was assessed for existing controls only.

3.2.4. Critical Controls

Critical controls were selected based on the ICMM guidelines (International Council on Mining Minerals 2015, Health and Safety Critical Control Management: Good Practice Guide) for critical control selection.

A total of two critical controls were selected on the bowtie diagram and are marked with a red band. These were

- Progressive rehabilitation (annually)
- Environmental monitoring

3.2.5. Consequences

A list of the potential consequences with the associated inherent risk rating (without controls) and residual risk rating (with current controls in place) is listed in Table 6 Risks can be further reduced following implementation of the potential controls.

Table 6 Consequences from RRA.

Table 6 Consequences from RRA

Consequence	Inherent risk rating	Residual risk rating
Financial impacts	Very High	High
Regulatory impacts	Very High	Moderate

Consequence	Inherent risk rating	Residual risk rating
Environmental impacts	Very High	High
Social licence impacts	High	Moderate
Reputational impacts	High	Moderate

3.2.6. Bowtie Diagram

The RRA bowtie diagram is included in Appendix B.

4. Rehabilitation objectives and rehabilitation completion criteria

4.1. Rehabilitation objectives and rehabilitation completion criteria

In order to achieve the rehabilitation objectives specified in this plan, AGLM has divided the areas to be rehabilitated into specific domains and each domain will be assessed and rehabilitated as per the management measures detailed in this RMP. Each domain and their proposed rehabilitation objectives, performance indicators and completion criteria are discussed in **Error! Reference source not found.8**.

The rehabilitation objectives for final landform and landscape for the site are summarised in Table 7.

Table 7 Rehabilitation objectives

Feature	Objective
General	<ul style="list-style-type: none"> Land will be rehabilitated in accordance with relevant NSW Resources Regulator standards applicable at the time of rehabilitation. Rehabilitated land will represent a minimal source of offsite environmental impacts, such as dust, water pollution, visual amenity, weeds and odour. Rehabilitated land will require ongoing management inputs no greater than similar adjacent land. Rehabilitation will be compatible with the proposed post-mining land-use.
Landform	<ul style="list-style-type: none"> Rehabilitated land will be safe and stable. Land and soil capability comparable to that pre-mining. Areas impacted by spontaneous combustion will be stabilised to the extent that a growing media and plant community can be developed. Land will be re-contoured to a landform compatible with the surrounding natural landscape. Reinstatement of a stable drainage network.
Growing media	A sustainable vegetation cover will be established on rehabilitated land (soils).
Vegetation	<ul style="list-style-type: none"> Growing media would be established on the rehabilitated land, fertilised and sown with pasture and/or native vegetation species. A sustainable vegetation cover will be established on rehabilitated land. Grazing areas will be established with a range of species suitable for pasture production in the area.

Feature	Objective
	<ul style="list-style-type: none"> Tree areas will be established with native species by either direct seeding or tubestock planting techniques.
Infrastructure	<ul style="list-style-type: none"> Infrastructure which has no use post the rehabilitation works including roads, will be removed and rehabilitated. Footings are only required to be removed to the existing ground level only, covered with a minimum of 0.5 metres of fill and rehabilitated. Electricity supply infrastructure (overhead lines, poles, substations, etc.) will be removed.

The rehabilitation completion criteria have been prepared to set the benchmark values for key indicators, to demonstrate that rehabilitation objectives have been met. Completion criteria provides a defined end point at which time rehabilitation can be deemed successful and the mining lease relinquishment process can proceed. The rehabilitation completion criteria have been developed to be consistent with the proposed final land use for the site.

This information is provided for all defined final land use domains in Section 2.4.1. Table 8 summarises rehabilitation objectives and completion criteria for the Ravensworth mining leases relinquishment.



Table 8 Rehabilitation completion criteria

Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
Agricultural – grazing (pasture)	Infrastructure; Other (ash emplacement); Tailings emplacement area; Water management area	Removal of infrastructure: All infrastructure that is not to be used as part of the final land use is removed to ensure the site is safe and free of hazardous materials.	Removal of all services (power, water, communications) that have been connected on the site as part of the operation.	All relevant utility infrastructure removed.	Statement provided, utility service disconnection record / notification.
			Removal of all footings or removal to a certain depth.	Footings removed and or removed to specific depths to avoid impacting pathways to subsequent final land use.	Surveyed and marked on as-constructed final landform plan.
			Removal of hardstand areas, roads, park up areas to be ripped with waste material removed from site.	Infrastructure removed	As-constructed final landform plan, photos, decommissioning reports etc.
			Removal of all ash and return water pipelines.	Pipes removed No ash slurry present on surface in former areas of pipe corridor	Statement provided and before/after photos



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
			Remove all chemicals and hazardous substances from the site.	All hazardous materials removed from site	Statement provided and before/after photos
			Removal of all water management infrastructure (including pumps, pipes and power).	Infrastructure removed.	Statement provided and before/after photos.
Native ecosystem (woodland)	Infrastructure;	Removal of infrastructure: All infrastructure that is not to be used as part of the final land use is removed to ensure the site is safe and free of hazardous materials.	Removal of all services (power, water, communications) that have been connected on the site as part of the operation.	All utility infrastructure removed.	Statement provided, utility service disconnection record / notification.
			Removal of all footings or removal to a certain depth.	Footings removed and or removed to specific depths to avoid impacting pathways to subsequent final land use.	Surveyed and marked on as-constructed final landform plan.
			Removal of hardstand areas, roads, park up areas to be ripped with waste material removed from site.	Infrastructure removed	As-constructed final landform plan, photos, decommissioning reports etc.



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
			Removal of all ash pipelines.	Pipes removed No ash slurry present on surface in former areas of pipe corridor	Statement provided and before/after photos
			Remove all chemicals and hazardous substances from the site.	All hazardous materials removed from site	Statement provided and before/after photos
Agricultural – grazing (pasture)	Infrastructure; Other (ash emplacement); Tailings emplacement area; Water management area	Retention of infrastructure: All infrastructure that is to remain as part of the final land use is safe and does not pose any hazard to the community.	Potential hazards (e.g. electrical, mechanical) have been effectively isolated and secured.	Hazards isolated and secured.	Statement provided by suitably qualified engineer.
			If any underground pipelines or other infrastructure are to remain in situ, they do not pose a hazard for the intended final land use.	The location of the infrastructure has been marked on a plan and registered with the relevant local authority (e.g. local Council) and Dial Before You Dig. Formal acceptance from the subsequent landowner that	Surveyed and marked on the as-constructed final landform plan. Copy of notification to local Council and Dial Before You Dig



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
				underground infrastructure has been left in a condition that is suitable for the intended final land use in accordance with formal agreement.	Formal acceptance from landowner. Identified on an appropriate legal instrument associated with the land title.
			Damage to access tracks has been repaired and stabilised.	Damage to access tracks has been repaired and stabilised.	Damage to access tracks has been repaired and stabilised.
Native ecosystem (woodland)	Infrastructure;	Retention of infrastructure: All infrastructure that is to remain as part of the final land use is safe and does not pose any hazard to the community.	Potential hazards (e.g. electrical, mechanical) have been effectively isolated and secured.	Hazards isolated and secured.	Statement provided by suitably qualified engineer.
			If any underground pipelines or other infrastructure are to remain in situ, they do not pose a hazard for the intended final land use.	The location of the infrastructure has been marked on a plan and registered with the relevant local authority (e.g. local Council) and Dial Before You Dig. Formal acceptance from the subsequent landowner that underground infrastructure has been left in a condition that is	Surveyed and marked on the as-constructed final landform plan. Copy of notification to local Council and Dial Before You Dig Formal acceptance from landowner.



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
				suitable for the intended final land use in accordance with formal agreement.	Identified on an appropriate legal instrument associated with the land title.
			Damage to access tracks has been repaired and stabilised.	Damage to access tracks has been repaired and stabilised.	Damage to access tracks has been repaired and stabilised.
Infrastructure	Infrastructure	Retention of infrastructure: All infrastructure that is to remain as part of the final land use is safe and does not pose any hazard to the community.	Where applicable, necessary approvals are in place (e.g. development consent under the Environmental Planning and Assessment Act 1979) where buildings and infrastructure are to be retained as part of final land use.	Permits and approval documents issued.	Copy of any relevant approvals.
			The structural integrity of the infrastructure is suitable and safe for use as part of the	The structural integrity of the infrastructure has been inspected by a suitably qualified engineer and determined to be suitable	Engineering report/statement, photos, risk assessment verifying modes of failure are adequately addressed to



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
			intended final land use.	and safe as part of the intended final land use.	minimise risks to public safety or the environment.
		<p>Remaining composting areas:</p> <p>Composting infrastructure on site will be appropriately managed to ensure safe landform and does not pose a risk of environmental harm</p>	<p>Leachate dams in place and managed in accordance with the Composting Guidelines to contain a 1 in 10 yr 24 hour storm</p> <p>Leachate dams isolated from stock areas</p> <p>Irrigation areas managed in accordance with the Environmental Protection licenses</p>	Leachate managed in accordance with the Composting guidelines, development consent for composting facility and EPLs.	Provision of consent and licence documentation
			<p>Hardstand areas maintained in accordance with the composting guidelines</p> <p>Hardstand areas isolated from stock, fences in working order</p>	Hardstand accepted as in good condition by landowner	Formal acceptance from landowner (commercial agreement in place between AGL and composting facility operator)



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
Agricultural – grazing (pasture)	Infrastructure; Other (ash emplacement); Tailings emplacement area; Water management area	Land Contamination: There is no residual soil contamination on site that is incompatible with the final land use or that poses a threat of environmental harm.	Waste material and/or visible contamination areas on site surface.	There are no visible signs of contamination following the removal of plant, equipment and materials. All rubbish/ waste materials removed from site.	Statement provided and before/after photos.
			Soil testing for contaminants of concern as listed by Health Investigation Level of the National Environment Protection (Assessment of Site Contamination) Measure (1999) applicable to land use type or other relevant guideline/s.	Contamination will be appropriately remediated so that appropriate guidelines for land use are met, e.g. Health Investigation Level of the National Environment Protection (Assessment of Site Contamination) Measure (1999) or other relevant guideline/s. Excess sludge/material has been removed from surface water dams.	Validation Report prepared by a suitably qualified person in accordance with NSW EPA Guidelines.
		Management of waste and process materials:	Visual –capping material placement,	Visual – verification that capping, type and placement consistent with design	Photos, rehabilitation monitoring reports, as-constructed surveys,



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
		<p>Residual waste materials stored on site (ash dam) will be appropriately contained / encapsulated so it does not pose any hazards or constraints for intended land use.</p>	<p>type across emplacement</p> <p>Visual – indication of capping performance on final landform – vegetation health</p> <p>Measured - survey of emplacement capping to verify construction and to monitor settlement.</p> <p>Quality assurance records for the construction of the emplacement material including (where relevant) capping material etc</p> <p>Measured- surface and groundwater levels to verify water balance modelling and capping function</p> <p>Surface and groundwater quality surrounding</p>	<p>Visual – no signs of compromised capping performance indicated by vegetation health</p> <p>Visual – no areas of unexpected seepage</p> <p>Survey verifies that capping placement consistent with design and settlement and/or material loss is within predicted limits and will not compromise final landform drainage via differential settlement.</p> <p>Quality assurance records verify capping constructed and in accordance with design specifications relevant to site risks and target final land use. For example:</p> <ul style="list-style-type: none"> • Ash Capping depth – 400mm • Capping material type as per specification <p>Groundwater and surface monitoring verify capping function e.g. ‘store and release’</p>	<p>quality assurance records for construction, erosion surveys, independent geotechnical reports (where required), groundwater/surface water monitoring reports.</p> <p>The structural integrity of the infrastructure and capping has been inspected by a suitably qualified engineer and determined to be suitable and safe as part of the intended final land use and water material adequately contained.</p>



