Alcoa of Australia Limited

Huntly Mine Closure Plan

March 2025

No.	Mine Closure Plan (MCP) checklist, as per Department of Mines, Industry Regulation and Safety (2020) mine closure plan guidance	Y / N / NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
1	Has the checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.)	Y		Below this table	NA		
	Public availability						
2	Are you aware that all MCPs will be made publicly available?	Y			NA		
3	Is there any information in this MCP that should not be publicly available?	N			NA		
4	If “Yes” to Q3, has confidential information been submitted in a separate document/section?	NA			NA		
	Cover page, table of contents						
5	Does the MCP include:						
	Project Title	Y	NA	Title page	NA		
	Company Name	Y	NA	Title page	NA		
	Contact Details	Y	1		NA		
	Document ID and version number	Y	NA	Title page	NA		
	Date of submission (needs to match the date of this checklist)	Y	NA		NA		
	Scope and purpose						
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements)	Y	3		NA		
	Project overview						
	Does the project summary include:						
	Land ownership details	Y	5		NA		

No.	Mine Closure Plan (MCP) checklist, as per Department of Mines, Industry Regulation and Safety (2020) mine closure plan guidance	Y / N / NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
	Location of the project	Y	6		NA		
	Comprehensive site plan(s)	Y	9		NA		
	Background information on the history and status of the project	Y	5		NA		
	Legal obligations and commitments						
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y	22		NA		
	Stakeholder engagement						
9	Have all stakeholders involved in closure been identified?	Y	28		NA		
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y	30		NA		
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	31		NA		
	Post-mining land use(s) and closure outcomes						
12	Does the MCP include agreed post-mining land use(s),	Y	93		NA		
	Closure objectives and	Y	112		NA		
	Conceptual landform design diagram?	NA			NA		
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	Y	109		NA		
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the	Y	109		NA		

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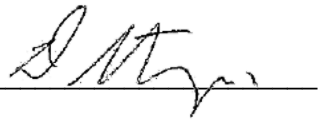
	operation of the mine, been reported to DWER as required under the *Contaminated Sites Act 2003*?						
	Development of completion criteria						
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y	116	Table 8-3	NA		
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y	32		NA		
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	NA			NA		
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	Y	151		NA		
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	95		NA		
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	122		NA		

No.	Mine Closure Plan (MCP) checklist, as per Department of Mines, Industry Regulation and Safety (2020) mine closure plan guidance	Y / N / NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
	Identification and management of closure issues						
21	Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	Table 5-14		NA		
22	Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?	Y	122		NA		
	Closure implementation						
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	122		NA		
24	Does the MCP include a closure work program for each domain or feature?	Y	122		NA		
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	NA			NA		
26	Does the MCP contain a schedule of research and trial activities?	Y	135		NA		
27	Does the MCP contain a schedule of progressive rehabilitation activities?	Y	129		NA		
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	139		NA		
29	Does the MCP contain a schedule of decommissioning activities?	Y	140		NA		
30	Does the MCP contain a schedule of closure	Y	143		NA		

No.	Mine Closure Plan (MCP) checklist, as per Department of Mines, Industry Regulation and Safety (2020) mine closure plan guidance	Y / N / NA	Page No.	Comments	Changes from previous version (Y/N)	Page No.	Summary
	performance monitoring and maintenance activities?						
	Closure monitoring and maintenance						
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?	Y	143		NA		
	Financial provisioning for closure						
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	147		NA		
33	Does the MCP include a process for regular review of the financial provision?	Y	148		NA		
	Management of information and data						
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y	149		NA		

Corporate endorsement: TO BE SIGNED AHEAD OF PUBLIC CONSULTATION

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of the Department of Mines, Industry Regulation and Safety.

Name: Darrin Strange Signed: 

Position: WA Manager of Mines Date: 11/03/2025

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1. Proponent and purpose

1.1 Proponent

Alcoa of Australia Limited (Alcoa) is a joint venture between Alcoa Corporation (60 per cent share) and Alumina Limited (40 per cent share).

Alcoa's operations in Australia represent one of the world's largest integrated bauxite mining, alumina refining and aluminium smelting systems. Operations include:

- Two bauxite mines in Western Australia (Huntly and Willowdale).
- Three alumina refineries in Western Australia (Kwinana[1], Pinjarra and Wagerup).
- One aluminium smelter in Victoria (Portland).
- Two dedicated port facilities in Western Australia (Kwinana and Bunbury).
- Two farmland sites in Western Australia (Pinjarra and Wagerup).

A map of Alcoa's operations in Western Australia is provided in Figure 1-1.

Each year Alcoa mines approximately 34 million dry metric tonnes of bauxite, refines approximately 9.5 million tonnes of alumina and produces approximately 300,000 tonnes of aluminium[2]. Alcoa produces almost 50 per cent of Australia's alumina and approximately 20 per cent of Australia's aluminium. Alcoa's alumina production in Western Australia accounts for approximately 7 per cent of total world production.

Proponent details are listed in Table 1-1.

Table 1-1 Proponent details

Proponent Details		
Company Name	**Alcoa of Australia Limited**	
ACN/ABN	93 004 879 298	
Site address	181 – 205 Davy Street, Booragoon WA, 6154	
Postal address	PO Box 252, Applecross WA 5953	
Key contact representatives	Name	Luke Gossage
	Position	Environment Manager – WA Mining
	Phone number	08 9530 2356
	Email	luke.gossage@alcoa.com
	Name	Darrin Strange
	Position	Huntly Mine Manager
	Phone number	08 9530 2803
	Email	Darrin.Strange@alcoa.com

[1] The Kwinana Refinery was curtailed in 2024, but may reopen within the lifespan of this Proposal subject to market conditions.
[2] Alcoa -- Australia

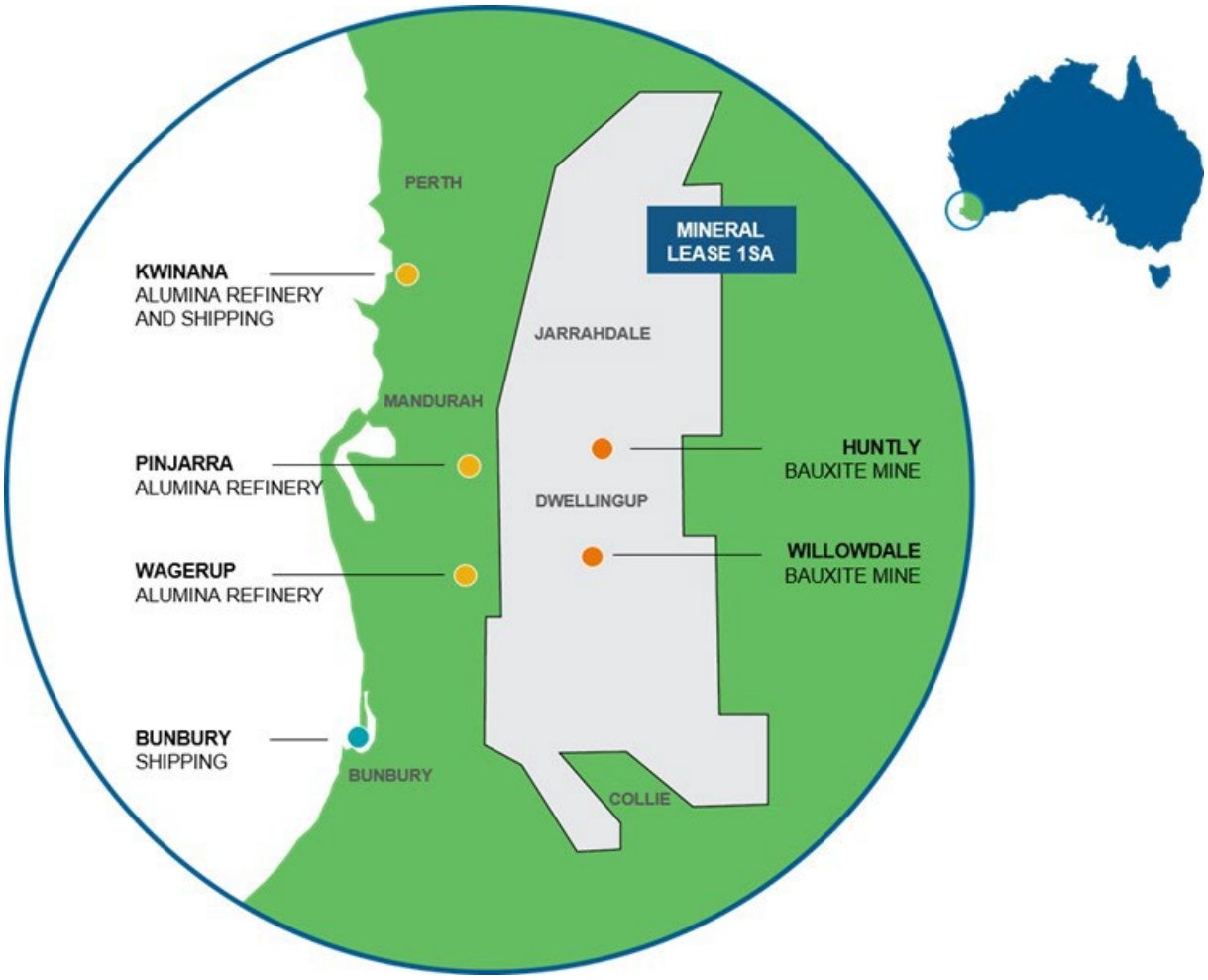


Figure 1-1 Mineral lease and locality plan

1.2 Scope

The scope of this Mine Closure Plan (MCP) is the Huntly Bauxite Mine (Mine) including its:

- Current mine operations, facilities and infrastructure at Myara.
- Former mining areas where there is redundant infrastructure that must still be demolished and the infrastructure area rehabilitated. Infrastructure at Del Park, Huntly 1 & 2and White Road as well as some storage facilities fall into this category.
- Mining areas at Myara under current rehabilitation.
- Former mining areas that are under rehabilitation or where rehabilitation has been completed but not yet signed off by the State as having achieved the applicable completion criteria under which the rehabilitation was done (at Huntly 1 & 2, McCoy, White Road and Del Park)[3]. These are described in Section 8.3.
- The proposed transition of the current mining operations into the Myara North and Holyoake regions.
- The reopening of the O'Neil mine region, including both previously cleared and rehabilitated areas and new areas within the region.

These areas are indicated in Figure 2-1.

1.3 Purpose

Planning for closure and rehabilitation needs to be undertaken in an effective and progressive manner in order to prevent and minimise adverse long term environmental, social and economic impacts. Effective and progressive closure planning is a prerequisite for leaving a post-closure landscape that is physically safe to humans, geotechnically stable, geochemically non-polluting/non-contaminating, and capable of sustaining an agreed post-mining land use (PMLU). Planning for closure needs to be conducted over the life of an operation. In general, planning aims to:

- Minimise the footprint of operations upon closure.
- Determine the optimum strategies for effective closure and rehabilitation of the site.
- Progressively rehabilitate disturbed areas during the life of the operation.
- Monitor the site during operations and upon completion of rehabilitation activities to demonstrate compliance with closure objectives.

The MCP has been developed in accordance with the Department of Mining, Industry Regulation and Safety (DMIRS) *Mine Closure Plan Guidance – How to prepare in accordance with Part 1 of the Statutory Guidelines for Mine Closure Plans* (DMIRS 2020).

The MCP describes the closure of the Mine in accordance with current regulatory requirements and guidelines, tenement conditions, previous approval commitments, company policies and commitments, and industry guidelines.

The objectives of this MCP are to:

- Describe the Mine and identify closure domains.
- Outline the legal framework for closure planning.

[3] Note: Alcoa has different sets of applicable completion criteria dependent on when the rehabilitation was implemented.

- Identify stakeholders, outline outcomes of stakeholder engagement and present the future stakeholder engagement strategy.
- Define the closure outcomes and PMLU.
- Detail an appropriate strategy to measure closure performance against agreed objectives and completion criteria.
- Present all related baseline data that informs closure.
- Identify early closure and final closure residual risks and controls to inform the closure plans.
- Describe the closure implementation plan for each domain (demolition and rehabilitation).
- Describe the current progressive as well as the final proposed rehabilitation methodologies to achieve successful rehabilitation of all areas disturbed by the Mine.
- Describe rehabilitation and decommissioning plans to create stable and non-polluting landforms that comply with soil, land, groundwater and surface water quality, and which does not impact post-closure amenity of surrounding land uses.
- Outline how closure knowledge gaps will be resolved.
- Present the methods for developing the closure cost model.
- Detail long-term management of closure related data.

The MCP may be used to inform the local and state government as well as other stakeholders of the progress of closure planning for the Mine.

As the Mine proceeds through operation to cessation of operations and closure, the MCP will evolve from this conceptual form through to a detailed plan. The level of detail will be refined as learnings are gained from rehabilitation or partial closure activities, accompanied by ever maturing stakeholder engagement.

2. Project summary

2.1 Background

The Mine is located within Alcoa's mineral lease (ML1SA) granted under the *Alumina Refinery Agreement Act 1961*. The total mineral lease area is approximately 750,000 ha. The Mine is located within State Forest on the Darling Plateau and lies predominantly within the shires of Murray, Serpentine-Jarrahdale and Boddington.

The Alcoa WA mining operations have to date cleared 4 per cent of the mineral lease and over the entire life of the mining operations, Alcoa expects to clear and rehabilitate less than 8 per cent of the mineral lease. Alcoa does not mine in old growth forest, gazetted national parks, nature conservation reserves, or other areas of high conservation value.

An overview of the Alcoa mining regions and Proposal Mine DE is shown in Figure 2-1, with the dates when they were mined, currently mined and planned to be mined in future. Mining currently occurs in the Myara mine region (mined 2014 – ongoing), located approximately 10 km south-east of Jarrahdale, with current and formerly used infrastructure located at Myara, McCoy (mined 2003 – 2015), Del Park (mined 1972 – 1978), Huntly 1 & 2 (mined 1986 – 1997), O'Neil (mined 2010 – ongoing) and White Road (mined 1989 – 2006). Planned expansions which are included in this MCP are Myara North (to be mined ~2025-2029),and Holyoake (to be mined ~2030-2035). The planned reopening of the O'Neil region (to be mined ~2026-2030) is also included in this MCP.

The Mine currently mines about 27 million tonnes per annum (Mtpa) of bauxite which is transported via overland conveyor to the Pinjarra Alumina Refinery and via an overland conveyer and rail to Kwinana Alumina Refinery.

Alcoa proposes to transition mining into the Myara North DE, located east of Jarrahdale and north of the existing operations, around 2028 with a further extension into the Holyoake DE, east of Dwellingup, in about 2033, and reopening of the O'Neil region, surrounding Mount Wells, in about 2026 (Figure 2-1). This would enable continuity of bauxite supply to the Pinjarra Alumina Refinery and Kwinana Alumina Refinery.

Although the Mine was established in 1976, an area known as Del Park previously supplied the Pinjarra Alumina Refinery and has rehabilitation dating back to 1972. Some remaining Del Park infrastructure, as mentioned previously, serves the current Huntly mining operation and as such is included in the scope of this MCP.

The Huntly Mine comprises a total area of approximately 80,298 ha (see Table 2-1) of which 56,398 ha comprises existing and historic mine regions and 23,900 ha comprises the three proposed Development Envelopes in Huntly (collectively the Proposal Mine Development Envelope).