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
			<p>emplacements consistent with modelled/predicted quality in relevant environmental assessments.</p>	<p>and design performance permeability/seepage. Groundwater and surface water monitoring surface and groundwater quality consistent with predicted quality.</p>	
		<p>Landform Stability: The final landform is stable for the long-term and does not present a risk of environmental harm downstream/downslope of the site or a safety risk to the public/stock/native fauna. Landform that is commensurate with surrounding natural landform and where appropriate, incorporates geomorphic design principles.</p>	<p>Visual - indicators of erosion and land instability. Visual - indicators that surface water management structure are functioning as designed. Measured - Survey of rehabilitated landform to verify final landform construction in accordance with Final Landform and Rehabilitation Plan6. Measured - survey of rehabilitated landform to specifically monitor</p>	<p>Visual- minimal erosion that would not require moderate to significant ongoing management and maintenance works. Visual – no signs of land instability such as mass movement. Visual - no areas of active gully erosion. No gullies greater than 20cm depth over transects Visual - no evidence of tunnel erosion. Visual – no evidence of active scour likely to compromise surface water management structure.</p>	<p>Before and after photos, rehabilitation monitoring reports, as-constructed surveys, erosion surveys, independent geotechnical reports (where required).</p>



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
			settlement, subsidence due to third party activities and/or material loss via erosion.	<p>Survey verifies final landform complies with final landform construction in accordance with Final Landform and Rehabilitation Plan.6</p> <p>Survey verifies that settlement and/or material loss is within predicted limits and will not compromise final landform drainage via differential settlement.</p>	
				Significant surface water management structures have been constructed in accordance with hydrological design.	An engineering assessment undertaken by a suitably qualified person concludes that significant surface water management structures have been constructed in accordance with hydrological design.
Natural ecosystem (woodland)	Infrastructure;	Land Contamination: There is no residual soil contamination on site that is incompatible with the final land use	Waste material and/or visible contamination areas on site surface.	There are no visible signs of contamination following the removal of plant, equipment and materials.	Statement provided and before/after photos.



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
		or that poses a threat of environmental harm.		All rubbish/ waste materials removed from site.	
			Soil testing for contaminants of concern as listed by Health Investigation Level of the National Environment Protection (Assessment of Site Contamination) Measure (1999) applicable to land use type or other relevant guideline/s.	Contamination will be appropriately remediated, if required so that appropriate guidelines for land use are met, e.g. Health Investigation Level of the National Environment Protection (Assessment of Site Contamination) Measure (1999) or other relevant guideline/s. Excess sludge/material has been removed from surface water dams.	Validation Report prepared by a suitably qualified person in accordance with NSW EPA Guidelines.
		<p>Landform Stability: The final landform is stable for the long-term and does not present a risk of environmental harm downstream/downslope of the site or a safety risk to the public/stock/native fauna.</p> <p>Landform that is commensurate with surrounding natural landform and</p>	<p>Visual - indicators of erosion and land instability.</p> <p>Visual - indicators that surface water management structure are functioning as designed.</p> <p>Measured - Survey of rehabilitated landform</p>	<p>Visual- minimal erosion that would not require moderate to significant ongoing management and maintenance works.</p> <p>Visual – no signs of land instability such as mass movement.</p> <p>Visual - no areas of active gully erosion.</p>	Before and after photos, rehabilitation monitoring reports, as-constructed surveys, erosion surveys, independent geotechnical reports (where required).



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
		<p>where appropriate, incorporates geomorphic design principles.</p>	<p>to verify final landform construction in accordance with Final Landform and Rehabilitation Plan 6.</p> <p>Measured - survey of rehabilitated landform to specifically monitor settlement and/or material loss via erosion.</p>	<p>No gullies greater than 20cm depth over transects</p> <p>Visual - no evidence of tunnel erosion.</p> <p>Visual – no evidence of active scour likely to compromise surface water management structure.</p> <p>Survey verifies final landform complies with final landform construction in accordance with Final Landform and Rehabilitation Plan.6</p> <p>Survey verifies that settlement and/or material loss is within predicted limits and will not compromise final landform drainage via differential settlement.</p> <p>Erosion rate monitoring (visual) verifies that erosion levels are within the range of target analogue sites representative of final land use.</p>	



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
				Significant surface water management structures have been constructed in accordance with hydrological design.	An engineering assessment undertaken by a suitably qualified person concludes that significant surface water management structures have been constructed in accordance with hydrological design.
Agricultural – grazing (pasture)	Infrastructure; Other (ash emplacement); Tailings emplacement area; Water management area	Bushfire: The risk of bushfire and impacts to the community, environment and infrastructure has been addressed as part of rehabilitation.	Appropriate bushfire hazard controls (where required) have been implemented on the advice from the NSW Rural Fire Service.	Bushfire controls implemented.	Statement provided and before/after photos.
		Spontaneous Combustion: The risk of spontaneous combustion and impacts on rehabilitated areas has been addressed.	Areas no longer show up on thermal scan No visible subsidence cracking.	No areas show up on thermal scan All subsidence cracking repaired by filling or ripping	Thermal scan reports Subsidence inspection and maintenance reports



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
		<p>Surface Water:</p> <p>Runoff water quality from mine site is similar to, or better than the pre-disturbance runoff water quality.</p>	<p>Water quality parameters selected from Environment Protection Licence (further guidance available on NSW Environment Protection Authority website).</p>	<p>Water quality discharged from rehabilitated mining operation meet specifications in Environment Protection Licence.</p>	<p>Water quality monitoring reports.</p> <p>Environment Protection Licence relinquished by Environment Protection Authority.</p> <p>Independent hydrological assessment report.</p>
		<p>Water Approvals</p> <p>Structures that take or divert water such as final voids, dams etc. are appropriately licensed (e.g. under the <i>Water Management Act 2000</i>) and where required ensure sufficient licence shares are held in the water source(s) to account for water take.</p>	<p>Final landform considers advice from relevant Government Agency whether sufficient licence shares are available in the water source to account for water stored in voids and dams in the proposed final landform.</p>	<p>Water approvals / licences are granted by relevant NSW Government Agency.</p>	<p>Confirmation from relevant Government Agency that relevant water approvals / licences are able to be granted.</p>
		<p>Groundwater Quality</p> <p>Groundwater quality is similar to, or better than the predicted/modelled</p>	<p>Water quality parameters included in environmental assessments for the</p>	<p>Water quality discharged from rehabilitated mining operation meet specifications in environmental assessment</p>	<p>Independent hydrological assessment report.</p> <p>Groundwater Monitoring results</p>



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
		groundwater quality in relevant assessment documents.	projector Environment Protection Licence).	and/or Environment Protection Licence.	
Natural ecosystem (woodland)	Infrastructure;	<p>Bushfire:</p> <p>The risk of bushfire and impacts to the community, environment and infrastructure has been addressed as part of rehabilitation.</p>	Appropriate bushfire hazard controls (where required) have been implemented on the advice from the NSW Rural Fire Service.	Bushfire controls implemented.	Statement provided and before/after photos.
		<p>Surface Water:</p> <p>Runoff water quality from mine site is similar to, or better water quality predicted or modelled in relevant environmental assessments.</p>	Water quality parameters detailed in environmental assessment documentation (Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 and or Environment Protection Licence (further guidance available on NSW Environment Protection Authority website).	Water quality discharged from rehabilitated mining operation meet specifications in environmental assessments and/or Environment Protection Licence and/or ANZECC guidelines for specific environment.	<p>Water quality monitoring reports.</p> <p>Environment Protection Licence relinquished by Environment Protection Authority.</p> <p>Independent hydrological assessment report.</p>



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
		<p>Groundwater Quality</p> <p>Groundwater quality is similar to, or better than water quality predicted in environmental assessments for the project.</p>	<p>Water quality parameters included in the project environmental assessment and/or EPL (Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 and or Environment Protection Licence (further guidance available on the NSW Environment Protection Authority website).</p>	<p>Water quality discharged from rehabilitated mining operation meet values predicted in environmental assessment and/or Environment Protection Licence and or ANZECC guidelines for specific environment.</p>	<p>Independent hydrological assessment report.</p> <p>Groundwater monitoring reports.</p>
Agricultural – grazing (pasture)	<p>Infrastructure;</p> <p>Other (ash emplacement);</p> <p>Tailings emplacement area;</p> <p>Water management area</p>	<p>Agricultural Revegetation:</p> <p>Revegetation is sustainable for the long-term and only requires maintenance that is consistent with the intended final land use.</p> <p>Land use capability is capable of supporting the target agricultural land use.</p>	<p>Routine soil testing indicates no key deficiencies that could prevent or affect pasture vegetation establishment, health and production.</p>	<p>Rural land classification system – criteria specified in environmental assessments met.</p> <p>Routine soil testing indicates no key deficiencies that could prevent or affect pasture vegetation establishment, health and production</p>	<p>Transect photos, rehabilitation monitoring reports</p>



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
				<p>Minimum 70% productive groundcover (live and litter cover)</p> <p>Less than 20% of foliage cover of pasture weeds (weeds listed Weedwise, Hunter Region).</p> <p>>75%of herbage cover is provided by grasses and legumes suitable for grazing</p> <p>Total herbage mass of pasture areas – >1,500 kg DM/ha pre introduction of cattle for grazing or comparable to reference sites (biomass of desirable pasture species only)</p>	Transect photos, rehabilitation monitoring reports
Natural ecosystem (woodland)	Infrastructure;	Ecological rehabilitation objective 1: The vegetation composition of the rehabilitation is recognisable as trees over pasture and corridor/shelter belts where able.	Vegetation composition recorded at fixed monitoring transect are comparable to are comparable to woodland vegetation for the Excluded area and Ravensworth South area.	<p>Excluded area (Ravensworth No2):</p> <p>Tree layer comprised of NSW native tree species</p> <p>Ravensworth South (ML1484 and 1485):</p> <p>Tree and shrub layers comprised of NSW native species</p>	Transect photos, rehabilitation monitoring reports



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
		<p>Ecological rehabilitation objective 2: The vegetation structure of the rehabilitation is recognisable as, or is trending towards (based on ongoing monitoring data) woodland/ trees over pasture.</p>	<p>Cover and abundance of trees and shrub species recorded from fixed monitoring transect are comparable to woodland vegetation for the Excluded area and Ravensworth South area.</p>	<p>Excluded area (Ravensworth No2): Minimum per ha 400 tree stems >5cm DBH ('tree' species consistent with NSW BAM definition) Ravensworth South (ML1484 and 1485): Minimum per ha 400 tree stems >5cm DBH ('tree' species consistent with NSW BAM definition) Presence of two minimum shrub species ('shrub' species consistent with NSW BAM definition)</p>	<p>Transect photos, rehabilitation monitoring reports</p>
				<p>GIS studies confirm woodland has been established in accordance with approved final land use mapping, and suitable for fauna species movement.</p>	<p>Aerial survey</p>
		<p>Ecological rehabilitation objective 3: Levels of ecosystem function have been established that demonstrate the rehabilitation is self-sustainable.</p>	<p>Ground cover % and litter cover % as a representation of nutrient cycling</p>	<p>Protective groundcover >70% combined live and litter</p>	<p>Transect photos, rehabilitation monitoring reports</p>



Final land use domain	Mining domain	Rehabilitation objectives	Performance indicators	Completion criteria	Justification/validation method
			Evidence of plant regeneration from fixed monitoring transects or a walk over of the ecological rehabilitation area	Evidence of reproductive structures and/or second-generation individuals for native trees and shrubs	Transect photos, rehabilitation monitoring reports
			Cover of exotic species within fixed monitoring transects is low	Total cumulative projected foliage cover of weeds <20% (inclusive of all strata) (weeds listed Weedwise, Hunter Region).	Transect photos, rehabilitation monitoring reports
			Habitat features	Habitat features have been established, rock piles, nest boxes etc	Transect photos, rehabilitation monitoring reports

4.2. Rehabilitation objectives and rehabilitation completion criteria – stakeholder consultation

Consultation was undertaken with various stakeholders in the development of the final landform during the Environmental Assessment process. Consultation and outcomes related to the proposed modification to DA 86/51 are detailed in Table 9.