2.2 Closure timeline

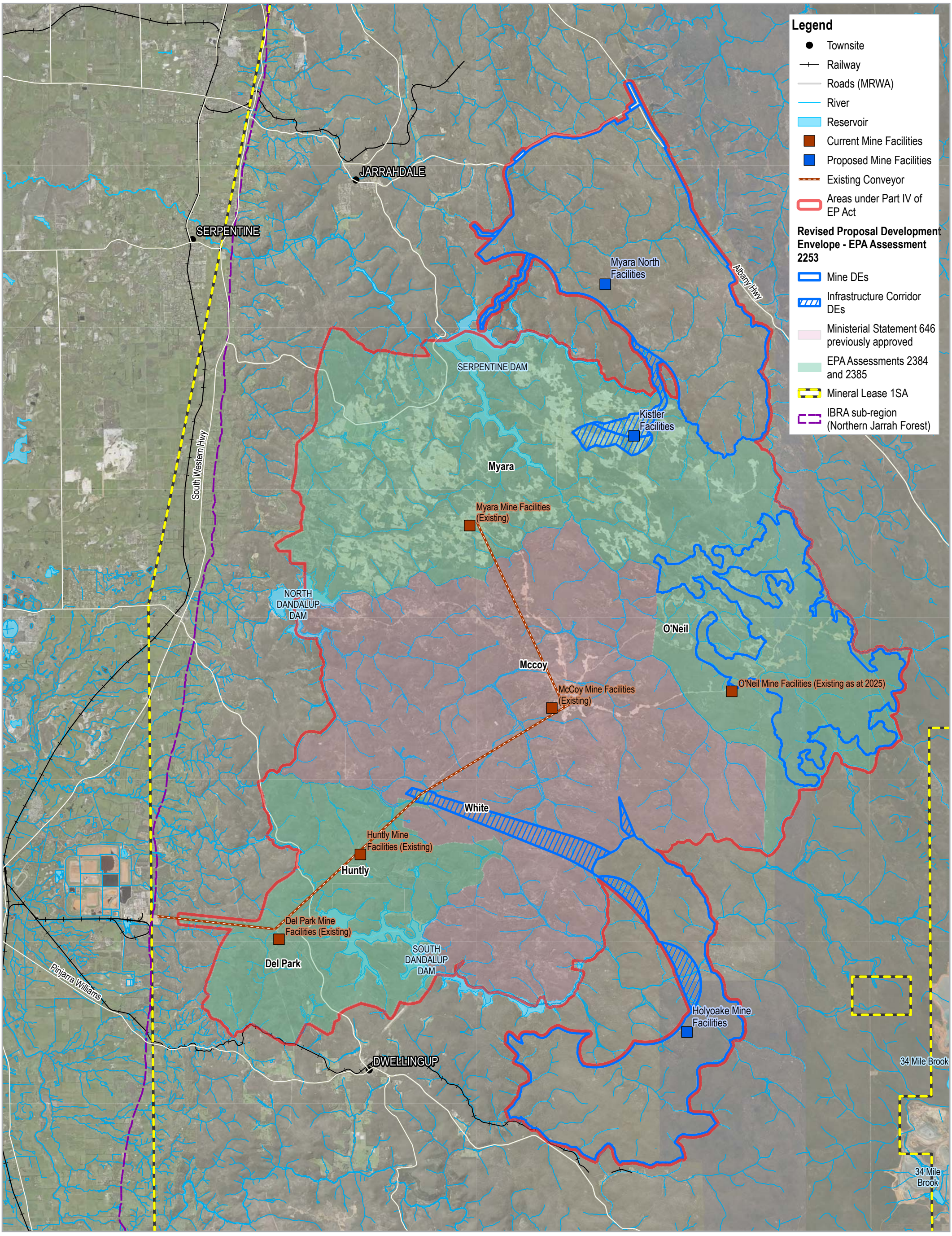
It is assumed for this MCP that the life of the Huntly mine (LoM) is until 2045. If the LoM is extended beyond 2045, the MCP will be updated as required to reflect the new LoM. The current assumption is that mining will cease in 2045 and that the MCP will be implemented from 2046 until final relinquishment of the site, once all completion criteria have been achieved. Although the MCP will be implemented once mining operations cease, Alcoa progressively rehabilitates mine areas over the operational life of mine.

Relinquishment is defined as when ownership, residual liabilities and responsibility for the Mine can be returned to the corresponding jurisdiction or original owner, or transferred to a third party, following completion of closure activities, and satisfying the agreed completion criteria. If

ongoing maintenance and management is required, the responsibility for this under relinquishment would also transition to the new responsible party.

2.3 Mine overview

The Mine lies predominantly in State Forest, which is under the management of DBCA, within Alcoa's mineral lease, ML1SA.



Scale: 1:160,000 at ISO A3

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Alcoa of Australia Limited
Pinjarra Refinery Revised Proposal - Environmental Review Document

Huntly Mine Closure Plan – Huntly Mine Overview

Project No. **12633192**
Revision No. **2**
Date **12/03/2025**

FIGURE 2-1

Data source: WANow: Landgate / SLIP.

Table 2-1 Huntly Mine regions

Region	Area (ha)	Status	Mining activity
Holyoake Mine DE	10,705	Proposed	~ 2026-2031
Myara North Mine DE	7,624	Proposed	~ 2026-2028
O'Neil DE	5,571	Reopened	~ 2026-2032
Myara	19,983	Existing	2014 - 2023
O'Neil	6,332	Historic	2010 - 2015
McCoy	15,731	Historic	2003 - 2015
White Road	11,486	Historic	1989 - 2005
Huntly 1 & 2	4,565	Historic	1986 - 1997
Del Park	4,633	Historic	1972 - 1987
Total	**80,298**		

2.4 Description of mining operation

2.4.1 Overview

Bauxite occurs as tabular ore pods that vary in depth from 2 -10 m and average about 3.5 m. The mining pits are located within the ore pods. The ore is overlayed with gravel and soils varying in depth from 0 - 1.5 m. The upper part of the ore frequently presents as cemented caprock, ranging in thickness from 0 - 2.5 m. Beneath the caprock is a friable zone that merges into clay with uneconomic quantities of alumina ore.

Due to the nature of the ore pods, the Mine is characterised by a constantly moving mining footprint followed by progressive rehabilitation. The Mine is therefore characterised by a mosaic of shallow mine pits linked via a network of haul roads to a centrally located crusher and facilities area. Crushed ore is conveyed to stockpiles at the Pinjarra Alumina Refinery, via a central conveyor and series of transfer stations. Some of the ore is transported to Kwinana Alumina Refinery by railway.

The mining sequence is illustrated in Figure 2-2 and described below.

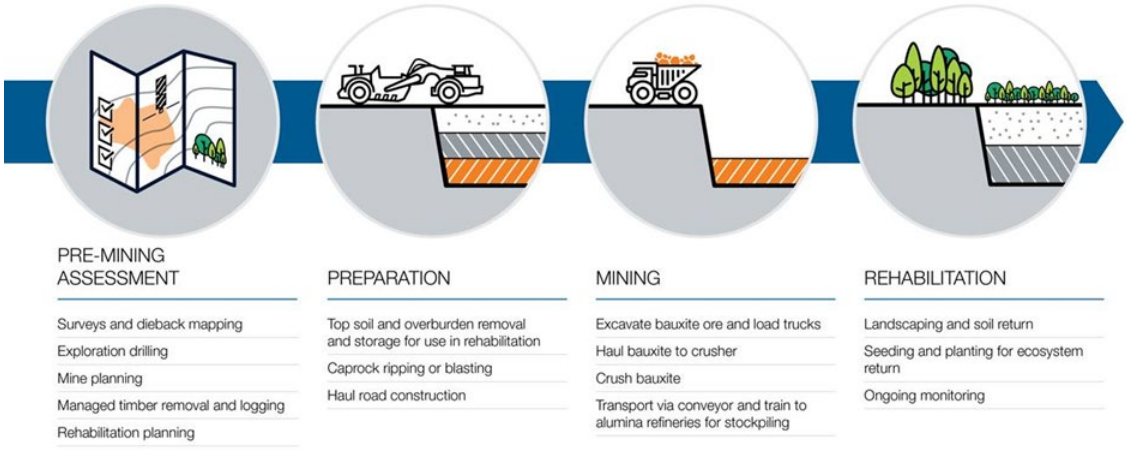


Figure 2-2 Mining sequence

2.4.2 Pre-mining assessment

Pre-mining surveys and exploration

As a part of the mine planning process, a range of surveys are undertaken at an early stage to characterise ore quality and volumes, and to assess geotechnical conditions. Surveys are also undertaken before mining as a part of the environmental approvals process to identify, and, where appropriate, protect or manage important environmental, cultural, heritage and social values.

After initial exploration, drilling commences at wide spacing (120 m grid) and then focuses in at closer spacing to define the extent of ore deposits. The final drill spacing to define ore boundaries is a 15 m grid. No drilling is done on granite outcrops or in stream zones. Drill lines are not cleared, with the small rigs manoeuvring between trees. Drill holes are capped after sample extraction to prevent fauna deaths.

Ecological surveys include vegetation mapping, establishing of vegetation monitoring plots, black cockatoo tree mapping, and assessment of *Phytophthora* dieback. The results of the surveys and exploration inform mine planning, including scheduling of mine pits and infrastructure, and planning of clearing, soil movement, and dieback management activities.

2.4.3 Preparation

Timber salvaging and clearing

Mine clearing is integrated with salvaging of forest products through Alcoa's working arrangements with the Forest Products Commission (FPC), along with other third parties, in accordance with the Forest Management Plan and Regional Forest Agreement. Any marketable timber within Alcoa's lease belongs to and is salvaged by the FPC. The remaining wood is provided to third parties for charcoal production, firewood or mulch. Some is also used to provide habitat for fauna in rehabilitated areas.

Soil stripping

Soil is stripped in two layers including a surface layer of topsoil (~ 150 mm) and a thicker layer (average 400 mm) of overburden.

The topsoil contains the majority of seeds, organic material, plant nutrients and microbial activity and is an important resource for rehabilitation. The topsoil for direct return is stripped to 75 mm

to avoid diluting the topsoil seed bank that is concentrated within the top 50-75 mm of the topsoil. This process involves stripping from one area that is about to be mined and returning the soil to an area that is being rehabilitated in a time-frame shorter than three months. This ensures that the biological components of the topsoil are not degraded due to long term storage in a stockpile. When topsoil is to be stockpiled for more than three months before being used in rehabilitation, it is stripped to a depth of 150 mm.

The overburden, averaging 400 mm in depth, extends down to the top of the cemented caprock layer, is stockpiled next to the mined area to be returned to the pit floor during rehabilitation.

2.4.4 Mining

The bauxite ore deposit that frequently presents as cemented caprock is broken either by blasting or by ripping with a large bulldozer. Blasting uses conventional Ammonium Nitrate - Fuel Oil (ANFO) explosives.

The broken cemented caprock and the underlying friable bauxite are removed by excavators and loaded on haul trucks. The mining fleet is diesel fuelled and includes excavators, loaders, trucks and earthmoving equipment.

The bauxite is trucked via a network of haul roads to Run of Mine (ROM) pads for primary and secondary crushing. The crushed ore is transported via a conveyor to stockpiles at the Pinjarra Alumina Refinery.

2.4.5 Rehabilitation

Landscaping and pre-ripping

Following the completion of mining, bulldozers push down the pit walls and shape the pits to a smooth undulating landscape, ensuring that the final topography does not allow water to run from the mined pits into downhill unmined areas. Large rocks are buried or incorporated into fauna habitat piles.

Before landscaping, areas that will be buried beneath fill, e.g. under pit faces, are deep ripped at 1.6 m spacing using a bulldozer fitted with a 1.5 m-long winged tine. This breaks up the compacted pit floor, allowing the infiltration of water through the soil profile and facilitating the growth of plant roots. After landscaping, areas that were not previously deep ripped are also deep ripped at 1.6 m spacing using a bulldozer fitted with a 1.5 m-long winged tine.

Overburden and topsoil return

Using scrapers, soil is returned to the landscaped area, first using stockpiled overburden and then topsoil that has been stockpiled for more than three months. The combined depth of returned overburden and stockpiled topsoil is targeted at 300 mm. Subsequently, direct return topsoil (that has been stored for less than 3 months) is spread at a targeted depth of 10mm to provide a soil seed bank that contributes substantial numbers of plants to the rehabilitation.

Return of logs and rocks for fauna habitat

Waste timber and rocks are placed in the rehabilitated areas to provide habitat for both vertebrate and invertebrate fauna. Logs and rocks are used as shelter and for foraging by mammals, reptiles, and a wide range of insects, spiders, and other invertebrates.

Contour ripping

Following topsoil and overburden return, the area is then ripped again on contour to 800 mm by a bulldozer with multi-tines. This final contour ripping removes compaction caused by the soil

return operation and produces contour furrows, which allow water infiltration and provide erosion protection until the vegetation develops.

Seeding and planting

A mixture of approximately 50 plant species, including tree and understorey plants, is represented in the broadcast seed mix. Seed is collected within a defined provenance zone up to about 30 km from each mine region to ensure that local genetic material is used for rehabilitation. The seeds are applied at a rate of about 1 kg/ha via a purpose-built air seeder attached to the ripping bulldozer or by hand seeding. Seeds are broadcast in the dry summer and autumn months. Appropriate pre-treatments to overcome dormancy and increase germination such as hot water or smoke are applied to some species before sowing.

The majority of rehabilitation is seeded with the objective to establish approximately 80 per cent jarrah (*Eucalyptus marginata*) and 20 per cent marri (*Corymbia calophylla*) as the dominant canopy species. Stream crossings are seeding with blackbutt (*Eucalyptus patens*) and bullich (*Eucalyptus megacarpa*) which are the dominant canopy species in stream vegetation communities.

Plant species that do not return from the soil seed bank or from the broadcast seed are called ‘‘recalcitrant’’ and are grown from seed (for species where seeds are scarce), cuttings or by tissue culture (Koch 2007). Propagation is carried out at various nurseries, and the plants are hand planted during winter. Up to 500,000 plants from 20 recalcitrant species are grown and planted each year. Many of these are dryland rushes and sedges that produce little viable seed. While young, the grass-like rushes and sedges are heavily grazed by kangaroos and are protected by small mesh guards to enable plants to establish.

If required, legume reseeding, Eucalypt planting and recalcitrant planting is done in rehabilitated areas where the cover does not appear to be on track to meet the required completion criteria, as determined at the 9 month monitoring point.

Fertilising

Fertiliser is applied in the second Spring after completion of rehabilitation, between August and September. This is a once-off fertiliser application.

Monitoring

In February/March each year (which is about nine months from the commencement of the previous wet season), the seeded and planted areas are monitored to assess compliance against the formal completion criteria agreed by the Bauxite Strategic Executive Committee (BSEC) (formerly known as Mine Management Planning Liaison Group (MMPLG)).

Areas of erosion or weeds are also identified and treated, if required, once the landform has stabilised. In the second spring after establishment (15 months old), the plant species richness is determined using 80 m^2 plots (one plot for first 5 ha plus one for each additional 5 ha) located randomly in the rehabilitated areas. A subset of these plots is permanently pegged and regularly re-monitored to become part of a long-term vegetation monitoring program. The 15-month monitoring as also assessed against the completion criteria agreed by the BSEC.

2.5 Description of mine facilities

Current and redundant Mine facilities are located at Myara, McCoy, Del Park, Huntly and White Road. These are illustrated in Plate 2-1 to Plate 2-5. Redundant mine facilities are those that are no longer in use but have not yet been removed and areas rehabilitated. Mine facilities include:

- Crushers
- Conveyors
- Roads
- Heavy and light vehicle refuelling bays
- Heavy and light vehicle wash bays
- Heavy and light vehicle maintenance sheds
- Fire station
- Oily wastewater treatment system
- Fuel and oil storage facilities
- Waste oil storage facilities
- Equipment and chemical stores
- Administrative offices and car parks
- General stores
- Laydown areas and hardstand
- Workshops
- Substations
- Domestic wastewater treatment and irrigation
- Ancillary buildings
- Lighting towers
- Fencing
- Storage facilities

Power is supplied by overhead and buried power lines or generated by diesel generators supplied by an above ground fuel farm. Explosives are located at appropriate sited facilities remote from human occupation. Non-explosive precursors are stored at a secure facility adjacent to Huntly Central. Minor offices are maintained at Huntly Central / Del Park to the south-west of McCoy. The Mine is a diesel only site, with all storage in above ground double walled tanks. Oily wastewater from workshops, fuel bay and vehicle wash down facilities is collected by an isolated drainage system and treated to remove sediment and hydrocarbons. The treated wastewater is tested to ensure it meets licensed water quality requirements before reuse. Clean stormwater runoff and treated water is reused for haul road watering, vehicle wash down and workshop hose down.