Table 9 Stakeholder Consultation

Stakeholder	Date	Comments	Action Plan
Resources Regulator	4 May 2022	<p>Site visit held to run through the Proposed Modification at RSCM. Resources Regulator generally supportive.</p> <p>Resources Regulator questioned how Ashton Coal Operations (ACO) proposed modification to mine under Void 5 would impact AGL's operations.</p>	AGL agreed to send a map to the Resources Regulator detailing the Proposed Modification.
DPE	22 June 2020	<p>A teleconference was held to discuss:</p> <ul style="list-style-type: none"> how the Proposed Modification would tie in with the separately proposed Bayswater Upgrade project; capacity of the voids and relevant approvals to fill up the voids, including figures and maps; ash production rate; and where the ash would be transferred in the remaining life of Bayswater Power Station. <p>During the meeting DPE advised that:</p> <ul style="list-style-type: none"> AGLM are to work with SC to ensure consistent plans apply across the whole site; and groundwater is a key item to be addressed and as such DPE - Water must be consulted with. 	A follow up meeting was held with DPE/EPA on the 11 January 2022. AGLM issued a scoping letter to DPE on the 31 March 2022 regarding the justification of the Proposed Modification and the next steps.
	19 April 2022	DPE responded to ALGM's correspondence regarding preparing the Proposed Modification.	N/A

Stakeholder	Date	Comments	Action Plan
Glencore & subsidiary companies	December 2020, January and February 2021 and February 2022	<p>Consultation included emails and teleconferences. Points of discussion included:</p> <p>access to AGLM and ROC land;</p> <p>EPL boundaries;</p> <p>ROC / AGLM infrastructure;</p> <p>leases; and</p> <p>void seepage/groundwater assessment.</p> <p>Glencore shared data to support groundwater modelling and assessment.</p>	Ongoing discussions regarding AGLM and Glencore's proposed modifications to RUM.
SC	25 May 2021	Meeting with Mary-Anne Crawford & Ziggy Anderson to provide project briefing.	SC informed AGLM they will review when Modification Report is formally lodged.
BCS	3 March 2021	BCS were emailed regarding the BDAR requirements and assessment approach.	BCS confirmed that a full BDAR would be required to support the Proposed Modification.
	28 April 2021	BCS were emailed required the requirements for Brush-tailed Phascogale assessments.	BCS responded and confirmed the assessment requirements.
EPA	11 January 2022	AGL met with the EPA to provide a briefing on the Proposed Modification and discuss a pollution reduction study relating to voids.	The EPA informed AGLM they will review when Modification Report is formally lodged.
DPE Water	20 January 2022	A letter was provided to DPE Water to provide a briefing on the Proposed Modification.	DPE Water informed AGLM they will review when Modification Report is formally lodged.
Ashton Coal Operations (ACO)	Ongoing	Consultation ongoing. Agreement between AGLM & ACO is currently under negotiation in relation to ACO's proposed	

Stakeholder	Date	Comments	Action Plan
		modification and AGLM's Proposed Modification.	

5. Final landform and rehabilitation plan

5.1. Final landform and rehabilitation plan – electronic copy

6. Rehabilitation implementation

6.1. Life of a mine rehabilitation schedule

This section describes the rehabilitation schedule over the life of the mine, from the commencement of the rehabilitation management plan until lease relinquishment.

As discussed previously in this plan, mining in the Excluded Area and Ravensworth South was completed by 1993 and 2000 respectively, the sites have been in the rehabilitation phase since then. As per DA 144/93, fly ash from BPS has been used to fill the final Voids 1 to the 3 with Void 4 to be rehabilitated following completion of ash deposition in Void 5 depending on electricity generation from BPS and ash production. Should Void 4 not be required for ash deposition, AGLM would seek an amendment to the final landform for Void 4. It is noted that Void 4 currently acts as a water storage facility for the rehabilitation works that occur in the Excluded Area and Ravensworth South including ash deposition system, water supply for dust suppression and seepage management. Void 4 also supplies water to the two composting that supply compost for use AGLM's rehabilitation works and supply to offsite third parties.

AGL has recently announced that BPS would close by no later than 2033 which has been brought forward by two years from the previous closure date of 2035. AGLM has recently submitted an application to modify DA 86/51 for the Ravensworth South Mine relating to the Void 5 final landform. Although the final landform relating to Void 5 was not contemplated in the original EIS, AGLM aim to create a final landform that is free draining from the north to the south then from the west to the east.

The current schedule for completion of filling Void 5 with fly ash is 2032, following this a low permeability capping layer would be constructed over the ash to limit infiltration whilst acting as a store and release of water to support vegetation growth. Once capping has been completed, the area would be ameliorated with compost and seeded with pasture species. Rehabilitation works across the site are expected to be completed by 2040.

The timing of key rehabilitation activities are described below:

The rehabilitation schedule and final landform are based on the following assumptions:

- Void 5 would be completely filled with ash from BPS and completed by 2032
- Void 4 would be partially filled or used for water management for the ongoing use of the compost facilities subject to the relevant modification approval/s; and
- The final land use will remain consistent with the proposed land use in the approvals for the Excluded Area and Ravensworth South.

The mine rehabilitation schedule is presented below in Plans 1A, 2A-2C and Plan 4.

6.2. Phases of rehabilitation and general methodologies

This section describes the phases of rehabilitation that will be undertaken at the site to achieve the rehabilitation outcomes and final land use. The final land use of the Excluded Area and Ravensworth

South is Agriculture -Grazing (Pasture), Native Ecosystem (Grassland) and Native Ecosystem (Woodland). Phases of rehabilitation are described in 10.

Table 10 Rehabilitation phases

Feature	Objective
Active mining	<p>Activities undertaken as part of active mining that are associated with rehabilitation include; Topsoil management, flora and fauna management, overburden emplacement, waste management, geology and geochemistry, spontaneous combustion, reject/tailings, erosion and sediment control, biological resources, mine subsidence, cultural heritage and exploration activities.</p> <p>There is no active mining occurring at the site. Coal extraction was completed in 1993 in the Excluded Area and in 2000 at Ravensworth South.</p>
Decommissioning	Removing infrastructure, hardstands, plant, equipment, buildings and other structures, contaminated and hazardous materials.
Landform establishment	Shaping unformed rock or other sub stratum material into a desired land surface profile including final landform and drainage features. This phase includes substrate material characterisation, ash deposit capping, hazardous material encapsulation and earthworks to achieve safe and stable slopes with the desired gradients and landscape characteristics.
Growth medium development	Establishing and enhancing physical structure, chemical properties and biological properties of a soil stratum for plant growth. This includes placing and spreading soil and applying ameliorants.
Ecosystem and land use establishment	Seeding, planting and transplanting plant species. Incorporates management actions such as weed and feral pest control to achieve species establishment and growth to juvenile communities and habitat augmentation.
Ecosystem and land use development	Applying management techniques to encourage an ecosystem to grow and develop towards a desired and sustainable post mining land use outcome. Incorporates features including species reproduction, nutrient recycling and community structure.

6.2.1. Active mining phase

This section summarises the risks and opportunities for rehabilitation associated with the active mining phase across the mining domains. There is no extractive mining taking place in the Excluded Area or Ravensworth South Mine as extraction was completed in 1993 and 2000 respectively.

a. Soils and materials

Soil test analysis results and field assessments across the Excluded Area, ML 1484 and ML 1485 confirmed the topsoil to be very sparse to non-existent in some locations. Topsoil from previous stripping activities are managed on site.

Prior to AGLM's acquisition, Macquarie Generation previously used biosolids as a topsoil substitute in the Excluded Area. It is difficult to determine the success of the biosolids given the impacts of spontaneous combustion and lack of maintenance since the biosolids were used in the early 2000s.

Due to the historical mining practices in the Excluded Area and Ravensworth South not managing topsoil, assessment have shown there is very minimal topsoil available for use across the sites. Instead AGLM uses compost from two composting facilities run by third parties that are located onsite. This material has been used for over five years now with the results from the rehabilitation monitoring showing its benefit. The composts consist of a mix of biosolids, garden organics and paper crumble. It is likely that composted food organics will also be added to the mixes in the future should it become available.

b. Flora

The site has been extensively disturbed and the predominant consideration will be for the revegetation of the site to encompass a mix of pasture (70% of the site) and woodland (30% of the site) where the overstorey species will be based on those species that are endemic to the project area. The use of non-endemic species would only be considered should the assessment and management options of the spontaneous combustion determine that these species may be suited to the amended conditions brought about by the impact of the spontaneous combustion.

c. Fauna

AGLM has designed an annual feral animal management and control program that will be undertaken on a campaign basis. Management timing, chosen target species and mode of management are functions of the nature and scale of the pest problem as evidenced during the rehabilitation monitoring program and either by Environmental staff or via reports to the Environmental staff. All work will be implemented in close liaison with the staff of the Local Land Services and in close communication with adjoining land users to ensure a coordinated approach to pest management. All baiting, trapping and culling operations will be undertaken in accordance with the relevant legislative requirements and within necessary licences such as those issued by the National Parks and Wildlife Service for Kangaroo population control.

AGLM have incorporated rock piles into its rehabilitation management works and fallen trees are left in place to create habitat where possible.

d. Rock/overburden emplacement

Rock/overburden emplacement is not occurring at this site as operational mining practices are no longer undertaken.

e. Waste management

Waste management associated with the operation of Bayswater including the Ravensworth site, is undertaken in accordance with AGL-HSE-STD-009.7 – Waste Standard and AGLM-HSE-PLN-009.07 Waste Management Plan and regulated under EPL 779.

AGLM has implemented a Total Waste Management System (TWMS) administered by an external waste contractor. This contract includes key performance indicators for the maximisation of waste recycling options, employee training and options for the minimisation of non-recyclable waste.

Disposal of coal ash from Bayswater and tailings into the voids is allowed under the relevant development approvals and EPLs.

f. Geology and geochemistry

The stratigraphic sequence in the region comprises two distinct units: Quaternary alluvium and Permian strata. The Quaternary alluvium consists of unconsolidated silt, sand and gravel in the alluvial floodplains of the Hunter River, Bowmans Creek and Bayswater Creek (except where it has been removed by mining). The alluvium unconformably overlies the Permian strata, which comprise coal seam sequences with overburden and interburden consisting of sandstone, siltstone, tuffaceous mudstone, and conglomerate. The stratigraphic sequence of the Permian coal measures in the Hunter Valley is shown in Figure 5.4. The Middle Permian strata form a regular layered sedimentary sequence, with the Whittingham Coal Measures containing the main economic coal seams.