Plate 2-1 Main Myara facilities

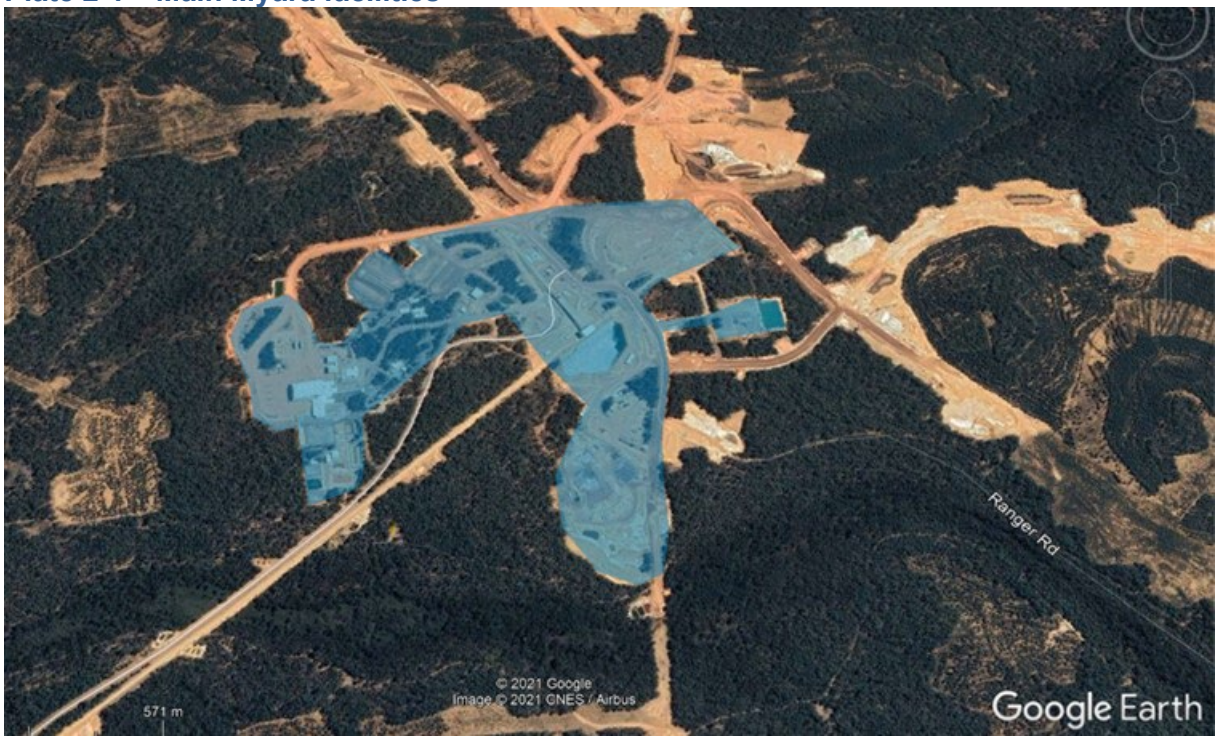


Plate 2-2 Main McCoy facilities

Plate 2-3 Main Del Park facilities

Plate 2-4 Main Huntly facilities

Plate 2-5 Main White Road facilities

2.6 Proposed future mining areas

New mine facilities for future mining at Myara North and Holyoake are proposed. These facilities include but are not limited to ROM stockpiles, refuelling and washdown facilities, fuel and oil storage, laydown areas, offices and wastewater treatment. These facilities will generally comprise similar facilities as the current Myara facility. The approximate area for each facility will be 100 ha. Plate 2-6 and Plate 2-7 present two aerial views of the existing Myara mine facilities, which are indicative of the scale and character of the new facilities proposed for Myara North. Power will be supplied by overhead power lines or on-site diesel generators and water supplies would be piped from existing mine water storage at McCoy.

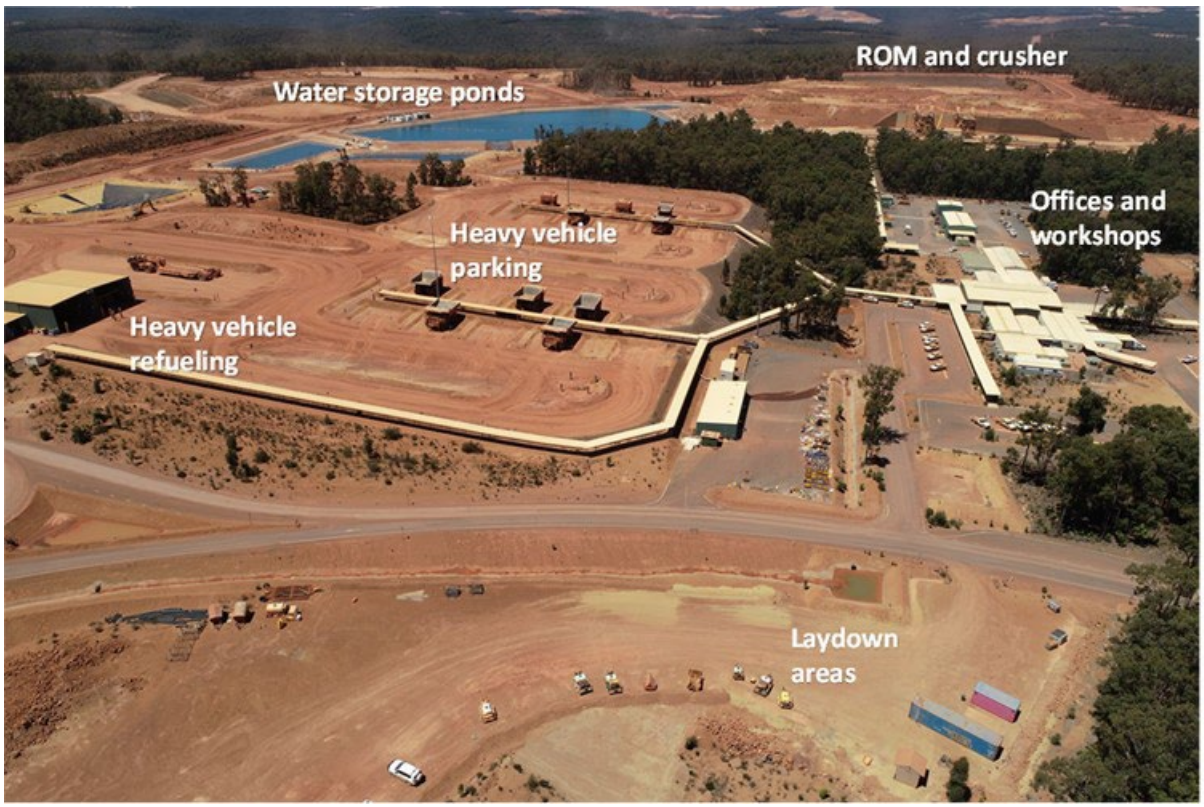


Plate 2-6 Myara mine facilities (View 1)

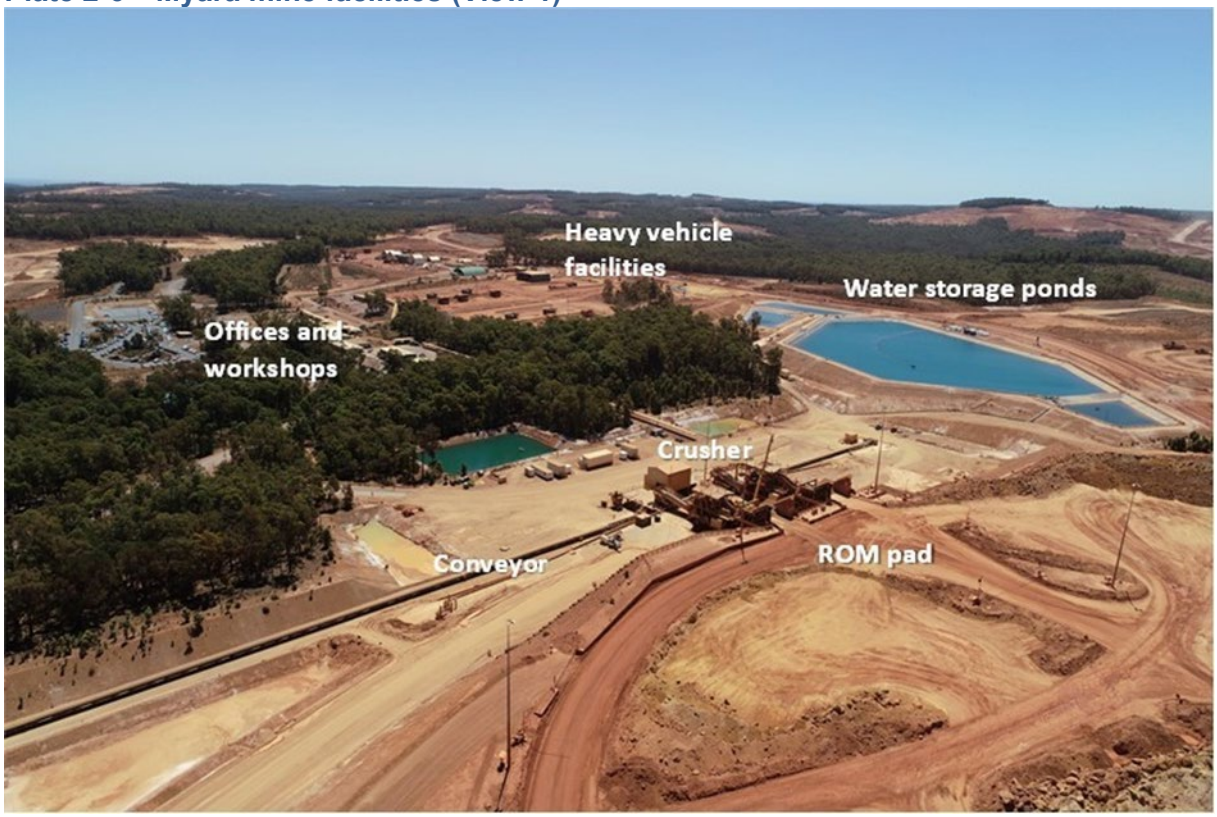


Plate 2-7 Myara mine facilities (View 2)

The development of Myara North and Holyoake would require the extension of new conveyors and haul roads and the development of new mine facilities in each respective DE. The proposed new conveyors and/or haul roads would connect with existing infrastructure where feasible, to maximise asset utilisation and minimise additional disturbance. The existing facilities at McCoy would be retained to provide support operations including vehicle maintenance, storage and fire response. The proposed new conveyor corridors would connect to the existing conveyor corridor, with the transfer stations retained at McCoy and White Road, to transport ore to the

Pinjarra Alumina Refinery. Haul road and conveyor corridors would be cleared to a width of approximately 30-50 m depending on topography.

No significant new facilities or conveyors are required to reopen the O'Neil region, as existing redundant infrastructure could be repurposed for the reopening of the region. However, haul roads within the O'Neil will need to be reopened and extended to facilitate the reopening, including connection to a primary haul road that links to the crusher at McCoy,

The Myara North, Holyoake and O'Neil DEs comprise approximately 10,705 ha, 7,624 ha and 5,571 ha respectively. The proposed future mining areas would involve a total of approximately 7,500 ha of clearing. Alcoa propose to transition the current Mine operations to the Myara North and O'Neil DEs from about 2026, to transition mining into the Holyoake DE from around 2028.

2.7 Mine water use and catchment protection

2.7.1 Mine water use

The Mine water supply is from surface water sources. The primary water supply for the Mine is the Alcoa Banksiadale Dam (which receives water from both its own catchment area and the Water Corporation South Dandalup Dam). Water from the Banksiadale Dam is pumped to a header tank on Radio Hill where the water is chlorinated and then pumped to Huntly Central, White Road, Myara and McCoy. Other sources include Boronia Waterhole, Pig Swamp Waterhole, and Myara and McCoy reservoirs.

The reservoirs are used to store water pumped from Banksiadale Dam, site stormwater runoff and treated oily wastewater. Reservoir water is used for haul road dust suppression, crusher wash down, dieback wash down and workshop hose down.

Domestic workforce sewage (as opposed to oily wastewater) is treated at mine facilities using Aerated Treatment Units which incorporate disinfection. The treated wastewater is discharged into irrigation / infiltration beds in forested areas adjacent to the mine facilities as well as to revegetated areas.

2.7.2 Catchment protection

Alcoa undertakes specific management practices to protect drinking water catchments within the Mine areas. Mining is excluded within defined distances from reservoir top water levels (TWL) and stream zone vegetation. Surface water drainage controls are provided to ensure safe mining and to prevent off-site flooding, erosion, impacts to water quality, and spread of *Phytophthora* dieback. All drainage is undertaken in accordance with Alcoa's drainage management and design manuals. The drainage management manual prescribes the engineering design of all drainage systems including haul roads, facilities and mine pits, to manage peak runoff and sediment loading during major storm events and prevent untreated discharges off-site. Turbidity and pollution prevention are thus managed through discharge and infiltration sumps. Drainage within pits can include uphill diversion drains, contouring, and water shots (blasted infiltration strips) to capture and infiltrate runoff from within pits, where required. Drainage is provided on haul roads including culverts, bunding, and sumps to divert, isolate, and capture surface runoff and sediment.

Sumps from mine pits and rehabilitation areas are designed to a 1 per cent 24 hour annual exceedance probability (AEP) rainfall event. For haul roads, sumps are designed with a capacity to retain runoff from a 1 per cent AEP 72 hour storm event. Plate 2-8 presents the general haul road drainage employed while Plate 2-9 presents the existing triple cell stormwater drainage sump at the Big Brook haul road crossing, which is indicative of the sumps that would be provided for the proposed crossing of the Serpentine and South Dandalup Rivers and major tributaries. Water retained in the third sump is tested prior to release into the tributaries. Spill

response equipment is maintained at the three stage (triple) sumps to facilitate immediate respond to hydrocarbon spills if they occur.

Plate 2-8 Myara Mine haul road drainage

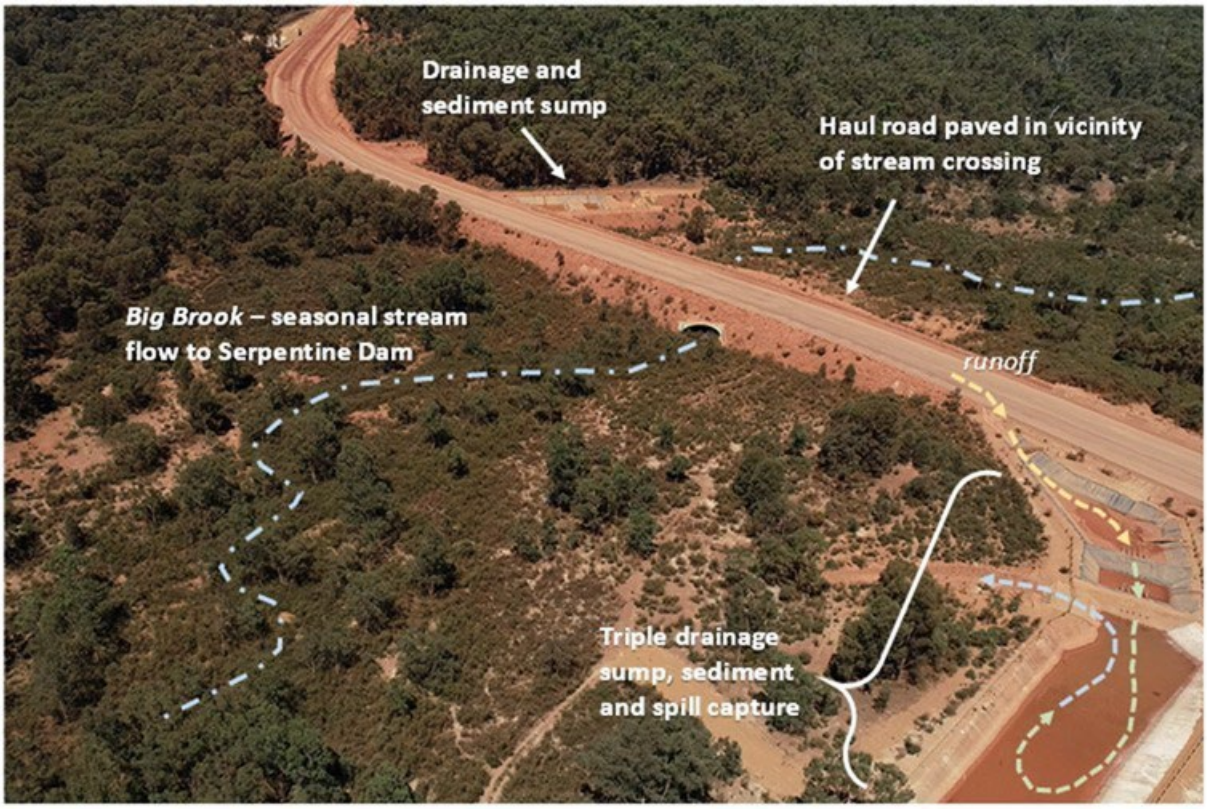


Plate 2-9 Sediment sumps at haul road crossing of Big Brook

2.8 Closure domains

To facilitate closure planning, the mine has been divided into two domains (Table 2-2) that represent groups of disturbed sites and/or infrastructure that will have comparable requirements at closure. In the closure work program in Section 9, an additional site-wide domain is described to capture closure works that cut across all domains.

Table 2-2 Project domains and disturbed sites

Domain	Disturbed site	Sub-domain area	Cleared area approx. (ha)
Mining support infrastructure	Facilities at the various sub-domains to support mining operations.	Myara	101
		McCoy	79
		Del Park	31
		Huntly	2,752
		White Road	66
		Myara North*	1,029
		Holyoake*	1,234
		O'Neil*	489
Mining and rehabilitation	Mining areas, haul roads and haul road corridors, conveyor corridors to Pinjarra Refinery and progressive rehabilitation areas	Huntly*	4,748
		Myara North*	2,190
		Holyoake*	1,985
		O'Neil*	573

*These areas have not been cleared and the area is indicative

3. Identification of closure obligations and commitments

3.1 Applicable legislation

The Mine operates in accordance with State Agreement Acts, environmental legislation and licences. These detail the rights, obligations, terms and conditions in relation to the operation of the Mine. The State Agreements, read together, and in conjunction with a range of Ministerial Statements issued under the *Environmental Protection Act 1986* (EP Act), create a regulatory framework that Alcoa has operated under since it first began operations in Western Australia. Other relevant acts which could potentially impact on closure planning and final closure are listed below:

- *Alumina Refinery Agreement Act 1961*
- *Alumina Refinery (Pinjarra) Agreement Act 1969*
- *Alumina Refinery (Wagerup) Agreement and Acts Amendment Act 1978*
- *Alumina Refinery Agreements (Alcoa) Amendment Act 1987*
- *Biodiversity Conservation Act 2016* (WA)
- *Conservation and Land Management Act 1984* (WA)
- *Rights in Water and Irrigation Act 1914* (WA)
- *Aboriginal Heritage Act 1972* (WA)
- *Dangerous Goods Safety Act 2004* (WA)
- *Mines Safety and Inspection Act 1994* (WA)
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
- Environmental Protection (Alcoa – Huntly and Willowdale Mine Sites) Exemption Order 2004
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth)
- *Contaminated Sites Act 2003* (WA)

3.2 Legal obligations and other commitments

3.2.1 State Agreement Acts

Alcoa's bauxite-alumina operations in Western Australia are subject to the *Alumina Refinery Agreement Act 1961*, the. *Alumina Refinery (Pinjarra) Agreement Act 1969* and *Alumina Refinery Agreements (Alcoa) Amendment Act 1987.* Section A26 11(2) of the *Alumina Refinery Agreement Act 1961* is in respect to crushing plant and states "Upon termination of this agreement the Company may remove the plant filling in consolidating and levelling off the land affected".

3.2.2 EP Act Part IV

Part IV of the EP Act requires assessment and approval of 'significant proposals' that, if implemented, may have a significant impact on the environment.

Alcoa referred the Pinjarra Alumina Refinery Revised Proposal (including Mine extensions to Myara North and Holyoake, and the reopening of O'Neil) to the Environmental Protection

Authority (EPA). On 6 July 2020 the EPA determined that the Pinjarra Alumina Refinery Revised Proposal was a significant proposal and requires assessment at the level of Public Environmental Review with a ten-week public review period (Assessment No. 2253). The preliminary key environmental factors for the assessment were:

- Flora and vegetation
- Terrestrial fauna
- Terrestrial environmental quality
- Inland waters
- Air quality
- Greenhouse gas emissions
- Social surroundings.

3.2.3 EPBC Act

The *Environmental Protection and Biodiversity Act 1999* (EPBC Act) protects Matters of National Environmental Significance (MNES) within Australia. Section 67 of the EPBC Act defines a 'controlled action' as one that is likely to cause a significant impact to a MNES and which must be approved under the EPBC Act. Parts 7 and 8 of the EPBC Act provides for the referral and assessment of controlled actions. Alcoa referred the Proposal to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the EPBC Act as a split referral for the Refinery (EPBC 2022/09213) and Mine (EPBC 2022/09204) components. On 18 August 2022, a delegate of the Commonwealth Minister for the Environment determined that both components of the Proposal were controlled actions and require assessment and approval under the EPBC Act. The controlling provisions were:

- Listed threatened species and communities.
- Ramsar wetlands.
- Listed migratory species.

The assessment approach for EPBC 2022/09204 and EPBC 2022/09213 was determined to be accredited assessment under the EP Act.

On 19 May 2023, Alcoa submitted a request to the DCCEEW to vary EPBC 2022/09204 under s156A of the EPBC Act. The variation was in accordance with the third modification of the Proposal under s43A of the EP Act, reducing the Mine DE by 7,300 ha and reducing the disturbance footprint from 9,273 ha to 8,323 ha. The variation to EPBC 2022/09204 was approved by the DCCEEW on 7 July 2023.

On 21 October 2024, Alcoa submitted a request to the DCCEEW to vary EPBC 2022/09204 under s156A of the EPBC Act. The variation decreased the size of the Myara North DE by 4,698 ha, from 15,403 ha to 10,705 ha and Holyoake DE by 11,076 ha, from 18,700 ha to 7,624 ha. The amendment reduced the disturbance footprint within the Proposed Action's Mine DE by 1,885 ha, from 8,323 ha to 6,438 ha.

The O'Neil DE is to be assessed under a separate assessment process under the EPBC Act.

3.2.4 Licences

The Mine operates subject to an Environmental Licence (L6210/1991/10) granted under Part V of the EP Act. The Licence is valid to 2035 and authorises the prescribed premises of processing or beneficiation of metallic or non-metallic ore.

The Mine has water abstraction licences granted under the RIWI Act, including SWL 63409 (500 ML/year), 83356 (70 ML/year) and 153635 (30 ML/year) from 2014-2024. These allow abstraction from South Dandalup catchment and Marrinup Brook. Alcoa also has an agreement to purchase water from the Water Corporation South Dandalup Dam.

Discharge of treated oily wastewater is licensed by DWER (L6210/1991/10). The oily wastewater includes runoff from refuelling bays, workshops and hardstand areas at risk of hydrocarbon contamination.

The Mine operates in accordance with Dangerous Goods Storage Licences (DGS004240 and DGS008201) granted under the *Dangerous Goods Safety Act 2004*.

3.2.5 Mining and Management Program

All bauxite mining is carried out in accordance with a Mining and Management Program (MMP) approved by the Minister for State Development on advice from the Minister for Environment and BSEC. Alcoa submits the MMP annually to the BSEC as required by Ministerial Statement 728 Procedure 4. The MMP includes:

- Five-year mine plan (clearing, mining and rehabilitation areas).
- Planned infrastructure, including access and construction.
- Mining method and rate.
- Water supply requirements and water sources.
- Catchment protection measures.

Bauxite Strategic Executive Committee (BSEC)

As of July 2024, the Bauxite Strategic Executive Committee (BSEC) replaced and now fulfills the existing advisory functions of the Mining and Management Plan Liaison Group as they are described in Ministerial Statement 728 and Environmental Protection (Alcoa – Huntly and Willowdale Mine Sites) Exemption Order 2004. The BSEC is chaired by the Department of Jobs, Tourism, Science and Innovation (DJTSI) and consist of representatives of the Department of Water and Environmental Regulation (DWER), Department of Health (DoH), Department of Planning, Lands and Heritage (DPLH), Forest Product Commission (FPC), Department of Biodiversity, Conservation and Attractions (DBCA), Department of Energy, Mines, Industry Regulation and Safety (DEMIRS), and the independent Chair of the Alcoa Independent Technical Advisory Group (ITAG).

BSEC provides advice and recommendations to the Minister for State Development with regards to approval decisions on the annual Mining and Management Program (MMP) that Alcoa is required by its State Agreement to submit and have approved.

The conditions accompanying the Minister for State Development's approval of Alcoa's 2023-2027 MMP included the requirement for Alcoa to provide adequate resourcing to ensure that the ITAG was reconstituted by 30 June 2024. ITAG provides technical input to assist BSEC fulfill its functions (ITAG function 1) as well as providing advice to Alcoa in co-designing and implementing a range of technical studies and reports (ITAG function 2). Membership for ITAG function 1 consists of officer-level representatives from BSEC member agencies, plus Water Corporation. ITAG function 2 requires additional membership that will be determined by BSEC upon advice from the ITAG Chair, as informed by function 1 members; it is expected this will consist of relevant academic and research institutions, catchment councils and Alcoa.

Each year, Alcoa submits a rolling five-year MMP to BSEC for review, which is approved by the Minister for State Development in whole or with conditions. The MMP sets out Alcoa's mining and

rehabilitation schedule for the Huntly and Willowdale Mines and includes priority land uses and management plans agreed through the ITAG.

3.2.6 Standards and guidelines

In addition to complying with decommissioning and closure requirements in the various State Agreement Acts, Alcoa must comply with its own internal standards and guidelines. Alcoa's corporate document *Bauxite Mine Rehabilitation Standards and Guidelines* states, "Areas used for mining must be restored to a land use that is socially and ecologically sustainable". Under the section titled Decommissioning and Divestiture the following standards are listed:

- When mining is completed, facilities and equipment must be removed from the site unless some of the infrastructure is of use to landowners or the public. These may be left upon approval from the landowner and/or regulatory authority.
- Where natural ecosystems have been restored, stability and acceptable regenerative capacity should be demonstrated before responsibility ceases.
- All rehabilitated lands must be monitored for achievement of the established completion criteria.
- Until such time as completion criteria can be met, adequate resources must be allocated for effective maintenance of rehabilitated land.
- If the land is under a mineral lease or concession and not freehold, divestiture should coincide with attainment of completion criteria and, where applicable, recovery of bonds.
- If the company plans to transfer land to private ownership or to a state authority, agreement should be reached on the future use and management of the land.
- Where restoration of natural habitat is the intended use, an agreed management plan may need to be developed to ensure continued sympathetic management towards the rehabilitation objective.

3.2.7 Working arrangements

To set frameworks for control of Alcoa's operations and environmental management and protection, Alcoa developed Working Arrangements in consultation with key stakeholders through the BSEC:

- Water Working Arrangements (with DWER and Water Corporation) (2018 – 2023)
- Alcoa / Department of Environment and Conservation (now DBCA) Working Arrangements (2011 – 2015).
- Alcoa / FPC Working Arrangements (2017 – 2019)

The Water Working Arrangements (Water Corporation, Alcoa, DWER, 2019) maintain a coordinated approach to the management of mining operations and the protection of public drinking water source areas (PDWSAs). These are updated every five years or as required. The Water Working Arrangements identify Alcoa's planning, operational, monitoring, incident management and reporting procedures with respect to meeting Department of Water and Environmental Regulation (DWER) and Water Corporation's expectations for the mitigation of water related impacts from mining. While the arrangements are not legally binding, some of the principles on which they are based stem from statutory documents.

The Alcoa/DBCA Working Arrangements prescribe procedures for each step of the mining process from clearing to rehabilitation. Prescriptions represent mutually agreed, practical and technically sound specifications for executing field operations such as management measures for rehabilitation, drainage, dieback, and burning.

The Working Arrangements also describe the current agreed techniques to address the criteria and intent of the approved completion criteria for 1988 Onwards – Current Era. It requires:

- Public consultation prior to finalisation of the completion criteria and public access to the final completion criteria.
- Regular review and revision of the completion criteria via the BSEC, involving public consultation and access to the final document.
- Application of best practice environmental management principles.
- A certificate of acceptance to be supplied to Alcoa by DBCA on behalf of the State, where rehabilitated areas have met all appropriate criteria.

Alcoa's rehabilitation practices and procedures have developed over decades and completion criteria is subject to periodic review. Alcoa's rehabilitation areas are thus assessed against differing criteria and expectations depending on the year of establishment (see Section 8.3). Rehabilitated areas established up to 1987 are collectively termed Early Era Rehabilitation and reflect the agreed practice at that time of establishing a non-jarrah forest ecosystem with restricted objectives and values. From 1988, the rehabilitation objective changed to that of restoring a self-sustaining jarrah ecosystem, and the criteria was increasingly influenced by ecological considerations.

4. Stakeholder engagement

Alcoa recognises that engaging with communities and other stakeholders, seeking input into plans, sharing environmental performance and understanding community and stakeholder needs and aspirations is critical to maintaining its social licence to operate. Consequently, a range of informal and formal consultation methods are employed by Alcoa to involve and inform the community of the Company's activities.

This section provides an overview of key stakeholders identified, the stakeholder engagement methods deployed to date, and the future stakeholder engagement strategy.

4.1 Stakeholder identification

4.1.1 Internal and external stakeholders

Internal and external stakeholders include parties who are likely to affect, be affected by or have an interest in the closure planning and outcomes.

Key stakeholders in the context of this document are listed in Table 4-1. These include near neighbours and communities of our post mining operations; Bindjareb Noongar Traditional Owners; the local governments of Murray, Serpentine-Jarrahdale, Boddington and Wandering; relevant regulators; and local State and Federal members of parliament.

Given the significant role the mining operations play in local employment and the economy across the Peel region, local business and development groups such as the Peel Chamber of Commerce and Industry and the Peel Development Commission are also considered key stakeholders.

Table 4-1 Internal and external stakeholders

Stakeholder Group	Description
Nearby landowners	Landowners with property close to past, present and future mining operations
Local communities	Residents in communities close to past, present and future mining operations. In particular, the communities of North Dandalup, Keysbrook, Jarrahdale and Dwellingup Landowners (farmers and other smallholding) in the North Dandalup, Keysbrook, Jarrahdale and Dwellingup areas
Local government	Shire of Murray Shire of Serpentine-Jarrahdale Shire of Boddington Shire of Wandering
Government agencies	Department of Jobs, Tourism, Science and Innovation Department of Water and Environmental Regulation Department of Energy, Mining, Industry Regulation and Safety Department of Planning, Lands and Heritage Department of Health WA Environmental Protection Authority Department of Biodiversity, Conservation and Attractions Water Corporation Federal Department of Climate Change, Energy, the Environment and Water
Traditional owners	Bindjareb Noongar Traditional Owners Bilya Aboriginal Corporation Winjan Aboriginal Corporation South West Aboriginal Land and Sea Council Gnaala Karla Booja working group
Local agencies	Peel Development Commission Regional Development Australia - Peel
Members of Parliament	Federal Member for Canning State MLA for Darling Range State MLA for Murray Wellington State MLCs for South West Region State MLCs for the East Metropolitan Region
Community and non-government organisations and interest groups	Peel-Harvey Catchment Council Birdlife WA Dwellingup Community Compact Dwellingup Protection Group Jarrahdale Forest Protectors Jarrahdale Heritage Society Jarrahdale Community Collective Munda Biddi Trail Foundation Bibblumun Track Foundation Peel Trails Group

Stakeholder Group	Description
	Landcare Serpentine Jarrahdale
Business	Business partners and suppliers Peel Chamber of Commerce and Industry Local businesses including tourism operators
Media	Local, State and National media
Other	Recreational forest uses
Internal stakeholders	Alcoa employees and their dependants Contractors

4.2 Current stakeholder engagement

4.2.1 Background

Developing and maintaining strong, mutually beneficial relationships with stakeholders, including in the communities where Alcoa operates, is fundamental to its business model. Alcoa believes it is important to maintain transparent and regular dialogue with stakeholders to ensure a mutual understanding of issues, concerns and opportunities. A Stakeholder Engagement Framework guides engagement practices including consultation for ongoing operations and projects.