The Hunter Coalfields regional geology map (1:100,000 scale) (Glen & Beckett, 1993) shows that the middle sequences of the Whittingham Coal Measures (Singleton Supergroup) subcrop in the Ravensworth area. Operations at Ravensworth South Mine extended down the Bayswater Seam (refer Figure 5.4). Ravensworth and Narama open cut mines both extracted coal from the seams between the Broonies and the Bayswater Seams. RUM extracted coal from the Pikes Gully Seam and was approved to mine coal from the Upper Liddell, Upper Lower Liddell and the Barrett Seams. Adjacent open cut mines such as Ravensworth North are approved to mine from the Broonies Seam to the Hebden Seam, and Ashton Underground Mine is approved to mine the Pikes Gully, Upper Liddell, Upper Lower Liddell and the Barrett Seams.

The creek and drainage lines are overlain by alluvium associated with both Bowmans and Bayswater Creek. The Bowmans and Bayswater Creek alluvium are in direct connection to the Hunter River alluvium.

Groundwater quality data provides useful information on the beneficial use of the groundwater associated with the major stratigraphic units. Salinity is a key constraint to water management and groundwater use and can be described by TDS concentrations. The baseline groundwater quality TDS values indicate that the groundwater within the alluvium aquifers on site is likely suitable for stock water supply; however, the groundwater is of limited potable use. In general, baseline groundwater quality of undisturbed Permian coal measures, groundwater quality in the Ravensworth sub-basin is reported to have a potential for hydrogen (pH) of between 6.4 and 7.0, an electrical conductivity (EC) of between 1,700 $\mu\text{S}/\text{cm}$ and 12,400 $\mu\text{S}/\text{cm}$, and calcium concentrations of between 66 mg/L and 472 mg/L.

g. Material prone to spontaneous combustion

The emplacement overburden material contains a significant amount of carbonaceous material making the Excluded Area and Ravensworth South susceptible to spontaneous combustion.

There is active spontaneous combustion present in the Excluded Area and smaller localised areas at Ravensworth South. Coupled with the historic cases of spontaneous combustion, successful and sustainable rehabilitation in those areas is difficult and will be for some time due to the short and long term changes brought about as a result of the heating and chemical changes within the soil.

In general, due to the extensive effort AGLM has put in to manage and treat the spontaneous combustion, the areas impacted by spontaneous combustion have reduced significantly with reduced observations of cracking, heating and vegetation dieback. The spontaneous combustion is now more localised. AGLM will continue to manage spontaneous combustion at the Excluded Area and Ravensworth South. Management measures include thermal scanning as required, visual inspections and rehabilitation monitoring to identify any new areas and monitoring existing known areas of spontaneous combustion.

Depending on the nature and extent of spontaneous combustion, rectification works may include the following:

- Civil works to starve oxygen in areas of active spontaneous combustion;
- Soil sampling to determine soil condition and any required amelioration that may be required;
- Weed management;
- Application of organic material to improve the soil condition;
- Seeding with pasture species or species more resistant to the spontaneous combustion to prevent erosion;
- Management of cattle to restrict access to areas where elevated potassium levels been recorded; and
- Monitoring to identify any further outbreaks.

Tree seeding will be avoided in areas that show up with heating present and where spontaneous combustion is visibly active. This is to avoid any rehabilitation failures as trees are the most susceptible to spontaneous combustion due to having deeper roots.

h. Material prone to generating acid mine drainage

Chemical analysis conducted on overburden including reject coal for the EIS' for Ravensworth South and Excluded Area (Pacific Power, 1993 and Electricity Commission of NSW, 1986) found no propensity for acid mine drainage.

AGLM conducts routine surface and groundwater monitoring to assess for any changes in the water quality associated with the Excluded Area and Ravensworth South. The results are reported on in the Annual Report.

i. Ore beneficiation waste management (reject and tailings disposal)

Works undertaken at the site includes tailings emplacement. Ashton Coal is currently depositing tailings in Void 4 east under DA 144/93 as modified. Tailings disposal into Void 4 East is due to be completed in 2028.

j. Erosion and sediment control

Natural soils are not present at the site and the normally referenced soil landscape mapping is not applicable. Instead, the site is covered by thick deposits of mine spoil that comprises a mix of the various coal measure strata which have been disturbed by open cut mining. The mine spoil can be used for re-establishing vegetation and soil ameliorants such as organic compost are also used in some locations to accelerate revegetation on the mine spoil. The exposed mine spoil also needs to be treated in the same way as exposed soils by limiting erosion and off site sedimentation. Mitigation measures to limit erosion and sedimentation include:

- identification of areas prone to erosion; and
- implementation of controls to prevent erosion and to retain any entrained sediment.
- Rehabilitation monitoring

Rehabilitation monitoring results show that the majority of the site is covered with >70% vegetation cover to the erosion risk is considered to be low.

k. Ongoing management of biological resources for use in rehabilitation

As discussed previously, due to the historical mining practices in the Excluded Area and Ravensworth South where topsoil was not managed, assessments have shown there is very minimal topsoil available for use across the sites. Instead AGLM uses compost from two composting facilities run by third parties that are located onsite to provide high quality organic soil ameliorants. AGLM will continue to support the ongoing operation of the composting facilities.

l. Mine subsidence

Mine subsidence can occur because of the amount of ground disturbance that occurs adjacent to a mine – particularly an underground mine.

The Ravensworth site has been subjected to subsidence related to historical underground mining undertaken at Ravensworth Underground Mine (RUM) and the Ashton Underground. Subsidence fracturing has been noted as evident through up to 70m of spoil cover that overlies the basement rock adjacent to Void 5. Impacts from subsidence at the site include spontaneous combustion and associated effects on rehabilitation and groundwater drawdown.

Impacts and consequences from subsidence including groundwater drawdown and spontaneous combustion related RUM and the Ashton Underground are regulated under DA 104/96 as modified and DA 309-11-2001 as modified respectively. Both operators are required to establish access and compensation agreement that include mitigation measures and rectification measures prior to commencing operations.

m. Management of potential cultural and heritage issues

Due to the complete removal of the original surface across the majority of the Excluded Area and Ravensworth South by strip mining methods to approximately 85m followed by mine spoil emplacement, the area is considered to be completely disturbed with all heritage potential removed, the management of the Aboriginal heritage sites across these areas is considered unnecessary.

There is a small area of undisturbed land in the south east corner of the Ravensworth South site north of Lamington Road and the New England Highway. This area has the potential to contain unidentified cultural heritage sites. AGLM has no plans to disturb this area. Should heritage items or suspected heritage items be found, AGLM would engage a suitably qualified expert to undertake an assessment of the items and the appropriate management measures would be implemented.

n. Exploration activities

There is no further planned exploration activities in the Excluded Area or Ravensworth South.

6.2.2. Decommissioning

The decommissioning phase provides for the removal of relevant infrastructure, hard stand areas, contaminated materials and hazardous materials where relevant. In context of the project area the only infrastructure that may be decommissioned relates to the relocation of pipelines and pumps linked to the movement of ash and water across the sites and power infrastructure related to AGLM operations.

a. Site security

During all phases of the RMP, all external gates are kept locked with restricted locks and signs in place around the perimeter advising of the dangers and that entry is prohibited to unauthorized persons. Site access is limited to only authorised key holders such as the civil contractors working on the site.

b. Infrastructure to be removed or demolished

Infrastructure and services which are not proposed to be utilised by subsequent approved land uses will be removed including:

- Ash transfer pipelines
- Return water pipelines
- Pumping infrastructure including pumps, water tanks and pontoons
- Powerlines and power infrastructure related to AGLM's operations that is no longer required
- Access roads no longer required following rehabilitation of the site

All demolition will be undertaken in accordance with *Australian Standard AS2601: The demolition of structures (AS 2601)*. All structures will be inspected for the presence of hazardous materials prior to demolition.

c. Buildings, structures and fixed plant to be retained

Infrastructure and services to be retained for future use as part of the final land use include:

- Ash and tailings retaining walls
- Water management such as dams and drains
- Stock water dams
- Fencing associated with cattle grazing
- All infrastructure associated with the composting facilities
- Main access roads and boundary access roads

Structural adequacy of built features will be undertaken to ensure that remaining structures are in a safe condition. Remaining structures will be surveyed and recorded on a plan, with a suitable caveat developed to provide that they are readily identifiable for future land holders.

The retainment of these structures in the final landform poses limited risk to rehabilitation and the public.

There are no permanent AGLM owned buildings onsite.

d. Management of carbonaceous/contaminated material

As part of the proposed modification to DA 86/51 for Ravensworth South, AGLM are proposing to establish onsite borrow pits to win material for capping Void 5 and Void 4 if required. This activity has the potential to uncover carbonaceous material. As part of the proposed works, AGLM would develop an unexpected finds protocol that details the management measures that would be implemented should carbonaceous material be encountered in the proposed borrow areas.

A contamination assessment will be undertaken for the site to identify areas of potential contamination at the site. The findings of the contamination assessment will inform any required management measures.

e. Hazardous materials and chemicals management

There are limited hazardous materials and chemicals stored at the Ravensworth Site. Prior to decommissioning and demolition, all hazardous materials and chemicals will be removed by a licenced waste contractor.

f. Underground infrastructure

There is no underground infrastructure in the Excluded Area or Ravensworth South that is associated with AGLM's activities approved under DA 144/93 and DA 86/51 respectively.

6.2.3. Landform establishment

In the context of this RMP, landform establishment corresponds to the processes involved to achieve stable landforms including slopes, erosion controls, and drainage lines with integrated landscape features, which are compatible with surrounding landforms, whilst ensuring also that the rehabilitated areas of native vegetation link with either undisturbed native vegetation or neighbouring native rehabilitation where able.

The majority of the site has undergone landform establishment that was undertaken either progressively during active mining operations or following cessation of mining operation. There is a small area in the northeast of the site that requires reshaping as it is very steep. As part of the rehabilitation process, AGLM is filling the final voids within the Excluded Area and Ravensworth South. The landforms associated with Void 4 and 5 will be dependent on the electricity generation at BPS which in turn the amount of filling in the voids. AGLM currently has an application to modify DA 86/51 to amend the final landform at Void 5, this change aims to enable drainage from the north of Void 5 to the south and then from the west to east following the shape of the void. AGLM has engaged a design consultant to design the final landform for Void 5 based on the current predicted ash disposal into Void 5.

Whether Void 4 is filled and to what extent Void 4 is filled is largely dependent on the amount of ash generation at BPS. At deposition in Void 4 is currently planned to commence following completion of ash deposition in Void 5, sometime in 2032. As discussed previously the closure date for BPS has been brought forward from 2035 to 2033 which would mean that there would be less than two years of ash deposition into Void 4. The capacity of Void 4 is approximately 9.7 million m³. Based on average annual filling of 1.3 million m³ this would mean that Void 4 would only be quarter filled at the most. AGLM plan to apply to modify DA 144/93 to amend the final landform of Void 4 and create flexibility. Void 4 is currently used as a water management dam and will likely continued to be used for this purpose following closure to provide water for the composting facilities.

The proposed final landform at the sites outside of the Void 4 and Void 5 areas, will be consistent with the surrounding landscape and will be generally consistent with the approved landforms in DA 144/93 and DA 86/51.

The final landform and rehabilitation domain types for AGLM during the life of the RMP are shown on Plans 1A.2 and Plan 4.

The objectives, criteria and performance indicators for AGLM rehabilitation domains are provided in Table 8.

a. Water management infrastructure

Void 4 is the main water management structure that is associated with the ash deposition system. As this stage it is unknown whether Void 4 will receive fly ash or be retained as part of the water management infrastructure. Retaining Void 4 as a water management structure would require modification of DA 144/93.

There are several other permanent dams and associated drainage lines and structures that will be made safe and stable and designed to fit into the final landform. These features will enable the polishing and movement of surface water which moves through the landscape ensuring that any water which occurs on the site and subsequently leaves the site to meet the criteria listed in Section 4.1.

These dams will provide water for grazing stock and habitat for aquatic ecology. The location of the dams will be such that they are aligned to the requirements of cattle in context of daily movement and the layout of fencing, holding yards and paddock configuration. Water management infrastructure planned to remain as part of the final landform is shown in Plan 3.

b. Final landform construction: general requirements

The final landform will be consistent with the approved landforms included in DA 144/93 as modified and DA 86/51 and be consistent with the rehabilitation objectives outlined in Section 4.1.

c. Final landform construction: ash emplacement areas and tailings dams

The design of the ash deposition into Void 5 has been designed in the attempt to recover decant water from the ash slurry. The ash is deposited into the void either from the north or the east behind terrace walls that are raised progressively ahead of filling. This leaves the southwest corner of the void for water management which would then be filled last to create a relatively flat landform prior to capping and revegetation. The current design aims to fill the ash to a maximum Relative Level (RL) of 101. As discussed previously, AGLM has lodged a modification application for DA 86/51 which would amend the current approved landform for Void 5 to enable earlier filling of the southwest corner of Void 5 to ensure this area is not left as a depression that would pool water. The aim of the amended final landform is to drain water from the north to the south then from the west to the east where it would report to water management dam/s before discharging from the site. AGLM has engaged a design consultant to develop an updated final landform design for Void 5 that takes into account the updated projected ash generation rates and earlier closure of BPS.

The original conceptual final landform for Void 4 assumed filling with ash to a maximum of RL 101. Due to decreasing demand for coal fired electricity and the bringing forward of the BPS closure to 2033 it is likely that minimal disposition of ash into Void 4 will occur. AGLM has engaged a design consultant to update the conceptual final landform for Void 4. Once the conceptual design has been updated, a modification to DA 144/93 will be lodged to request a change to the final landform.

The Ashton Coal tailings facility in Void 4 east is currently still be used for tailings emplacement and will continue to be in use until 2028. The final landform for Void 4 east has been included in Ashton Coal's approved *Ravensworth Void No. 4 Tailings Storage Facility Tailings Emplacement Operations Plan*, dated 30 January 2014.

Long term drainage structures direct surface water from the areas of capped ash to reduce potential infiltration into the ash filled void. The ash will be capped with approximately 400mm of mine spoil once the maximum height for the ash placement has been reached.

The areas including those comprising the borrow pits – where cover material will be obtained- will be reshaped to blend into the surrounding landform. Following shaping all compacted areas returning to woodland will be ripped to a depth of at least 0.5m to promote moisture infiltration and root elongation. Where soil analysis results identify the need, soil ameliorants such as gypsum, fertilisers and organic matter will be spread over and raked into freshly ripped surface to a depth of approximately 15cm.

The ripping and ploughing may result in rock material being brought to the surface. Where this occurs and it is deemed necessary in terms of ensuring ease of access to pasture areas in the future, the larger material will be mounded into heaps of a maximum height of 1.5m and approximately 2m across. This concept has been used on other post mined landscapes and have shown to provided beneficial habitat for fauna recolonising the area.

Revegetation methods is predominantly based on direct seeding, with the addition of tubestock species in defined areas to assist in providing visual screens and enhanced revegetation. The direct seeding involves utilising a tractor supporting a spreader or drill seeder. In locations too steep to access with a tractor such as embankments, hydroseeding/hydro mulching will be utilised to seed these areas.

d. Final landform construction: final voids, highwalls and low walls

Refer to Section 6.2.3.c above for final Voids.

There is a small highwall in the north of the Excluded area. This is approximately 10m in height with limited access as there is an Ausgrid switchyard at the top. A review of the final landform will be conducted as part of the modification assessment for DA 144/93, this area and any requirements will be included in this assessment.

e. Construction of creek/river diversion works

Not applicable to the Excluded Area or Ravensworth South.

6.2.4. Growth medium development

In the context of this RMP, Growing Media Development incorporates the processes involved to achieve a soil which is capable of supporting a sustainable plant community. It includes consideration of the chemical, physical and biological properties of the media and takes into account issues such as the specialist requirements (e.g. soil ameliorants) aligned to the revegetation of the disturbed areas, whilst also incorporating consideration of land use both for grazing and biodiversity that may deviate from the traditional post mining land use.

Compost treatment for topsoil use

Prior to AGLM's acquisition, Macquarie Generation previously used biosolids as a topsoil substitute in the Excluded Area. It is difficult to determine the success of the biosolids given the impacts of spontaneous combustion and lack of maintenance since the biosolids were used in the early 2000s.

Given the varied success of straight biosolids on other rehabilitation sites, AGLM have adopted a different approach to the use of biosolids for new rehabilitation areas and remediation of failed rehabilitation areas.

Due to the historical mining practices in the Excluded Area and Ravensworth South not managing topsoil, assessment have shown there is very minimal topsoil available for use across the sites. Instead AGLM uses compost materials from two composting facilities run by third parties that are located onsite. This material has been used for over five years now with the results from the rehabilitation monitoring showing its benefit. The composts consist of a mix of biosolids, garden organics and paper crumble. It is likely that composted food organics will also be added to the mixes in the future should it become available.

The compost is incorporated into rehabilitation areas at allowable rates as directed by soil analysis. Analysis results of the topsoil substitute will also determine the rates of gypsum, lime and fertilisers to

be used if required. Prior to incorporating the compost onto the rehabilitation areas that require management, weed management will be undertaken to reduce the risk of weed infestation.

Weed control

The following obligations relate to weed control:

- Systematic surveillance and treatment for noxious weeds;
- Staff training in the identification of noxious weeds;
- Treatment following a reported weed sighting;
- Prevention of the establishment of additional noxious weed species; and
- Maintain up to date knowledge of the latest weed control techniques and products.

AGLM undertake regular weed surveys to identify weed infestations. These weed surveys are used to development the annual weed management programs that target priority areas. All noxious weeds are managed and controlled as per the requirements of the *Noxious Weeds Act 1993*. Where required, control of weeds will be undertaken in direct consultation with the Local Land Service and Upper Hunter Weeds Authority staff utilising a combination of mechanical, biological and chemical controls.

6.2.5. Ecosystem and land use establishment

In the context of this RMP, Ecosystem and Land use Sustainability incorporates the:

- Development of land use and land capability which is consistent with the surrounding areas;
- Nutrient Cycling;
- Development of land use options that provide optimal and sustainable social and economic benefit to the local community;
- Species diversity and abundance for both flora and fauna;
- Development of profiles in the growing media; and
- Vegetation communities capable of withstanding catastrophic events e.g. bushfire and extensive drought.

Direct seeding will be undertaken for both pasture species and natives at rates specified in Table 11 and 12. Tube stock planting may be used in woodland areas to improve structure, stem densities and diversity. Note that the native species availability is variable and therefore the not all of the listed species may be used. A starter fertiliser and / or bulking agent will be applied with the seed at a rate to be determined via soil analysis.

Direct seeding is usually conducted during late autumn to enable the plants to germinate and establish prior to the hot and dry conditions typical during summer.

Areas to be seeded with native species will be ripped prior to seeding. These areas will also be seeded with a reduced rate of pasture and or cover crop species to control the risk of erosion.

The species chosen for pasture have been done so on the basis that they provide effective cover to reduce the risk of erosion and suppress weeds, whilst also ensuring the provision of adequate fodder for livestock. The species mix is also based on lessons learnt from across the coal mining industry of the Hunter in optimising those species that are known to germinate and establish on post mined lands and also provide adequate feed value for the beef cattle that will in time feed on these areas. It is recognised that Rhodes grass has formed a dense ground cover in many areas and whilst there are limitations of this species in context palatability and productivity, grazing trials from across the Hunter have shown that cattle do well on managed pastures where Rhodes dominates (Glencore, 2015 and NSW DPI, 2015). A review will be undertaken to assess the optimal Rhodes Grass cultivar in terms of establishment on the project areas where maintenance work is required and in context of palatability and productivity.

This species mix may be amended in response to the recommendations of the assessment and subsequent management of the areas impacted by spontaneous combustion.

Table 11 Recommended Pasture Species Direct Seeding and Rates

Grasses Mix (pasture)	Seeding Rate (kg/ha)
Japanese millet (spring/summer only)	10
Coolabah oats (autumn/winter only)	10
Brassica – Hunter - autumn	0.75
Brassica – Rangji - autumn	0.75
Consul Lovegrass	1
Couch grass - Hulled	5
Kikuyu	3
Medic - Sephi	1
Perennial rye grass – Kangaroo Valley	6
Rhodes Grass	3
Rye - Eclipse	5
Sub-clover - Seaton Park	3
White clover - Haifa	3
Woolly Pod vetch - Namoi	4

Table 12 Recommended Woodland Species Direct Seeding and Rates

Cover crop species	Seeding Rate (kg/ha)
Japanese millet (spring/summer only)	10
Coolabah oats (autumn/winter only)	10
Low Shrub Species	Seeding Rate (kg/ha)
<i>Acacia amblygona</i>	0.4
<i>Acacia falcata</i> (Sickle wattle)	0.8
<i>Acacia decora</i> (Western Silver Wattle)	0.5
<i>Bursaria spinosa</i> (Blackthorn)	0.5
<i>Daviesia genistifolia</i> , <i>D. ulicifolia</i>	1
Mid Shrub Species	Seeding Rate (kg/ha)
<i>Acacia paradoxa</i>	0.4
<i>Acacia implexa</i> (Hickory Wattle)	0.8
<i>Acacia parvipinnula</i> (Silver Stemmed Wattle)	0.4
<i>Acacia salicina</i> (Cooba)	1
Tree Species	Seeding Rate (kg/ha)
<i>Angophora floribunda</i> (Rough Barked Apple)	0.6
<i>Corymbia maculata</i> (Spotted Gum)	1.2
<i>Eucalyptus crebra</i> (Narrow Leafed Ironbark)	1.0
<i>Eucalyptus melliodora</i>	0.5
<i>Eucalyptus moluccana</i> (Grey Box)	1.0
<i>Eucalyptus tereticornis</i> (Forest Red Gum)	0.5

A typical list of native species, all of which align to the tree species characteristic of the pre mining and surrounding plant communities, used in the revegetation program under tubestock planting for visual screens and on bunds include: *Angophora floribunda*, *E. crebra*, *E. moluccana*, *E. sideroxylon*, *E. tereticornis*, *E. albens*, *Corymbia maculata*, *Acacia concurrens*, *A. decora*, *A. decurrens*, *A. falcata*, *A. filicifolia*, *A. implexa*, *A. paradoxa*, *A. salicina*, *Allocasuarina luehmannii*, *Casuarina glauca*

Planting of tubestock is not considered practicable or cost effective over extensive areas, but localised plantings would be used to increase stem densities, species diversity and structure where required. AGLM will source tubestock from local provenance where available at time of planting.

Key factors in successful seed establishment are:

- Preparation of soil to ensure it is friable and planting into moist soils;
- Ensure low bulk density so roots are able to grow, penetrate and capture moisture;
- Ensure adequate nutrition, using fertiliser if necessary;
- Pre-planting and follow-up weed control;
- Monitor survival rates and replanting where necessary;
- Watering of seedlings to assist establishment and survival until established; and
- Vermin control.

Where tubestock planting is planned, the area will be sprayed for weeds and ripped prior to planting.

Natural recruitment may be utilised in some of the woodland areas such as the area in the southeast of ML 1484 and ML 1485 where the rehabilitation area borders a large stand of natural vegetation. In order to encourage natural recruitment, these areas will be excluded from grazing and unnecessary vehicular access.