Alcoa has developed its neighbour relations and stakeholder engagement program in Western Australia over many decades. Dedicated community relations representatives at each location are responsible for managing local engagement programs, including responding to local questions and concerns, as well as Alcoa's community investment and employee volunteer programs. Engagement with community members and other stakeholders occurs via a range of channels and forums as outlined below:

- Stakeholder briefings – conducted with key stakeholders including local, state and federal government representatives on a regular basis. These briefings provide an opportunity for Alcoa to update on business operations and developments and for questions and concerns to be raised with the company.
- One-on-one neighbour engagement – is ongoing with community relations representatives at each of Alcoa's sites available to meet with neighbours to discuss ongoing operations, development plans and field questions or concerns. Each year, as part of the preparation of the Mine's Five Year Mine Management Plan, Alcoa invites mine neighbours to discuss the plan.
- Dedicated working groups – are convened as required to explore particular topics with stakeholders.
- Open house/community forums – provide an opportunity for broader community engagement in an open setting. This format is typically used to share information about specific projects with relevant subject matter experts available to share insights and answer questions.
- Site tours – offered by Alcoa for more than 40 years, providing the opportunity for people to visit and see the company's Western Australian operations, including the Huntly Mine, first-hand.

- Advertorials – published in community newspapers where Alcoa operates to provide a regular information flow to the broader community about the company's activities.
- Employee and contractor communications – occur via a variety of channels including townhall meetings, newsletter articles and briefings.

4.2.2 Myara North, Holyoake and O'Neil regions

Traditionally, Alcoa initiates consultation with landowners near future mine areas approximately five years prior to the commencement of mining as part of the preparation of the Five-Year MMP. Consultation on Huntly's next three proposed mine regions – the new Myara North region, the new Holyoake region and the reopened O'Neil region – has commenced as part of an environmental assessment being conducted by both the State and Commonwealth.

The proposed Myara North mine region is to the south-south-east of Jarrahdale in the Shire of Serpentine-Jarrahdale. Alcoa has been engaging with Jarrahdale stakeholders regarding potential mining in the vicinity since 2017. These stakeholders will continue to form part of Alcoa's engagement program. The proposed Holyoake mine region is east of Dwellingup in the Shire of Murray and extends into the Shire of Boddington. Alcoa has been engaging with nearby Dwellingup landowners and other stakeholders regarding potential future mining in the vicinity of the town since 2014.

4.3 Future stakeholder engagement

This MCP, being the first developed for the Mine under the DEMIRS Statutory Guidelines, will form the basis for future consultation on closure plans for the Mine. Prior to the next update of the MCP (proposed to be at five-yearly internals), Alcoa will consult with key stakeholders on the content of the MCP, particularly in terms of the proposed post-mining land use (PMLU) and the closure objectives.

Formal consultation between Alcoa and key stakeholders as well as concerns and issues raised by other stakeholders will be captured and included in the next version of the MCP.

During these stakeholder engagement processes Alcoa will focus on (but not be limited to) the following issues:

- Planned PMLU.
- Research and rehabilitation trials to inform closure.
- Planned progressive rehabilitation and closure activities.
- Providing updates on completion criteria (if any).
- Anticipated residual risks post closure.
- Potential reuse of infrastructure assets at closure.
- Lease relinquishment, liability transfer and post closure land management.

Alcoa is committed to ongoing engagement with key and other stakeholders on all aspects related to mine closure over the remaining life of mine.

5. Baseline and closure data and analysis

5.1 Natural landforms and topography

The Huntly Mine lies over the Darling Plateau land system, interspersed by the Murray Valleys land system. The Darling Plateau land system comprises an undulating lateritic plateau which is the remnant of a once extensive peneplain (Hickman et al 1992). The Darling Plateau is dissected by the Murray Valleys land system, which comprises deeply incised valleys of larger rivers such as the Serpentine and Murray and the lower reaches of smaller rivers (e.g. South and North Dandalup) as they approach and cut through the Darling Scarp. The Darling Plateau system is associated with the predominant lateritic surficial geology of the region whereas the Murray Valleys system has a higher prevalence of exposed bedrock.

The landforms of the Darling Plateau have been described by Churchward and McArthur (1980) and are presented in Figure 5-1.

The Darling Plateau lies in a region of rejuvenated and active drainage, which is distinct from the ancient drainage to the east in the Avon-Wheatbelt region (Pen and Hutchison 1999). The rejuvenated and active drainage is characterised by deep incised river valleys, such that the predominant lateritic upland and minor valley landforms of the Darling Plateau are dissected by major valley and valley floor landforms.

Over the Mine the lateritic uplands comprise the Dwellingup system and the minor valleys comprise the Yarragil system, which are widespread across the high rainfall zones of the western Darling Plateau. These two systems comprise approximately 86 per cent of the Mine.

The major valleys comprise the Murray system and within the Mine are primarily associated with the Serpentine River, Big Brook and the lower reaches of the Dandalup rivers. The system comprises approximately nine per cent of the Mine.

The Darling Plateau includes pockets of hills that can host concentrations of granite outcrops, which comprise the Cooke system. Over the Mine, the Cooke system includes the vicinity of Mount Solus within the Myara region and hilly pockets in Myara North, McCoy and Huntly 1&2 regions. The system comprises approximately nine per cent of the Mine.

Table 5-1 Mine landforms

Landform	Description	Total Huntly Mine (ha)
Cooke	Hills rising above general plateau level; mainly mantled by laterite but with some rock outcrop.	2792
Dwellingup (incl. Dwellingup 1, 2 and 3)	Gently undulating landscape with duricrust on ridges; sands and gravels in shallow depressions.	43365
Goonaping	Level to gently sloping imperfectly drained swampy margins with deep grey, yellowish brown or brown siliceous or bleached sands.	56
Hester	Ridges and hill crests on laterite and gneiss. Soils are sandy gravels, loamy gravels and loamy earths.	766
Mornington Hill	Low hills on laterite overlying granite. Relief 40-80m with a 5-20% slope. Soils are sandy and loamy gravels with some deep sands and loamy earths.	111

Landform	Description	Total Huntly Mine (ha)
Murray (incl. Murray 2 and 3)	Deeply incised valleys with red and yellow earths on slopes; narrow alluvial terraces. Subsystem	7313
Murray Valley	Incised valleys with shallow duplexes and rock outcrop. Gently to moderate slopes in some instances with duplex soils and common rock outcrop. 1, 2, 3	50
Pindalup	Valleys of the central part of the plateau; gravelly duplex soils on slopes; some rock outcrop; grey sands, duplex yellow soils and orange earths in broad floors.	1990

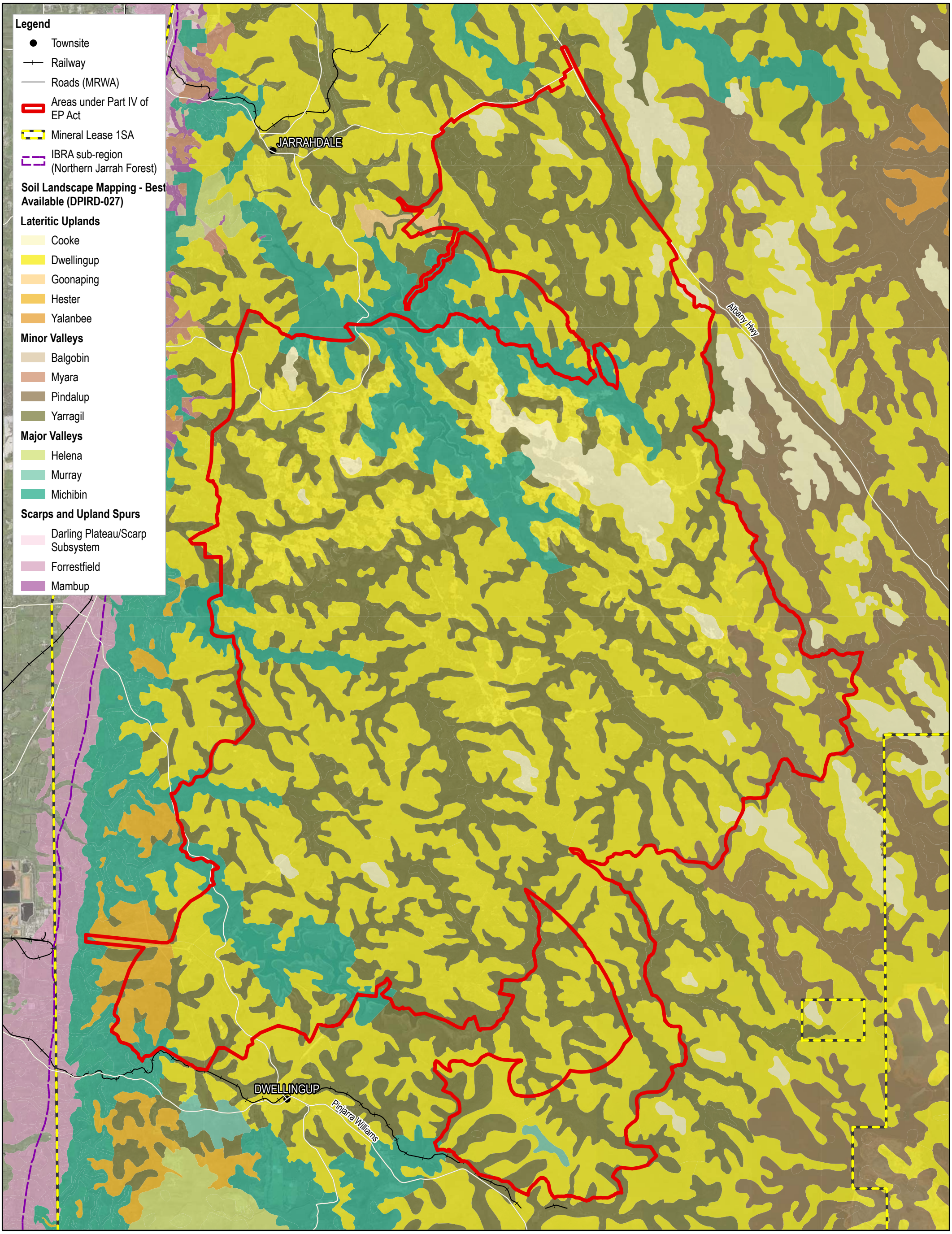
Landform	Description	Total Huntly Mine (ha)
Yarragil (incl. Yarragil 1, 2 and 4)	Valleys of the western part of the plateau; sandy gravels on the slopes; orange earths in swampy floors.	27196
Total		**83639**

As presented in Table 5-1, the landforms over the Mine are predominantly Dwellingup lateritic uplands interspersed by Yarragil minor valleys with swampy floors. Murray landform major valleys occur along the Serpentine River and South Dandalup River. Cooke upland hills and rock outcrops occur as pockets along the eastern portion of the Mine.

The Myara region within the Mine has the most diverse landforms, with approximately 17 different landforms occurring. The Myara North and Holyoake DEs are much less diverse, with over 90 per cent of the DEs covered by Dwellingup or Yarragil landforms. Yarragil, Dwellingup and Murray landforms occur within every region of the Mine. Small areas of Goonaping and Mornington Hill landforms occur only in the Holyoake and Myara North DEs, and both Mambup and Myara landforms are only found within the Myara region. A fair portion of the O'Neill DE also consists of the Pindalup landforms.

5.1.1 Knowledge gaps

No knowledge gaps identified.



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0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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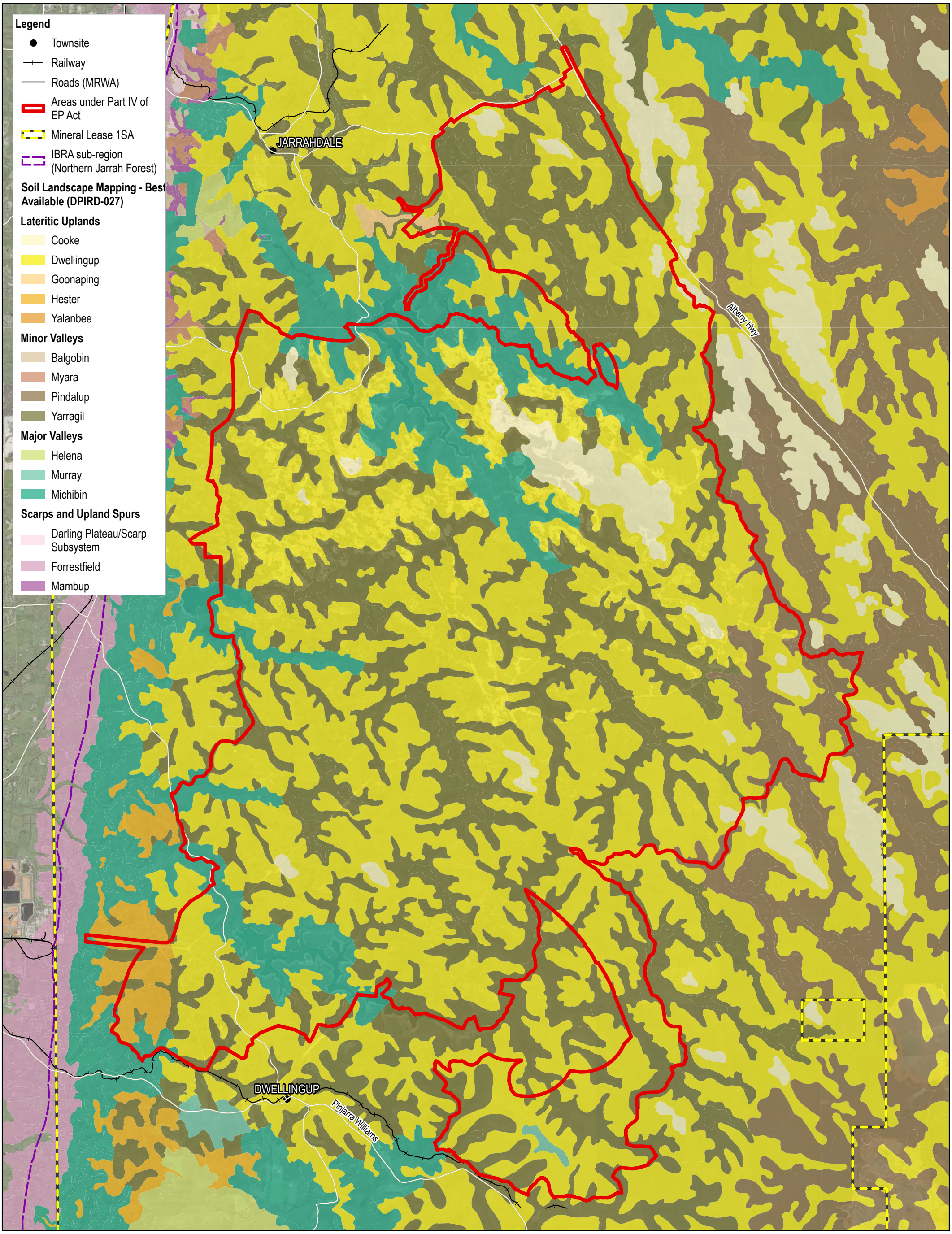
Alcoa of Australia Limited
Pinjarra Refinery Revised Proposal - Environmental Review Document

Huntly Mine Closure Plan – Land Systems

Project No. **12633192**
Revision No. **2**
Date **12/03/2025**

FIGURE 5-1

Data source: WANow: Landgate / SLIP.