6.2.6. Ecosystem and land use development

Rehabilitated lands will be actively managed to achieve the approved final land use through the following measures:

- Rehabilitation will be consistent and undertaken in accordance with relevant NSW Resources Regulator standards applicable at the time of rehabilitation;
- Rehabilitated land will be managed to reduce and eliminate the possibility of offsite impacts such as dust, water pollution and visual amenity. This will be achieved through maintenance fertilising and establishment of vegetation to prevent erosion and sedimentation;
- Ongoing management of rehabilitated land will be consistent with surrounding environments (for example, grazing land will be managed in a similar manner to how it is managed in unmined environments in the local area);
- Drainage systems incorporated into the final landform will be monitored to ensure they are hydrologically stable;
- Rehabilitated landforms will be monitored to ensure structural stability, revegetation success and containment of wastes.

Maintenance fertilising

Depending on the results of the soil analysis a maintenance fertiliser program will be undertaken annually during spring for a period of five years.

Grazing

Rehabilitated land with a final land use of grazing will be managed in the following ways:

- Groundcover will be established to a minimum of 70% to ensure protection from soil erosion;
- Implementation of rotational grazing to reduce fuel loads in the landscape;
- Continue monitoring of pastures to ensure that they are progressing towards the completion criteria;
- Implementation of corrective action as described in Section 10 if monitoring identifies those rehabilitated areas are not progressing towards completion criteria.

Weed and feral animal control

Weed and feral animal control will follow procedures outlined in Section 6.2.1.

6.3. Rehabilitation of areas affected by subsidence

The current subsidence impacts are generally historical and are associated with spontaneous combustion which has been discussed previously in the plan.

Any new subsidence associated with the Ravensworth Underground Mine operating again or from the Ashton Coal Underground, would need to be managed in accordance with the relevant development consent conditions and subsidence management plans.

7. Rehabilitation quality assurance process

This section describes the processes for rehabilitation quality assurance that will be implemented throughout the rehabilitation phase of the Excluded Area and Ravensworth South. The purpose of this section is to:

- Implement the rehabilitation in accordance with the nominated methodologies
- Adequately identify risks to rehabilitation before proceeding to the next phase of rehabilitation.

The rehabilitation quality assurance process is summarised by rehabilitation phase in Table 13.



Table 13 Rehabilitation Quality Assurance Process

Rehabilitation phase	Quality assurance actions and processes	Responsibilities for implementation	Method for documenting and recording process	Method and timeframe for reviewing and refining process
Active mining	Not relevant to AGLM's operations as mining was completed in 1993 and 2000 respectively for the Excluded Area and Ravensworth South	N/a	N/a	N/a
Decommissioning	<p>Hazardous materials survey prior to demolition</p> <p>Subsidence inspections</p> <p>Inspection and demolition reports for all infrastructure to be removed</p> <p>Structural adequacy assessment of built features to be retained</p> <p>Validation testing confirming that contaminated areas are fit to progress to next phase of rehabilitation</p> <p>Waste management and disposal</p>	AGL Decommissioning Team	<p>Hazardous materials survey report</p> <p>Statement provided and before/ after photos</p> <p>Structural adequacy report</p> <p>Validation report</p> <p>Waste management documentation</p> <p>Copy of notification to local Council and Dial Before You Dig for underground services retained (if applicable)</p> <p>Engineering report/ statement, as-constructed drawings, records of fill materials</p>	Process reviewed annually and/or following an incident.



Rehabilitation phase	Quality assurance actions and processes	Responsibilities for implementation	Method for documenting and recording process	Method and timeframe for reviewing and refining process
Landform establishment	Rehabilitation monitoring Soil testing Survey and preparation of as-constructed drawings of final landform for relevant structures i.e. Void 5 capping and walls Thermal scan	AGL Suitably qualified consultant/contractor	Rehabilitation monitoring report Photos As-constructed survey reports/QA Thermal scan report	Process reviewed annually and/or following an incident.
Growth medium development	Rehabilitation monitoring Soil testing Erosion and sediment control inspection Weed management Recording depths of ripping and rehabilitation Weed and pest management scope documents	AGL Suitably qualified consultant/contractor	Rehabilitation monitoring report Soil testing reports Biosolid/Ameliorant application reports Records of erosion and sediment control inspections Annual reporting of progress in forward program and annual rehabilitation report Weed and pest management documentation Q/A documentation	Process reviewed annually and/or following an incident.



Rehabilitation phase	Quality assurance actions and processes	Responsibilities for implementation	Method for documenting and recording process	Method and timeframe for reviewing and refining process
Ecosystem and land use establishment	<p>Visual inspections</p> <p>Collection of quality assurance documentation for seed sourced from suppliers (such as batch of seed, germination cert.)</p> <p>Initial rehabilitation inspection three months after growth medium application and seeding of an area</p> <p>Regular inspections of rehabilitated areas to assess soil conditions and erosion, drainage and sediment control structures, runoff water quality, revegetation germination rates, plant health and weed infestation.</p> <p>Rehabilitation monitoring</p> <p>Weed and pest management</p> <p>Thermal scan</p>	<p>AGL</p> <p>Suitably qualified consultant/contractor</p>	<p>Documentation of visual inspections</p> <p>Annual reporting of progress in forward program and annual rehabilitation report</p> <p>Rehabilitation establishment documentation and records</p> <p>Quality assurance documentation from suppliers</p> <p>Rehabilitation monitoring reports</p> <p>Before and after photos</p> <p>Weed and pest management documentation</p> <p>Thermal scan report</p>	<p>Process reviewed annually and/or following an incident.</p>
Ecosystem and land use development	<p>Visual inspections</p> <p>Rehabilitation monitoring</p> <p>Weed and pest management</p> <p>Thermal scan</p>	<p>AGL</p> <p>Suitably qualified consultant/contractor</p>	<p>Documentation of visual inspections</p> <p>Annual reporting of progress in forward program and annual rehabilitation report</p>	<p>Process reviewed annually and/or following an incident.</p>



Rehabilitation phase	Quality assurance actions and processes	Responsibilities for implementation	Method for documenting and recording process	Method and timeframe for reviewing and refining process
			Rehabilitation monitoring results Before and after photos Weed and pest management documentation Thermal scan report	

8. Rehabilitation monitoring program

8.1. Analogue site baseline monitoring

Three analogue sites were established in 2017. All sites were established in areas of native pasture communities with a history of active cattle grazing and were located within the buffer lands of the BPS approximately 10 km west of the Ravensworth site. The sites were selected to be representative of the pasture condition in the area whilst covering different slopes and aspects.

The data derived from the analogue sites are to be used to provide sensible comparisons to the completion criteria defined for the rehabilitated pastures, and will be used for benchmark targets, particularly in relation to pasture feed quality and potential carrying capacities.

Table 14 Analogue monitoring sites

Site name	GPS Coordinates		Final land use	Spontaneous combustion area	Slope	Aspect
	Easting	Northing				
ANA_Past01	306,025	6,409,810	Pasture analogue	N/A	13%	SE
ANA_Past02	305,909	6,410,129	Pasture analogue	N/A	10%	W
ANA_Past03	305,215	6,409,270	Pasture analogue	N/A	7%	SW

Monitoring at analogue sites follows the monitoring program established below for rehabilitation establishment monitoring.

8.2. Rehabilitation establishment monitoring

AGLM has implemented formalised monitoring of the existing rehabilitation and new rehabilitation as they develop to ensure ongoing success and to detail whether rectification measures are required. This monitoring commenced in 2016 and occurs on an annual basis in autumn. Monitoring will continue until the land is relinquished from the Mining Lease/Deed of Agreement. Monitoring will be conducted generally in accordance with Table Table . Findings from monitoring may trigger further investigations such as thermal scanning and soil testing.

Table 15 Rehabilitation Monitoring Schedule

Area	Monitoring	Method	When	By Whom
Existing rehabilitation	Spontaneous combustion	Thermal scan, visual inspection	Every five years	AGLM and suitably

Area	Monitoring	Method	When	By Whom
		and mapping (as required)		qualified contractor
	Rehabilitation monitoring Landscape function, vegetation dynamics assessment (including groundcover, woody species diversity and density, percentage crown canopy cover), abundance of species at each strata, visual monitoring of habitat complexity and disturbance factors, pasture assessments, plant health / decline, photographic monitoring and soil sampling and analyses	Plot monitoring and photographic monitoring	Annually	AGLM or appointed consultant
New rehabilitation areas (i.e. rehabilitation of capped areas)	Vegetation strike and survival survey	Visual inspection and random quadrat count of survival status and health of direct seeding	4 to 8 weeks post completion of new vegetation area (dependent on rain)	AGLM or appointed consultant
	Site survey (including rehabilitation condition, weeds, pest animal, erosion, spontaneous combustion and subsidence monitoring)	Site inspection using random area monitoring and photographic monitoring	Annually	AGLM or appointed consultant
	Rehabilitation monitoring	Plot monitoring and photographic monitoring	Annually	AGLM or appointed consultant
Areas impacted by third party underground mining (if restarted)	Subsidence (visual inspection for cracking)	In accordance with the relevant consent requirements and subsidence management plan	Weekly during active mining Quarterly during Care and Maintenance	Glencore/Ashton Coal RUM

Area	Monitoring	Method	When	By Whom
Dam walls	In accordance with requirements of the DS NSW			Qualified consultants or suitably trained AGLM personnel.

8.3. Measuring performance against rehabilitation objectives and rehabilitation completion criteria

Monitoring events will occur as per Section 8.2. Following completion of monitoring events, data will be reviewed and compared to previous years to identify long term trends in rehabilitation development. Once three datasets have been acquired, they will be compared with rehabilitation objectives and completion criteria outlined in Section 4.1. The rehabilitation monitoring program objective is to track the progress of rehabilitation and document any changes and trends in relation to rehabilitation objectives and completion criteria.

If deficiencies are found at monitoring locations, then the Trigger Action Response Plan/s (TARPs) outlined in Section 10 will be enacted. Actions in the TARPs will form part of the environmental works planning for the following period.

9. Rehabilitation research, modelling and trials

9.1. Current rehabilitation research, modelling and trials

9.1.1. Investigation Method Within the Excluded Area

A field investigation on the Excluded Area was conducted during September 2014 with a report issued in October 2014 (Landloch, 2014). This investigation involved a series of eight test pits dug to a depth of 1.5m. Seven of the eight test pits were located in areas where woodland vegetation dieback had occurred whilst the other test pit was located in woodland rehabilitation perceived to be thriving. From the eight test pits a total of 24 soil samples were taken from the soil profiles and subsequently analysed to determine whether any agronomic limitations to growth in the rehabilitated areas were present.

Based on the soil analysis a number of issues were identified that are contributing to the decline in health and or death of both the woodland and understorey species within the Excluded Area. A summary of the key issues follows.

- The site has marginal quality topsoil with high concentrations of carbonaceous material present within the subsurface.
- Large areas of the site have been subjected to spontaneous combustion associated with the high levels of uneconomical coal incorporated into the spoil material. This has led to changes in the soil properties affecting the deep rooting plants first (trees) and progressing to the surface vegetation.
- The spontaneous combustion is exacerbated by long wall mining via the development of subsidence cracks through the chimney effect feeding oxygen below ground and igniting the coal reject.
- There are high levels of available sulphur and potassium at the surface most likely as a result of the spontaneous combustion.
- There is reduced water holding capacity due to the impacts of the spontaneous combustion.
- Investigation areas were generally quite compacted.

9.1.2. Investigation Method Within ML 1484 and 1485

A field investigation into the rehabilitation dieback within ML 1484 and ML 1485 was conducted on 18 February 2015. The investigation involved excavating five test pits to a depth of 1.5m. A total of 16 soil samples were taken from the soil profiles and subsequently analysed to determine whether any agronomic limitations to growth in the rehabilitated areas were present.

Two of the test pits were located within areas of good rehabilitation and three located where both tree and groundcover dieback was evident. This enabled comparison between the areas to assist in the remediation works for the areas with rehabilitation dieback.

Based on the soil analysis a number of issues were identified that are contributing to the failure of both woodland species and groundcover within ML 1484 and ML 1485. These are similar to those found in the Excluded Area and are summarised below.

- Very little, if any topsoil present.
- The overburden material is hostile for vegetation growth with salinity, sodicity and compaction present in most areas.
- There is a high level of carbonaceous material present within the overburden leading to spontaneous combustion associated with subsidence cracking from long wall mining.
- Reduced water holding capacity.
- High levels of sulphur present in the surface layers.

A series of land management recommendations followed this assessment:

- A targeted approach to rehabilitation of the failed revegetation areas is required. This should be done based on soil analysis as there is variability across the site so a tailored approach can be adapted to each location.
- With regards to the spontaneous combustion impacted areas, once the heating and combustion has ceased, these areas could then be revegetated.
- Firstly, the areas need ripping to approximately 300mm to reduce compaction and to improve water movement. Prior to this AGLM will undertake broad scale weed spraying to minimise and manage the risk of weed growth in the newly rehabilitated areas.
- utilising more salt tolerant species such as Consul Lovegrass and Couch. AGLM will also trial the use of Wallaby Grass in the seeding mix as it has been found to grow adequately in the heated areas.
- AGLM will utilise organic waste material such as biosolids and mulches that will be incorporated to improve the soil conditions. AGLM aims to trial different blends of waste organics to achieve a topsoil substitute that is best suited to the conditions at the site. The depth of the cover of this material will be dependent on soil analysis of the both the organic materials and the Ravensworth soils to ensure compliance with the relevant waste exemptions and guidelines.

A recommendation was also made that pasture species be planted first followed by tree species. AGLM has the preference not to plant trees and other deep rooting plants in areas previously impacted by spontaneous combustion unless it can be absolutely sure that there is minimal risk of further failure of tree species and/or triggering spontaneous combustion. This will be reviewed over time as management of these areas progresses and to ensure that the 30% woodland commitment is met.

9.1.3. Assessment of flyash for stabilisation with pasture species at Ravensworth

In January 1997 the then Department of Land and Water Conservation undertook research and subsequent report (NSW Dept Land & Water Conservation, 1997) into the options for emplacement ash at Ravensworth to determine rehabilitation requirements in order to produce environmentally and ecologically stable agricultural rehabilitated land.

The outcomes of the study showed that:

- Levels of molybdenum and boron in the ash were sufficiently elevated to be a potential toxic risk to sustainable pasture usage without a capping of soil;
- Selenium toxicity was not found to be an issue for ash from the Bayswater Power Station;
- A proposed capping of 0.4m of non-toxic overburden known to provide a satisfactory media for those pasture species commonly used for mine rehabilitation in the area, should effectively isolate the ash from any potential environmental risk and minimise any potential uptake of minerals from the ash;
- The high bulk density of ash combined with very high pH and high levels of boron would severely restrict root proliferation into the ash deposit and inhibit the uptake of any heavy metals from the 400mm capped ash;
- The trialling of acidifying fertilisers is recommended on both the capped ash emplacements and mine spoil generally to improve plant and animal nutrition; and
- Most pasture species currently used for mine spoil rehabilitation in the area should be satisfactory for rehabilitation. Rhodes grass and Couch grass would be expected to provide the most effective vegetative stabilisation.

Based on the findings and conclusions of this study, that a 400mm depth of capping material has been approved and used on Void 1 and 2 and the fact that the ash dams capped material will be sourced from Borrow Pit 2 for Void 5, the capping depth of a minimum of 400mm of insert material is to be used. To ensure the isolation of underlying ash material and in keeping with the land management practices across the site Woodland areas are the only sites where ripping of the growing media will occur.

In line with the recommendations of the study, AGLM will undertake trials using acidifying fertilisers on the previously capped Void 1 and Void 2 areas during 2017 and 2018. Prior to undertaking the trials, sampling of the capping layers and vegetation will be taken to enable comparison once the fertilizers have been applied. The trial areas will also be compared to non-ash emplacement areas. The soil sampling will include agronomic and chemical analysis with particular focus on the copper:molybdenum ratio and nitrogen availability as highlighted in the study.

A number of appropriate acidifying fertilisers will be utilised in different rates to determine the most appropriate rate to use (if found to be beneficial) in future capping. Additionally, some trial areas will have the composted growing media applied and these will be compared to those treated with acidifying fertilizers.

The study also recommends monitoring of the cattle grazing over capped ash emplacements. Cattle grazing over Void 1 or Void 2 has not commenced to date Following the commencement on these areas, monitoring will be undertaken and compared to overburden areas. Soil and vegetation analysis

will be undertaken during annual monitoring events. Results of the monitoring will be made available in the Annual Environmental Management Report.

Based on the outcomes of the monitoring, AGLM may look to increase the cap thickness for future capping at Void 4 and Void 5 should the results indicate this is necessary.

9.2. Future rehabilitation research, modelling and trials

9.2.1. Growth media trials

Growth media trials have occurred to determine the most beneficial blend of waste exempt organics for both the woodland areas and pasture areas. These trials are used to record the success of various blends in order to replicate the blend as best as possible to enable the most beneficial results to be achieved with the proposed topsoil substitutes.

Prior to these trials being undertaken AGLM consulted with other mining operators from across the Hunter to ascertain the current status of the use of these materials and the lessons learnt in context of their success on rehabilitated lands.

10. Intervention and adaptive management

The following Trigger Action Response Plan (TARP) has been developed to identify proposed contingency measures to address unexpected variations to the planned rehabilitation outcomes with data as obtained from the monitoring programs and performance criteria and indicators as stipulated in Section 4 3.2.6 of this RMP. A risk-based approach has been used to assess the potential consequences and mitigation measures in terms of the Consequence Category – Environment.

The key risks associated with site rehabilitation have been assessed using the maximum reasonable consequence ratings, likelihood ratings, risk matrix and classifications as discussed in Section 3 and Appendix B.

Table 16 outlines the key identified risks, triggers and proposed mitigation measures.



Table 16 Trigger Action Response Plan for Rehabilitation

Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
Landform stability	Wind and water erosion	Rehabilitation monitoring	<p>Exposed areas not revegetated to achieve 70% covered within 6 months</p> <p>Visual- minimal erosion that would not require moderate to significant ongoing management and maintenance works.</p> <p>Visual – no signs of land instability such as mass movement.</p> <p>Visual - no areas of active gully erosion.</p> <p>No erosion from concentrated flow</p> <p>No gullies greater than 20cm depth over transects</p>	<p>A suitably trained person to inspect the site. Investigate opportunities to address erosion issues. Implement bespoke measures to manage erosion and sediment issues.</p> <p>Maintenance earth and revegetation works undertaken in areas where erosion is identified.</p> <p>If erosion issues persist following initial corrective action, a review of drainage systems within the landform will be undertaken. Remediation outcomes out of this review will be implemented.</p>	Manager – Environment and Approvals Thermal Transition



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
			Complaints relating to dust.		
	Major storm event resulting in flooding, geotechnical instability, major erosion	Inspections of erosion and sediment control	Noticeable damage or impacts to the landscape	<p>Identify, investigate, and report on impacts caused by major storm events.</p> <p>Implementation of other bespoke corrective actions based on the identified source/cause of the issue.</p> <p>If damaged landforms are identified to pose a risk to personal safety, a geotechnical inspection will be completed. The recommendations of the inspection will be implemented.</p>	<p>Manager – Environment and Approvals Thermal Transition</p> <p>Senior Civil Engineer</p>
Water quality	Unauthorised discharge to waterways outside site	Visual	Water quality exceeds agreed discharge criteria	<p>Repeat water quality sampling immediately to confirm exceedance</p> <p>If during landform construction, inspect and repair temporary controls as required.</p> <p>Identify, investigate, and report on impacts to surface water.</p> <p>Implementation of other bespoke corrective actions based on the identified source/cause of the issue.</p>	<p>Manager – Environment and Approvals Thermal Transition</p> <p>Senior Civil Engineer</p>



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
	Stock dam water quality not suitable for livestock	Water monitoring	Stock water quality is outside the following criteria: pH 6.5-8.5 TDS < 4500mg/L EC < 7800 µS/cm Chloride <4000mg/L	Repeat water quality sampling immediately to confirm exceedance Identify, investigate, and report on impacts to surface water. Implementation of other bespoke corrective actions based on the identified source/cause of the issue.	Manager – Environment and Approvals Thermal Transition
	Impacts to groundwater	Water monitoring	Water quality exceeds predicted values in relevant approvals documentation or Water quality discharged from rehabilitated mining operation meet specifications in Environment Protection Licence and or ANZECC guidelines for specific environment.	Repeat water quality sampling to confirm. Identify, investigate, and report on impacts to groundwater Implementation of other bespoke corrective actions based on the identified source/cause of the issue.	Manager – Environment and Approvals Thermal Transition



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
	Seepage quality	Water monitoring	Water quality exceeds predicted values in relevant approvals documentation or Water quality discharged from rehabilitated mining operation meet specifications in Environment Protection Licence and or ANZECC guidelines for specific environment.	<p>Identify, investigate, and report on impacts to groundwater</p> <p>Implement regular monitoring of runoff and seepage waters during operations to validate predictions.</p> <p>Implementation of other bespoke corrective actions based on the identified source/cause of the issue.</p>	Manager – Environment and Approvals Thermal Transition
Ecosystem development	Inadequate or insufficient topsoil to create/enhance the desired ecological communities.	Rehabilitation monitoring	<p>Protective groundcover >70% combined live and litter</p> <p>Soil depth including topsoil substitute, organic matter and soil ameliorates measured to be less than 100mm.</p>	<p>Implement maintenance revegetation program including seeding, tubestock planting of native overstorey species, fertiliser</p> <p>Amend growing media by the addition of organic matter e/g biosolids in areas returning to pasture</p> <p>Review species mix and adjust to achieve the targeted ecosystem.</p>	Manager – Environment and Approvals Thermal Transition



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
				Assess soil for weed contamination and treat affected soil.	
	Impact of weeds and /or vertebrate pest animal leading to widespread failure of revegetation ecosystems	Rehabilitation monitoring	Total cumulative projected foliage cover of weeds <20% (inclusive of all strata) (weeds listed Weedwise, Hunter Region).	Engage weed management contractor/pest contractor to remove introduced species from the site. Application of ameliorants or additional ground cover species from the approved species list	Manager – Environment and Approvals Thermal Transition
	Poor native ecosystem establishment success.	Rehabilitation monitoring	Excluded area (Ravensworth No2): Tree layer comprised of NSW native tree species Ravensworth South (ML1484 and 1485): Tree and shrub layers comprised of NSW native species Less than 30% of total project area is	Review native seed mix and amend accordingly. Consider remedial actions such as tube stock planting or reseedling to achieve required species composition	Manager – Environment and Approvals Thermal Transition