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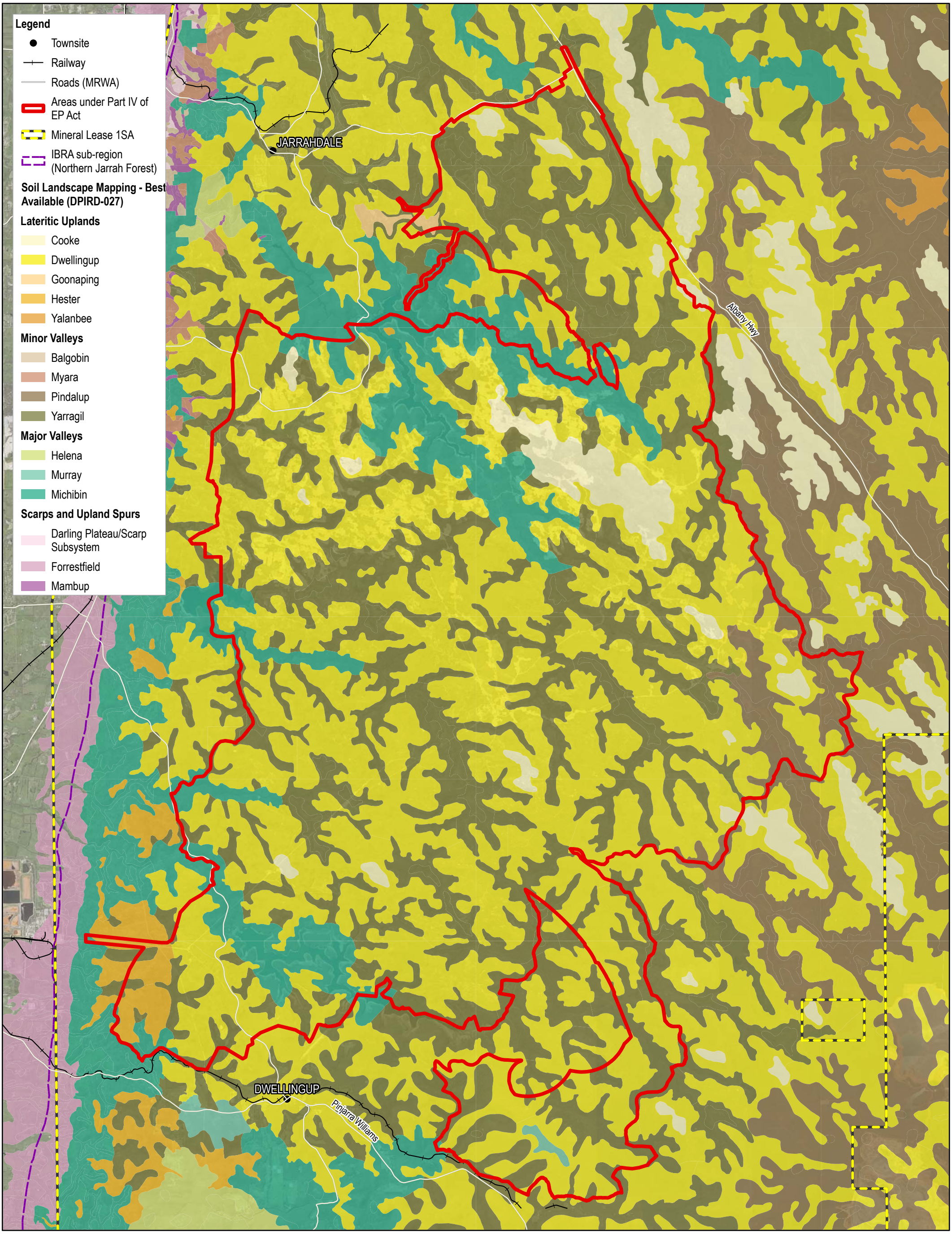

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Date **12/03/2025**

FIGURE 5-1

Data source: WANow: Landgate / SLIP.

5.2 Climate

Western Australia's south-west region has a 'Mediterranean' type climate characterised by typically high winter rainfalls and an intense summer drought.

The monthly rainfall, temperature and evaporation statistics from the Bureau of Meteorology (BoM) Karnet Station (No. 009111) from 1965 to 2020 are shown in Figure 5-2.

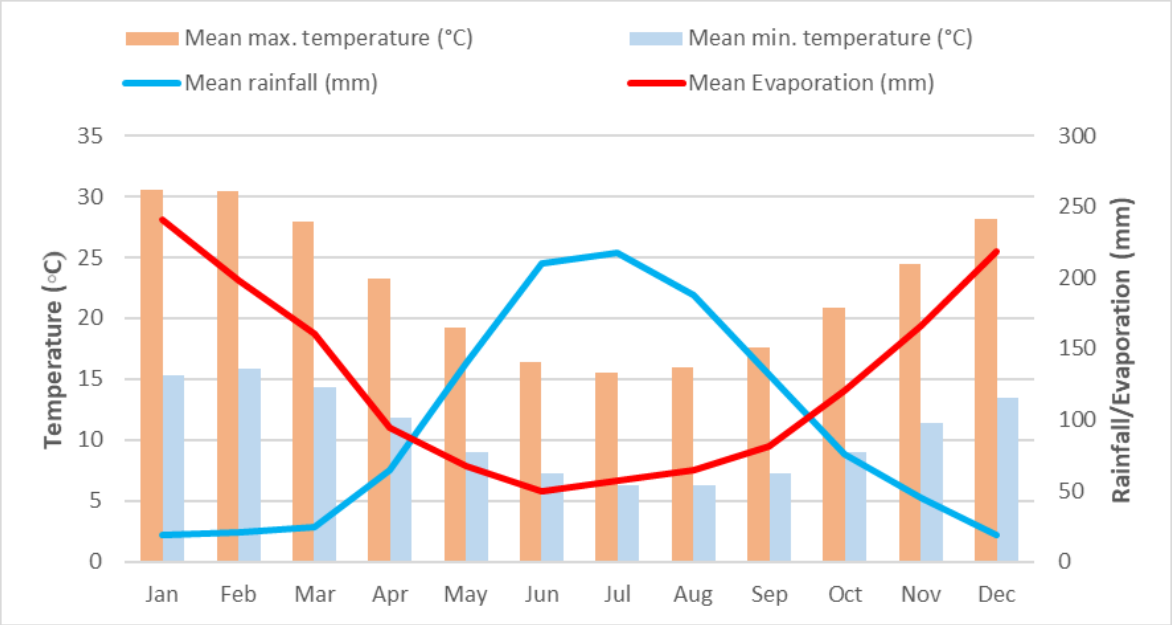


Figure 5-2 Monthly climate statistics at Karnet Station (Years 1965-2020)

5.2.1 Rainfall

Approximately 80 per cent of the total annual rainfall is recorded between April and September. Average annual rainfall between 1995 and to 2019 was approximately 1100 mm with the highest annual rainfall in 2017 (890 mm) and the lowest annual rainfall in 2010 (500 mm). The area has been experiencing a significant decreasing annual rainfall trend since the late 1960s and this decrease has further accelerated since the early 1990s. This trend is consistent across the South West of WA. The change to a lower rainfall regime in the late 1960s shows a reduction of 166 mm from 996 mm in the period 1917 to 1968 to 830 mm in the period 1969 to 2014. Figure 5-3 presents annual rainfall for the Karnet Station location based on extracted SILO[4] point data.

[4] Rainfall, temperature, and evaporation data sourced from the SILO data downloaded from https://legacy.longpaddock.qld.gov.au/silo/ppd/ on 5 June 2020. Point data from the SILO climate database (Queensland Department of Science, 2015) provides a continuous daily climatic record for a given point with gaps infilled based on interpolation of records from nearby weather stations.

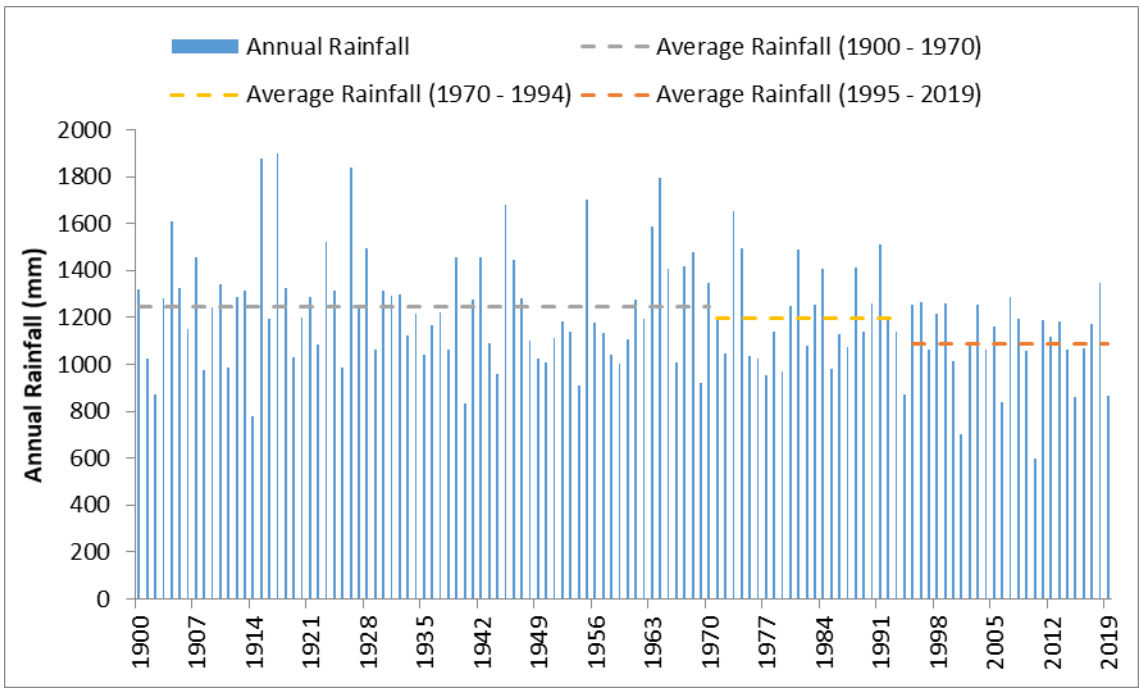


Figure 5-3 Annual rainfall at Karnet Station

5.2.2 Wind

Winds in the area are controlled by synoptic weather patterns and local features such as the topography and land breezes. The mine is located east of the Darling Scarp and has limited effects of the southwesterly sea breezes, drainage flows, pressure jumps from the escarpment or eddies that can form under strong easterly winds.

In summer, the predominant winds are moderate with strong east-southeasterly winds and moderate southwesterly winds. The strong southeasterlies are the result of the frequent synoptic easterlies in summer and the development of accelerated flows east of the escarpment. The southwesterly winds are associated with development of the sea breeze. For the winter months, the winds are light to moderate and predominately northwesterly and east-southeasterly, that are typical during winter (GHD 2021).

5.2.3 Temperature and humidity

The area temperatures are characteristic of the South West region of Western Australia. The mean monthly maximum temperature ranges from 15.8°C in July to 30.9°C in January. The warmest months at Karnet Station are January and February, when maximum temperatures average over 30°C, The coldest months are July and August when the maximum temperature is around 16°C .

Humidity at the Karnet Station generally peaks in the early mornings and drops during the day. Humidity is higher in winter than summer

5.2.4 Evaporation

Average annual evaporation (1,520 mm) typically exceeds average annual rainfall (1,153 mm), albeit rainfall exceeds evaporation during winter and shouldering months.

Pan evaporation at the Department of Primary Industries and Regional Development (DIPRD) Dwellingup monitoring station (PI001) indicates that average annual evaporation between 2011 and 2020 was 1,505 mm, with the lowest annual evaporation in 2012 (1,324 mm) and the highest in 2019 (1,863 mm).

5.2.5 Knowledge gaps

Impact of climate change. Revegetation monitoring to continue to determine adaptions (if any) required due to climate change.

5.3 Existing land use

The Huntly Mine lies predominantly within State Forest, as presented in Figure 5-4.

A brief summary of the existing infrastructure and land use is provided in the following sections based on review of relevant town planning schemes, DWER's contaminated sites database and aerial imagery.

Existing and historic land use, infrastructure and activities within the Mine include:

- **Tree farming** – Includes pine plantation and native timber harvesting.
- **Mine rehabilitation** - Bauxite mining and rehabilitation has been undertaken by Alcoa across various areas of the mining regions. Figure 5-9 shows areas which have been rehabilitated.
- **Recreation** - activities include camping, hiking, cycling, horse riding, picnicking, illegal hunting, licensed and unlicensed vehicle access.
- **Infrastructure** – includes Drinking water dams, Western Power transmission line, pipelines, roads, telephone lines and towers.

A review of the Shire of Serpentine-Jarrahdale, Shire of Boddington, Shire of Murray and Shire of Wandering Town Planning Schemes indicate that land uses in the north of the Mine are consistent with those identified in the Serpentine and Pipehead Dam and Wungong Brook Dam Catchment Protection Plans.

It is noted that Boddington Gold Mining (BGM) acquired under 100 ha of private land in the Serpentine Catchment with the intent to use it as part of a land exchange with DBCA. BGM do not intend to use this land for mining.

Alcoa is currently undertaking mining works within the Serpentine Dam catchment area in Myara, the potential impacts of which are covered in Section 5.6.1.

Existing and historic land use activities in the southern regions of the Mine include land and forest management, including timber harvesting, mining and gravel extraction, and recreation.

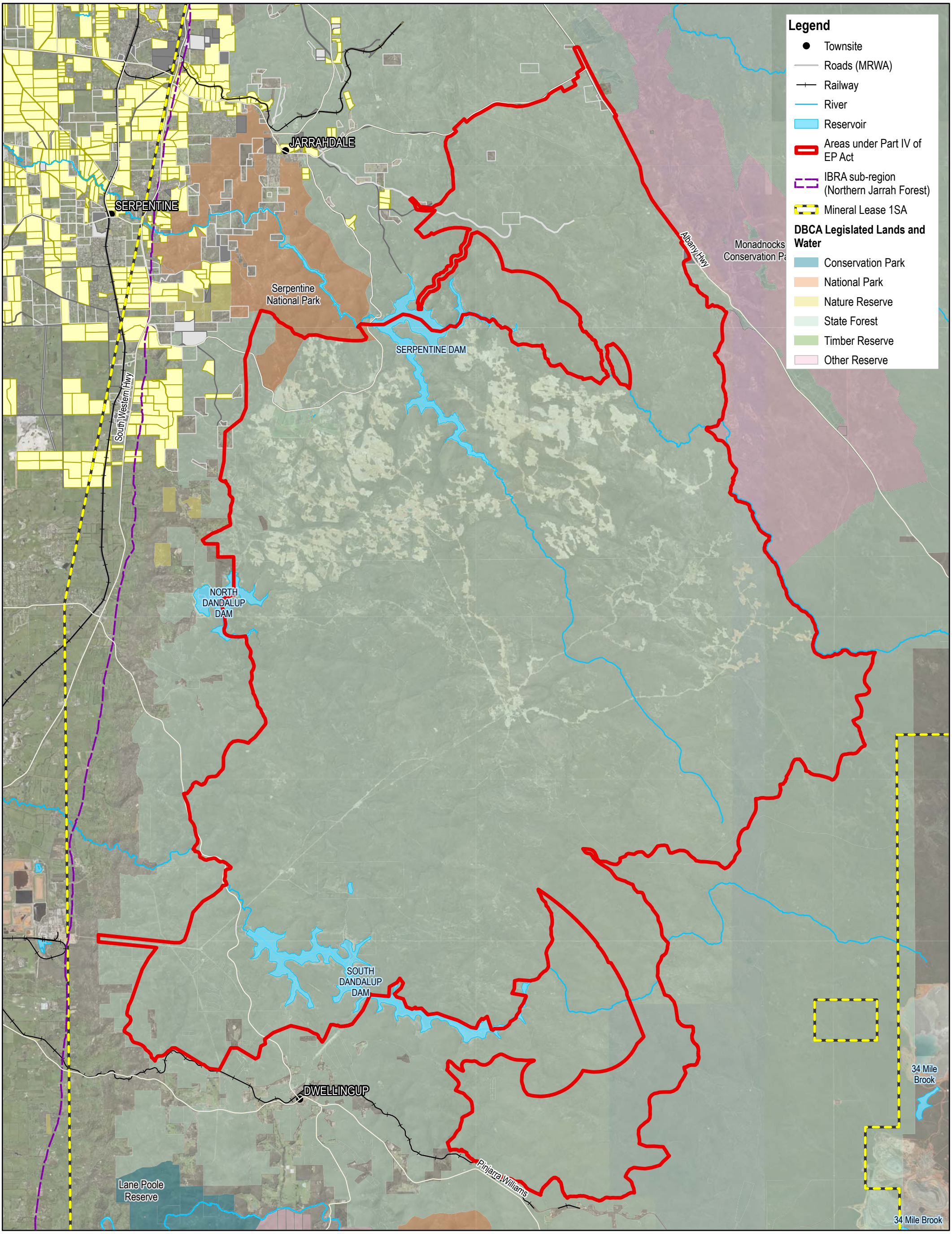
About 400 ha, or 1.2 per cent, of the South Dandalup Dam catchment is private land. The two private properties are located along the eastern boundary of the catchment and are owned by Bunnings Forest Products Pty Ltd and BGM joint venture. The area of land within the catchment is primarily native vegetation. The BGM operation does not currently encroach on the gazetted catchment boundary of the South Dandalup Dam catchment.

5.3.1 Receptors

The Mine is present within State Forest, which is multiple-use and managed for water catchment protection, timber production, recreation and conservation. Recreational uses of the Jarrah forest include bushwalking and cycling, as well as outdoor activities associated with the various rivers, wetlands and dams present throughout the region. There are also residential properties and agricultural activities within and adjacent to the ML1SA mineral lease area.

5.3.2 Knowledge gaps

No knowledge gaps identified.



Paper Size ISO A3

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Huntly Mine Closure Plan – Land Use

Project No. **12633192**
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FIGURE 5-4

Data source: WANow: Landgate / SLIP.

5.4 Geology

The Huntly Mine lies within the Darling Plateau, an undulating lateritic regolith over Archaean granite with dolerite intrusions. The Darling Plateau occupies the south-western fringe of the Yilgarn Craton and is bordered by the Darling Fault and Perth Basin to the west. Bedrock underlying the Huntly Mine is over two billion years in age and predominantly comprises granite with areas of granitic gneiss. Faults run in an approximate south-east to north-west direction. Dolerite dykes are common, intruding through the granite mostly in a north-northwest direction and ranging from 1-200 m thick (about 10 m average) (Hickman et al 1992).

The presence of granite, gneiss or dolerite is a major determinant on the characteristics of the regolith which overlies most of the bedrock. The bedrock outcrops in pockets throughout the Darling Plateau, including on hills or 'monadnocks' as well as within incised valleys where rivers have eroded through the regolith material. The bedrock has an irregular topography, with pinnacles and isolated boulders occurring at shallow depths in the regolith, at places reducing the thickness of laterite (Hickman et al 1992).

The regolith that covers the bedrock was formed through a long period of bedrock weathering, and averages about 30 m thick over the Darling Plateau (Hickman et al 1992). The upper layers of the regolith are lateritic, being rich in iron and aluminium derived from the bedrock, with a characteristic rusty-red colour. The regolith has a complex vertical sequence which is generalised as follows (from surface to bedrock) (Hickman et al 1992):

- Overburden, comprising sandy gravels about 0.2-4 m thick (average 0.4 m)
- Lateritic bauxite about 4-6 m thick comprising two distinct layers:
    - Duricrust or caprock, comprising iron or aluminium cemented rock about 1-2 m thick
    - Friable fragmental layer about 2 m or more thick
- Mottled and pallid clays (saprolite) about 20-30 m thick
- Saprock, comprising rock fragments about 2-5 m thick that define a basal interface between saprolite and bedrock.

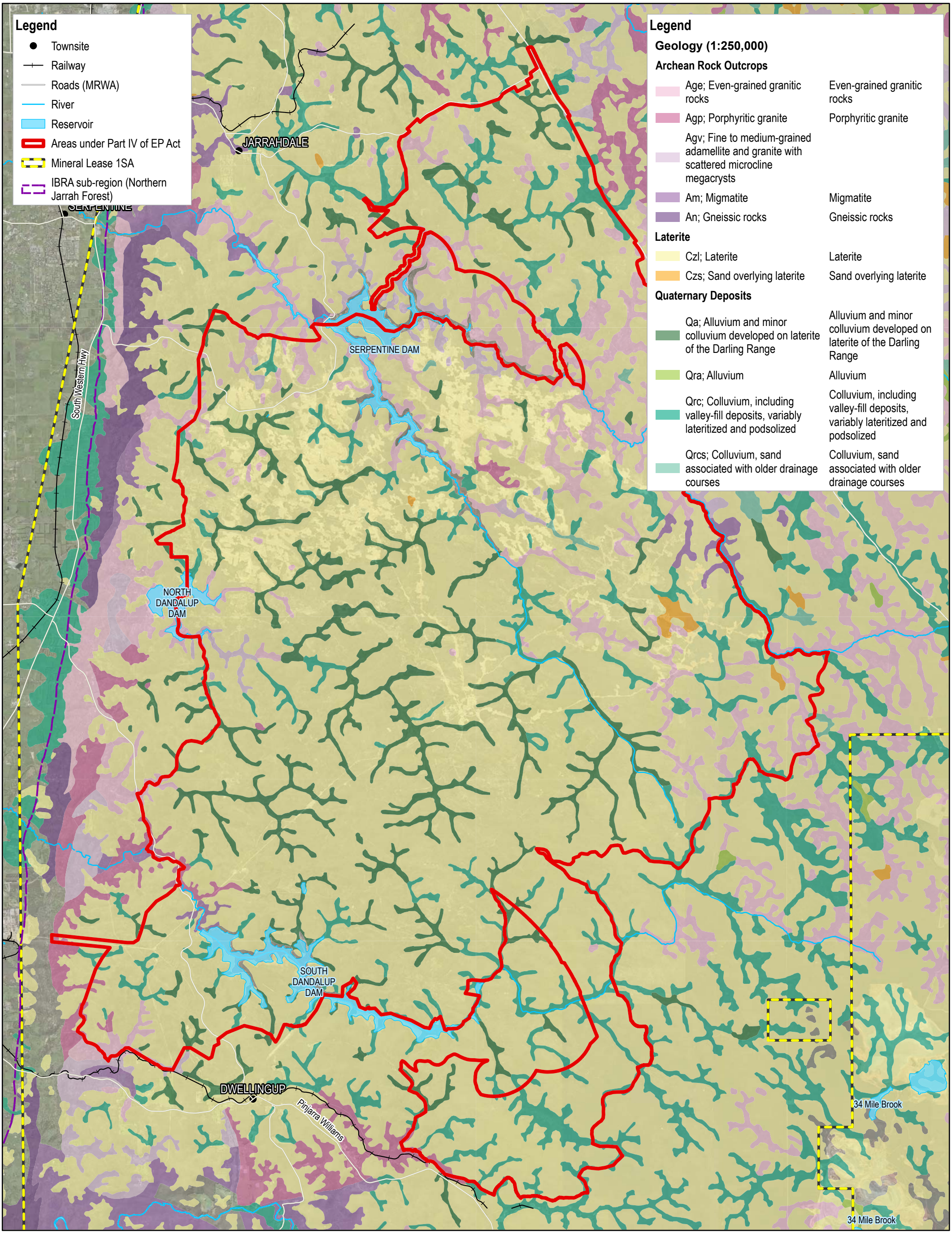
The regolith is partially or fully eroded in valleys that dissect the Darling Plateau, with the upper lateritic layers often absent and replaced by colluvial or alluvial deposits (Hickman et al 1992, Fordyce et al 2007). In some areas the regolith is fully eroded to expose bedrock.

5.4.1 Seismicity

It is also important to note that the South West region of Western Australia is of particular interest to seismologists as there is an apparent concentration of earthquakes in the area. This area, roughly between Geraldton and Albany, is known as the South West Seismic Zone. The zone exists on the Yilgarn Craton and runs in a northwest-southeast direction inland from the Darling Escarpment (although the exact boundaries of the zone are still imprecise) (Alcoa 2016).

5.4.2 Knowledge gaps

Although the site-specific information on the thickness of the weathering zone and how it changes spatially within the mine region area is not available, it does not present a knowledge gap for closure.



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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Huntly Mine Closure Plan – Geology

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FIGURE 5-5

Data source: WANow: Landgate / SLIP.

5.5 Soils

Superficial soils on the Darling Plateau comprise a thin veneer of topsoil (typically less than 0.1 m thick), which contains sand, silt and the majority of the seedbank, over a sandy gravel overburden layer (Hickman et al 1992). The overburden ranges from about 0.2 - 4 m thick and averages about 0.5 m. The overburden is underlain by lateritic bauxite, which is approximately 4 - 6 m thick and comprises a caprock (duricrust) layer and underlying friable fragmental layer. The caprock layer is discontinuous and varies from absent to a thickness of a few metres. The friable fragmental layer contains nodules, pisoliths and weathered rock fragments in fine-grained, loose earths or sands. The friable fragmental layer is generally about 2 m thick but can be up to 10 m thick on the Darling Plateau (Hickman et al 1992). Beneath the bauxite layers lie mottled, pallid and saprolite clay layers that are typically 20 - 30 m thick (Hickman et al 1992). These underlying layers form the pit floor following bauxite mining.

The soil catena of the Darling Plateau varies from the lateritic uplands (Dwellingup system) to the valleys (Yarragil system). The regolith is partially eroded in minor valleys, with the upper lateritic layers often absent and replaced by colluvial or alluvial deposits (Section 7.4.1.1). Whereas the upper and mid slopes comprise shallow gravelly sands, the lower slopes and valleys comprise thicker deposits of finer grained soils including silts, clays and loams (Hickman et al 1992, Fordyce et al 2007). Churchward and McArthur (1980) describe the soils of the minor valleys (Yarragil system) as orange earths and those of the major valleys (Murray system) as comprising red and yellow earths with some red and yellow duplex soils.

5.5.1 Knowledge gaps

No knowledge gaps identified but soil monitoring (soil texture / erodibility of mine pit areas) will continue during operations and closure.

5.6 Surface water

5.6.1 Catchments

The Mine is located within the basins of the Serpentine, Murray and Canning rivers. Approximately 87 per cent of the Mine lies within the catchments of eight water supply dams (Table 5-2). The eight dams are used for drinking water and their catchments comprise Priority Drinking Water Source Protection Areas (PDWSAs) (Figure 5-6). The majority of the Mine (77 per cent) lies within the catchments of Serpentine, North Dandalup and South Dandalup dams.

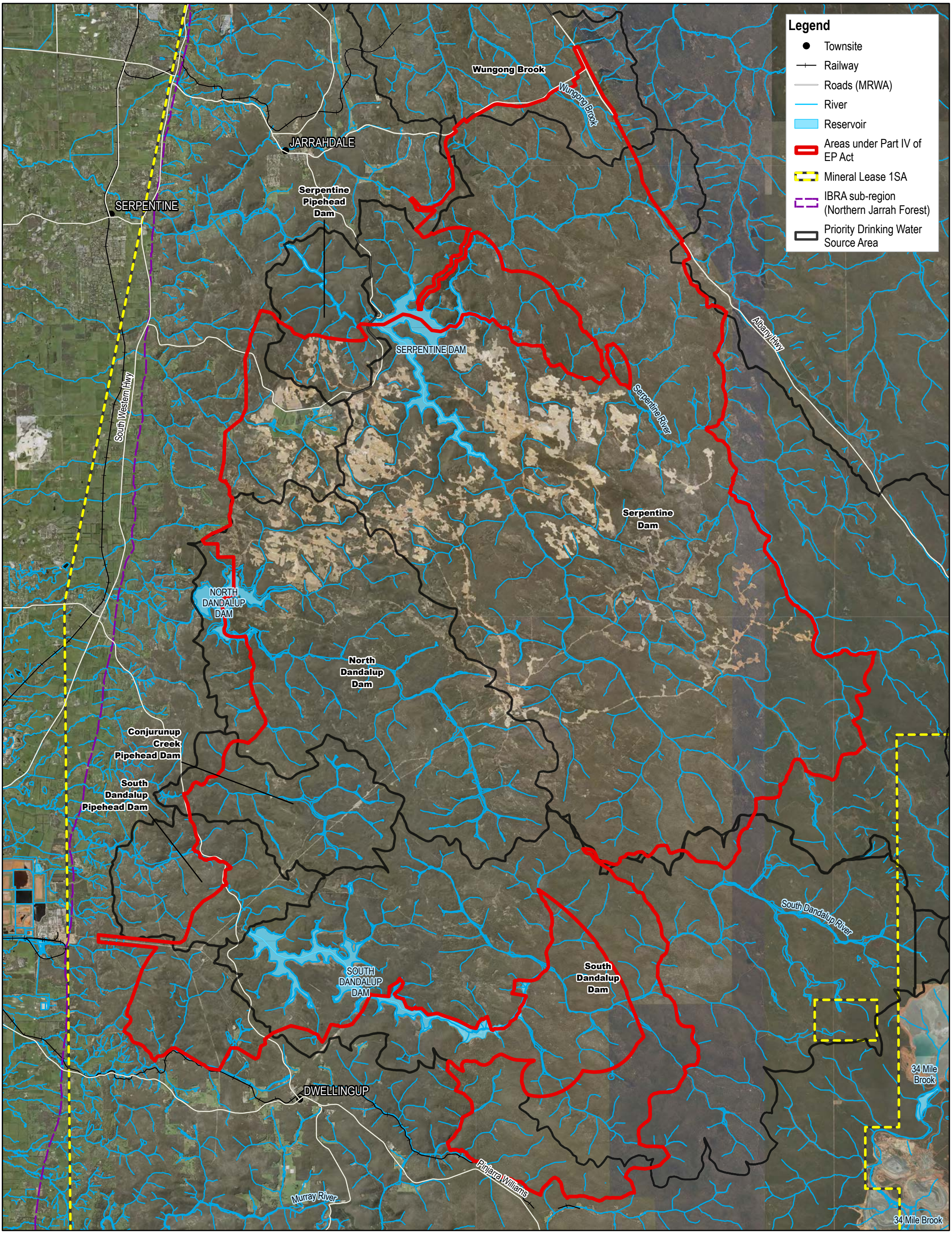
The remaining approximately 13 per cent of the Mine lies within the un-regulated catchments of the Serpentine and Murray Rivers.

The Serpentine, Murray and Canning River Basins have their headwaters in the Darling Plateau, an undulating lateritic regolith over Archaean granite with dolerite intrusions that retains extensive forested land of the Northern Jarrah Forest (NJF). The Darling Plateau generally lies at elevations of approximately 250 to 350 m Australian Height Datum (AHD), interspersed by isolated granite hills or ‘monadnocks’ that can exceed 400 mAHD. Rainfall is greatest in the western edge of the plateau near the Darling Scarp, decreasing to the north and east. The Serpentine, Murray and Canning rivers run in a characteristic north-west direction influenced by underlying granite and dolerite structures (Hickman et al 1992).

Public water supply dams have been developed along the Darling Scarp (Figure 5-6) including the western portion of the Mine. The water supply dams have been subject to declining rainfall and inflows since the 1970s.

Table 5-2 Surface water catchments

Catchment name	Area within Huntly mine (ha)	Proportion of Huntly Mine area (per cent)
Conjurunup Creek Pipehead Dam	3455	4.6
North Dandalup Pipehead Dam	13749	18.1
Serpentine Dam	40,635	53.5
Serpentine Pipehead Dam	1,146	1.5
South Dandalup Dam	13,997	18.4
South Dandalup Pipehead Dam	1,883	2.5
Upper Wungong Brook	1,046	1.4
Subtotal – regulated catchments	**74,766**	98.5
Unregulated catchments – Serpentine and Murray Rivers	**1,146**	1.5
Total	**75912**	100.0



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Huntly Mine Closure Plan – Surface Water Catchments

Project No. **22633192**
Revision No.
Date **12/03/2025**

FIGURE 5-6

Data source: WANow: Landgate / SLIP.

5.6.2 Reservoirs

The Mine lies east and adjacent to three drinking water reservoirs which comprise man-made perennial water bodies (see Figure 5-6):

- Serpentine Dam
- North Dandalup Dam
- South Dandalup Dam

The Mine contains a portion of the Serpentine Dam reservoir along Big Brook. The northern portion of the Mine lies in the upper catchment of Wungong Dam, northwest of the proposed Myara North DE.

Serpentine Dam diverts the majority of flow from its catchment for drinking water beneficial use. The Dam discharges into the Serpentine Pipehead Dam immediately downstream, which supplies the Integrated Water Supply Scheme (IWSS).

North Dandalup Dam diverts the majority of flow from its catchment for drinking water beneficial use. The Dam supplies the IWSS.

The South Dandalup Dam, the South Dandalup Pipehead and Wungong Dam divert all flow from the catchment for drinking water beneficial use. The South Dandalup Dam and Pipehead supply the IWSS.