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
			rehabilitated to native ecosystem		
	Poor pasture establishment success.	Rehabilitation monitoring	<p>Minimum 70% productive groundcover (live and litter cover)</p> <p>Less than 20% of foliage cover of pasture weeds (weeds listed Weedwise, Hunter Region).</p> <p>>75%of herbage cover is provided by grasses and legumes suitable for grazing</p> <p>Total herbage mass of pasture areas - >1,500 kg DM/ha pre introduction of cattle for grazing or comparable to reference sites (biomass of</p>	Review native seed mix and amend accordingly. Consider remedial actions such as soil amelioration or reseeded to achieve required species composition	Manager – Environment and Approvals Thermal Transition



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
			desirable pasture species only)		
	Major storm event resulting in widespread damage to rehabilitated areas.	Inspections	Weather warnings relate to severe storms and localised flooding.	Investigate and redesign final landforms and revegetation to cope with major storm events. Undertake maintenance on rehabilitated areas if damage is noted.	Manager – Environment and Approvals Thermal Transition
	Severe and/or prolonged drought leading to widespread failure of revegetation.	Rehabilitation monitoring	Monitoring and vegetation assessments highlight inadequate ground cover and species abundance compared to previous monitoring rounds	Re-seeding with a selection of drought tolerant species for revegetation. Time seeding/plantings to take advantage of ideal weather conditions, such as if rain is forecast Assess against analogue site to determine if impact rehabilitation specific. Investigation into the possibility of utilising irrigation as part of the water management system to promote germination and establishment of vegetation;	Manager – Environment and Approvals Thermal Transition
	Changing climate leading to failure of rehabilitation, failure of	Rehabilitation monitoring	Monitoring and vegetation assessments highlight	Assess climate change risks and implement appropriate measures where required.	Manager – Environment and Approvals Thermal Transition



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
	environmental management controls and/or inability to attain completion criteria.		inadequate ground cover and species abundance compared to previous monitoring rounds	Use of biosolids, compost materials and mulches to increase organic carbon levels and improve soil structure with resultant increase in infiltration and water holding capacity.	
Hazards	Asset Protection Zone (APZ) is not maintained in context of bushfire risk.	Rehabilitation monitoring	Site assessment shows unacceptable fuel levels.	Control and maintain a suitable Asset Protection Zone surrounding rehabilitation areas by slashing and controlled grazing.	AGLM
	Subsidence – Longwall Mining	Visual inspections	Surface cracking Visible smoke / emissions	Notify Glencore/Ashton Coal to have cracking repaired (notification procedure)	Manager – Environment and Approvals Thermal Transition
	Subsidence – Longwall Mining	Visual inspections	Exceedance of predicted subsidence range by 25%	RUM survey to contact RUM Management. Review of physical integrity of area/infrastructure. Photo records to be taken. Notification of AGLM as per the agreed protocol should any material impacts occur Liaise with AGLM regarding repair of any damage.	Glencore/Ashton Coal



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
				Subsidence reporting as per the Subsidence Management Plan. (Glencore Ravensworth Underground Mine Macquarie Generation, Aug 2013)	
	Subsidence - Longwall Mining	Visual inspections	Exceedance of predicted subsidence range by 50%	<p>RUM survey to contact RUM Management.</p> <p>Undertake investigation of exceedance.</p> <p>Notification of AGLM as per the agreed protocol should any material impacts occur.</p> <p>Inspection of area to review the physical integrity of the area and or any infrastructure.</p> <p>Photo records to be taken.</p> <p>Subsidence specialist to review subsidence results.</p> <p>Liaison with DTIRIS and Subsidence Advisory NSW if required.</p> <p>Liaise with AGLM regarding repair of any damage.</p> <p>Subsidence reporting as per the Subsidence Management Plan. (Glencore Ravensworth Underground Mine Macquarie Generation, Aug 2013)</p>	Glencore/Ashton Coal



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
	Subsidence – Longwall Mining	Visual inspections	Damage to infrastructure	<p>Notification from RUM to AGLM as per the agreed protocol should any material impacts occur.</p> <p>Liaise with AGLM regarding repair of damage.</p> <p>Inspection of area to review the physical integrity of the area and or any infrastructure.</p> <p>Photo records to be taken.</p> <p>Liaison with DTIRIS and MSB if required.</p> <p>Repair of damage in consultation with AGLM.</p> <p>Subsidence reporting as per the Subsidence Management Plan. (Glencore Ravensworth Underground Mine Macquarie Generation, Aug 2013)</p>	Glencore/Ashton Coal
Regulatory requirements	New regulatory requirements or evolving community expectations leading to difficulties negotiating or	Review of legislation	Changes in relevant legislation.	<p>Monitor trends and developments in legislation and changes to community expectations.</p> <p>Consult with stakeholders to gain acceptance of completion criteria.</p>	Manager – Environment and Approvals Thermal Transition



Aspect	Risk	Monitoring process	Trigger threshold	Action and mitigation measures	Person responsible
	attaining completion criteria.				

11. Review, revision and implementation

The ongoing effectiveness and efficiency of the site Management System is monitored as part of the operation’s day-to-day management. Feedback from this and other more formal reviews and/ or following special occurrences, form the basis for System improvement and re-design. Statutory triggers for reviewing and revising this RMP are provided in Table 17.

Table 17 Statutory triggers for RMP review and revision

Condition	Review trigger requirement
<p><i>Mining Amendment Regulation 2021</i></p> <p>Clause 11</p> <p>Schedule 8A</p>	<p>The holder of a mining lease must amend the rehabilitation management plan for the mining lease as follows—</p> <p>(a) to substitute the proposed version of a rehabilitation outcome document with the version approved by the Secretary—within 30 days after the document is approved,</p> <p>(b) as a consequence of an amendment made under clause 14 to a rehabilitation outcome document—within 30 days after the amendment is made,</p> <p>(c) to reflect any changes to the risk control measures in the prepared plan that are identified in a rehabilitation risk assessment—as soon as practicable after the rehabilitation risk assessment is conducted,</p> <p>(d) whenever given a written direction to do so by the Secretary—in accordance with the direction.</p>

Additionally, the RMP will be reviewed every three years, when there is significant changes in legislation, when there are any amendments to the rehabilitation objectives, completion criteria or final landform rehabilitation plan, when there are changes in risk control measures or when directed to do so by the Secretary.

Continual improvement

Operational activities will be subject to regular review to ensure conformance with commitment made in the EMS and subordinate plans and strategies.

Document management

Copies of this document are managed under the Group Document Management System. This document and other relevant documents are kept on site and are available to all employees.

Implementation

The company directors are responsible for the overall rehabilitation and environmental performance at AGLM. The General Manager has direct responsibility for the rehabilitation process. The Environmental Manager provides direction and advice to ensure site environmental compliance is maintained. The



Environment Manager and Environment Advisors are responsible for the implementation of the works as described in this RMP. This involves ensuring all aspects of the rehabilitation processes, as outlined in this document, are followed and carried out.

12. References

Aurecon. 2015. Ravensworth Void 5 Ash Emplacement Management Plan. Report prepared for AGL Macquarie

Glencore. 2012. Ravensworth South Mine Final Void Rehabilitation Plan (South EMP)

Glencore. 2013. Subsidence Management Plan - Macquarie Generation Owned Land and Infrastructure.

Glencore. 2015.. Liddell Grazing Trial. Upper Hunter Mining Dialogue presentation.

Hansen Bailey. 2014. Ravensworth Operations Final Landform Modification Assessment

Landloch. 2014. Soil and Rehabilitation Assessment.

NSW DPI. 2015. Interim report ACARP Ref 53259. *A study of sustainability and profitability of grazing on mine rehabilitated land in the Upper Hunter NSW.*

NSW Department of Land & Water Conservation. 1997. Assessment of Flyash for Stabilisation with pasture Species at Ravensworth

NSW Office of Environment & Heritage. 2012. The Land and Soil Capability Assessment Scheme - 2nd Approximation. Sydney.

NSW Resources Regulator. 2021. Form and Way: Rehabilitation Management Plans for Large Mines guideline

Pacific Power. 1993. Ravensworth No. 2 Mine Fly Ash Disposal and Rehabilitation Environmental Management Plan Volume 1 and 2

Appendix A – Current development consents, leases and licences

Description	Issue Date	Expiry Date
Bayswater Power Station Development Approval (Muswellbrook Council)	18/09/1980	-
DA 86-51 Ravensworth South Coal Mine (Department of Planning and Environment)	15/12/1986	15/12/2006 (Coal Extraction)
DA 144/93 Fly Ash Disposal in Ravensworth No. 2 Mine Void (Singleton Council)	8/12/1993	8/12/2028
DA 138/1993 Bayswater Power Station Site Ash Disposal (Muswellbrook Council)	16/12/1993	16/12/2028
DA 144/93.1 Modification of DA for Fly Ash Disposal in Ravensworth No. 2 Mine Void (Singleton Council)	17/03/1994	8/12/2028
DA 138/1993.1 Additional parallel return water pipeline from Ravensworth Void Rehabilitation Site to Bayswater Power station (Muswellbrook Council)	1/02/2006	1/02/2041
DA 144/93.3 Modification of DA for Fly Ash Upgrade for Disposal in Ravensworth No. 2 Mine Void (Singleton Council)	25/07/2006	8/12/2028
DA 144/93.5 Modification of DA to allow disposal of tailings into Void 4 East (Singleton Council)	4/01/2007	8/12/2028
DA 144/93.6 Modification of DA to facilitation rehabilitation of Ravensworth South Mine Final Void and defer filling, capping and rehabilitation of Void 4. (Singleton Council)	29/10/2012	8/12/2028
Deed of Agreement Between DRE and AGLM	11/03/1994	-
Deed of Agreement between Nardell Coal Corporation Pty Limited and Macquarie Generation for the Ravensworth South Site	7 /11/ 2002	-
Deed of Agreement between Nardell Coal Corporation Pty Limited and Macquarie Generation for Disposal of Tailings and Reject	7/11/2002	-

Description	Issue Date	Expiry Date
Deed of Assignment , Assumption and Release for Macquarie Generation Agreements - Nardell Coal Corporation Pty Limited, Newpac Pty Limited and Macquarie Generation	-	-
DA309-11-2001 as modified, Construction and Operation of tailings pipelines (ACOL)	19 Feb 2007	
Agreement for the Disposal of Tailings – Ashton Coal Operations Pty Limited and Macquarie Generation	1 Aug 2006	-
Access and Compensation Agreement (Agreement) with Resource Pacific Limited, RUM’s owner, which stipulates RUM’s requirements in relation to repair of damage caused by longwall activities.	-	-
Mining Lease 1484	10/10/2001	31/07/2024
Mining Lease 1485	10/10/2001	17/08/2036
DA140/2016 Ravensworth Composting Facility	19/04/2018	-
DA173/2016 Ravensworth South Composting Facility		

Key licences and permits

Issued By	Number	Grant date	Expiry, renewal or anniversary date	Comment
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Environmental Protection Licence				
NSW Environment Protection Authority	Bayswater Power Station Environmental Protection Licence 779	20/04/2000	01 July	Licence varied by notice 1603865 issued on 11 December 2020.
NSW Environment Protection Authority	Liddell Power Station Environmental Protection Licence 2122	26/04/2000	01 July	Licence varied by notice 159155 issued on 23 July 2020.
NSW Environment	Bettergrow Pty Ltd Environment	25/09/2000	22 June	Licence varied by notice 1565003 issued on 14 June 2018. Licence

Issued By	Number	Grant date	Expiry, renewal or anniversary date	Comment
Protection Authority	Protection License 7654			transfer approved by application 1591894 on 06 August 2019.
NSW Environment Protection Authority	LOOP Organics Pty Ltd Environment Protection License 20892	30/06/2017	30 June	License varied by notice 1576241 issued on 08 March 2019.

Appendix B – Rehabilitation risk assessment bowtie