5.6.3 Wetlands

The Mine is located approximately 25 km to the east of the closest Ramsar Wetland of International Importance, the Peel-Yalgorup System. The Mine is predominantly within the Serpentine, Dandalup and Murray River catchments, which are within the catchment of the Ramsar wetland. The Peel-Yalgorup System consists of shallow estuaries, freshwater marshes and coastal saline lakes that include the Harvey Estuary, Peel Inlet, Lake McLarty, Lake Mealup and ten Yalgorup National Park wetlands.

The Mine is located approximately 20 to 30 km to the east and south-east of the closest wetlands mapped under the Directory of Nationally Important Wetlands (NIWs). The Mine does not lie in the catchment of the NIWs, which are located in the Perth Metropolitan region, to the north of the Serpentine River catchment, with the exception of the Peel-Harvey Estuary which forms part of the Peel-Yalgorup System Ramsar wetlands. The nearest NIWs are:

- Forrestdale Lake
- Gibbs Road Swamp System
- Spectacles Swamp
- Becher Point Wetlands
- Peel-Harvey Estuary

The State Government has undertaken geomorphic wetland mapping over regions subject to extensive clearing, including the Swan Coastal Plain and Avon Wheatbelt.

There is no geomorphic wetland mapping of the Darling Plateau; however, geomorphic wetland mapping for the Swan Coastal Plain extends approximately 10 km east into the Darling Plateau and covers the western extent of the Mine. The mapping classifies wetlands present within valley floors as palusplain or floodplain flats, and headwater swamps as sump or dampland basins.

The geomorphic wetland mapping classifies wetlands as conservation category (where they are relatively intact), and resource enhancement (where they partially cleared for development, e.g.

rural properties, Karnet Prison). The wetlands located within the existing and historic Mine regions are mapped conservation category, reflecting the lack of clearing except for occasional haul road crossings.

5.6.4 Surface water flows

Some of the larger streams in the High Rainfall Zone (HRZ) west of the historic 1,100 m isohyet have previously exhibited perennial base flows. However, the drying climate discussed has caused a significant reduction in streamflow, leading to a shift from perennial to ephemeral streams and a decline in the runoff coefficient in recent decades. These declines have been observed as a step-change response to below-average rainfall years (Petrone, Hughes, Van Niel, & Silberstein, 2010; Hughes, Petrone, & Silberstein, 2012). For the Upper Serpentine catchment, a further decline in streamflow of 24 per cent has been forecast by 2030, compared to the historical (1997-2007) average streamflow (Silberstein, et al., 2012).

Groundwater storage is a key factor influencing the step-change response in streamflow, as it acts as the catchment memory. Where permanent groundwater levels fall below the stream bed and become disconnected after low rainfall years, this step-change in streamflow is observed. Unless above-average annual rainfalls persist, these streams will there after only flow after saturation has occurred causing runoff and infiltration to occur (Petrone, Hughes, Van Niel, & Silberstein, 2010; Hughes, Petrone, & Silberstein, 2012).

There are several flow gauging sites relevant to the Mine. Table 5-3 contains a list of gauging sites along with their catchment areas and average annual streamflow, calculated from the full datasets available for each station. Note that some stations have ceased recording and others have no available flow data.

The South of East Falls gauging station is located within the Serpentine River Catchment and has a catchment area of 381 km^2. These gauging stations provide flow datasets from the late 1970s to the last five years.

Measurements at the Jack Rocks gauging station (located on the largest tributary of the Serpentine River within the Myara North DE) indicates a step change in streamflow since around 2012, whereby average annual streamflows from 2012 to 2016 were around 75 per cent lower than the six years prior to 2012, despite average annual rainfall decreasing by only 8 per cent over the same period (GHD, 2020).

Table 5-3 Gauging sites relevant to Huntly Mine

Site ID	Site name	Flow record	Catchment area (km^2)	Average Annual Streamflow (ML)
Serpentine River				
614035	River Road	1982 – 1998 2008 - 2019	243	5572
614031	Jack Rocks	1981 – 1998 2006 - 2016	55	3660
614004	M Dam Rd	1971 - 1998	663.64	-
614033	Below Main Dam	1980 - 2008	0.98	-
614037	O'Neil Rd	1983 - 2021	149.4	3519
614038	West Cameron	1983 - 1995	1.07	7.6
614039	Central Cameron	1983 - 1989	1.75	4.2
614040	East Cameron	1983 - 1984	0.57	108.9

Site ID	Site name	Flow record	Catchment area (km^2)	Average Annual Streamflow (ML)
614064	Cameron West	1991 - 2017	2.09	6.6
614066	Cameron Central	1992 - 2017	4.94	23.6
614075	Unnamed	1952 - 1960	243	18640
614076	South East of Falls	1952 - 1960	381	27030
614093	Jayrup	1995 - 2018	45.54	505.1
Wungong Brook				
616058	Wungong Brook – Cobiac Rd	1992-2016	3.64	181
Murray River and Tributaries				
614045	Chadoora (Swamp Oak Tributary)	1984-1997	5	20
614047	Davis Brook – Murray Valley Plntn (Murray River Tributary)	1954-2002	66	6407
614006	Baden Powell (Murray River)	1952-2020	6737	244,189
South Dandalup River and Tributaries				
614043	Pindalup	1984-1998	7	59
614059	Skeleton Road	1988-1998	19	2519
614060	Gordon Catchment	1988-2018	2	17
614001	Duncan's Rd Crossing	1939 - 1941	159	-
614007	Del Park	1974 - 2021	1.33	181.5
614017	Warren Catchment	1977 - 2014	0.87	109.4
614018	Bennetts Catchment	1977 - 2014	0.88	145.1
614019	Hansens Catchment	1977 - 2015	0.73	118.4
614020	Higgens Catchment	1977 - 1999	0.6	42.1
614062	Bates Catchment	1988 - 2021	2.23	275.4
614122	Conjurunup	2008 - 2018	36.1	1530
614186	Back Huntly Rd	1963 - 1971	8.7	43270
North Dandalup				
614021	Lewis Catchment	1977 - 2021	2	164
614024	Jones Catchment	1977 - 1999	0.69	32.6
614036	North Rd	1983 - 2021	79.74	4723

5.6.5 Surface water quality

The Mine operations are subject to current water quality conditions shown in Table 5-4 (GHD, 2020).

Table 5-4 Existing water quality criteria

Parameter	Limit	Monitoring frequency	Location	Criteria source
pH	5.5 – 9.0	Prior to each discharge of wastewater unless there has been no addition of treated wastewater to the sumps or batching tanks since the last sampling event.	Specific batching tanks and sumps in Huntly mine.	Huntly Mine Licence L6210/1991/10 (issued 13/09/2013 and amended 09/02/2021).
Total dissolved solids	1000 mg/L			
Oil and grease	5 mg/L			
Surfactants (as MBAS)	5 mg/L			
Zinc	5 mg/L			
Total phosphorus	2 mg/L			
Chromium	0.06 mg/L			
Copper	1 mg/L			
Discharge volume	-	Continuous.		
Turbidity	>25 NTU for >1 hour	Continuous.	Compliance Monitoring Points.	Water Working Arrangements.

Surface water quality in the proposed Myara North, Holyoake and O'Neil regions

Water quality data within the proposed Myara North region predominantly comprises laboratory measurements of salinity (as total dissolved solids (TDS) and/or electrical conductivity (EC)), turbidity and pH), and within Holyoake comprises EC, turbidity and pH.

The spatial distribution and monitoring frequency varies widely across the proposed Myara North area, with historical focus on research catchments and proposed mining catchments.

Results of surface water TDS and EC measurements over various periods ranging from the 1980's to present (GHD, 2020) are summarised in Table 5-5. Only the maximum result with its concomitant site ID for each tributary is reflected in the table. The water is classified as fresh (0 - 500 mg/L TDS) in the surface water tributaries west of the 1,100 mm isohyet, with maximum TDS of 486 mg/L reported for site TN14 (Jack Rocks) on 39 Mile Brook. For tributaries east of the 1,100 mm isohyet, the maximum TDS typically exceeds 500 mg/L. Results of surface water EC support the increase in surface water salinity in the eastern extent of the Myara North region (GHD, 2020)

Table 5-5 Summary of water quality (TDS and EC)

Tributary	No of sampling points	Max TDS (mg/L)	Site ID	Max EC (uS/cm)	Site ID
West of 1,100 mm isohyet					
Wungong Brook	13	398	WG17	764	WG17
Gooralong Brook	5	247	GG03	468	GG03
39 Mile Brook	11	486	TN14	938	TN14
East of 1,100 mm isohyet					
Banksia Gully	1	583	SN01	1,129	SN01
Gold Mine Gully	2	574	SN05	3,874	SN02
Eastern Tributary 1	2	653	SN03	1,268	SN03
Eastern Tributary 2	1	728	SN04	1,415	SN04

Results of surface water turbidity and pH measurements are summarised in Table 5.6. Only the maximum result associated with a site ID for each tributary is reflected in the table. The data indicates that median turbidity is typically below 1 Nephelometric Turbidity Unit (NTU), with maximum values exceeding 25 NTU (Alcoa compliance guideline) at some locations on Gooralong Brook, 39 Mile Brook and Banksia Gully. Available pH data indicate that median pH of all tributaries is neutral with some tributaries minimum pH values in the acidic range (GHD, 2020).

Table 5-6 Summary of water quality (turbidity and pH)

Tributary	No of sampling points	Max turbidity (NTU)	Site ID	Min pH	Site ID	Max pH	Site ID
West of 1100 mm isohyet							
Wungong Brook	7	3.8	WG19	6.1	WG14 WG19	6.9	WG13
Gooralong Brook	5	5.4	GG03	5	GG07	7.4	GG03
39 Mile Brook	6	45	TN14	5.1	TN02	8.5	TN14
East of 1100 mm isohyet							
Banksia Gully	1	8.8	SN01	5.2	SN01	6.6	SN01
Gold Mine Gully	1	3.2	SN02	5.6	SN02	6.5	SN02
Eastern Tributary 1	1	4.8	SN03	5.9	SN03	6.5	SN03
Eastern Tributary 2	1			5.6	SN04	6.8	SN04

Surface water quality monitoring within the proposed Holyoake region has primarily been undertaken by DWER, with Alcoa monitoring in this region limited to one site on Davis Brook (DV04) with sufficient data for review. Results of surface water EC and turbidity measurements ranging from the 1980's to present (GHD, 2020) are summarised in Table 5.7. Only the maximum result with its concomitant site ID for each tributary is reflected in the table. Results of surface water EC indicates higher salinity in the Holyoake region. Available pH data is only available for two sites at South Dandalup and not included in the summary. The pH measurements indicate that median pH for this tributary is neutral (GHD, 2020).

Table 5-7 Summary of water quality (EC and turbidity)

Tributary	No of sampling points	Max EC (uS/cm)	Site ID	Max Turbidity (NTU)	Site ID
Davis Brook	1	914	DV04	3.5	DV04
South Dandalup	15	6880	61406011	1064	6141345
Swamp Oak Brook	1	941	6141021	NA	NA

Historic water quality monitoring is not available for the O'Neil DE (GHD 2023a). GHD (2024) undertook baseline water monitoring at six monitoring sites within the O'Neil between July and November 2023. Key observations of surface water flow conditions include that all sites recorded flows during the wet season, which gradually declined and ceased by October and November 2023. By the November monitoring round, all locations were dry. Results of the baseline surface water program identified the following characteristics:

- non-saline
- near neutral pH with minor exceedance of the ANZECC 2000 Upland River assessment criteria of 6.5 – 8 pH units (recorded value of 6.25).
- low to moderate turbidity and low total suspended solids.
- the nutrient concentrations in the samples are generally low and align with the expected conditions of national park land use, where no nutrients are applied.
- metal concentrations representative of the geological setting, with exceedance of guidelines for zinc and copper in a small number of samples
- microbiological parameters were detected at all sampling sites on at least one of the sampling rounds
- low concentrations of PFAS were detected across five sites however, all detections were significantly below drinking water assessment criteria.
- other contaminants of potential concern, including surfactants, BTEX compounds, TRH, PAH, OC pesticides and explosives, all samples analysed returned results less than the laboratory limit of reporting with the exception of TRH recorded at one site in October.

5.6.6 Existing water use and environmental values

The surface water resources in the vicinity of the Mine support a range of social and environmental values including:

- Human consumption (i.e. drinking water).
- Water dependent ecosystems, including groundwater dependent vegetation and seasonal aquatic ecosystems.

- Recreational use including aesthetic values.

The Mine lies over the catchment areas of public drinking water supply reservoirs, including:

- Serpentine Dam
- Serpentine Pipehead Dam
- Upper Wungong Brook
- South Dandalup Dam
- South Dandalup Pipehead Dam
- North Dandalup Pipehead Dam
- Conjurunup Creek Pipehead Dam
- Canning River

Due to declining surface inflows, the Serpentine Dam is also used for storage of groundwater and desalination sources from the IWSS.

5.6.7 Knowledge gaps

A number of additional gauging stations are planned for installation as part of the mine extension into Myara North and Holyoake, and back into O'Neil.

Long-term observations of streamflow, groundwater level observations and water quality monitoring from the O'Neil mine DE are not available. Despite the lack of historic observational data within the O'Neil mine DE, the nature of and the processes involved in surface water and groundwater connectivity are expected to be comparable to those described for Myara North and Holyoake mine region.

More comprehensive surface water monitoring is required in the Holyoake DE.

Surface water quality monitoring, including turbidity and toxicants will continue over the life of the mine and post closure until relinquishment.

5.7 Groundwater

5.7.1 Overview

The groundwater host rocks of the Mine predominantly comprise the weathered and fresh Archaean basement crystalline rocks. In addition, more recent sediments are incised into the basement rocks, coincident with existing drainage or palaeodrainage lines.

The generalised hydrogeology comprises three main aquifer units:

- Shallow weathered zone aquifer: comprising lateritic cap rock and shallow gravely to sandy sediments which represents a seasonal aquifer with significant storage, infiltration and flow capability.
- Deep weathered zone aquifer (lower saprolite): an aquifer of high storage potential, but limited bulk permeability (comprising clays).
- Fractured bedrock aquifer: permeability and yields are dependent on fracture development and connectivity of the fractures.

In addition to the above, where drainage lines are sufficiently developed, and have eroded the basement material, sediments, typically alluvial, have accumulated in the lower lying areas. The permeability of the sediments is variably distributed and related to lithology.

Detailed thicknesses of these aquifer zones are not known across the whole mine area and can only be approximated based on general knowledge from the Darling Range regions. Weathered zones are missing in some locations, with indications that up to 10 per cent of the landscape would be basement outcrops.

Broadly, groundwater levels within all aquifers appear to follow the topography, such that groundwater level is highest in areas of highest topography and lowest in areas of lowest topography. Groundwater provides baseflow, following winter rains and aquifer recharge, to the major surface water bodies of the area.

5.7.2 Groundwater recharge, flow and discharge

Groundwater recharge into the subsurface occurs through rainfall infiltration into the soils and downwards percolation of the stored rainwater to the groundwater table.

The stored rainwater is also subject to evapotranspiration (water loss) by the overlying vegetation (e.g. Jarrah forest), so that a portion of infiltrated rainwater would reach and recharge the groundwater table. Where vegetation is cleared (e.g. for agriculture and mining purposes), evapotranspiration may be reduced which may increase recharge to the groundwater table.

Groundwater migrates from topographical highs towards the groundwater discharge boundaries of the region which based on the regional groundwater flow direction, is generally to the west and southwest, but can be locally modified in response to topographic and drainage trends.

5.7.3 Groundwater level and salinity observations

This section presents information relevant to Myara North, Holyoake and O'Neil mine regions, further to environmental studies conducted for the Mine transition to these regions. An overview of the geology across the Huntly Mine is presented in Section 5.4. It is expected that there will be localised variation in groundwater depths, flow and salinity across the Mine, in response to varying geology, topography and rainfall.

Groundwater levels / depth to groundwater in the Myara North, Holyoake and O'Neil regions

The Mine has an extensive groundwater monitoring network. The majority of monitoring bores are located in topographically elevated areas (between 250 and 350 m AHD) and previously active research areas east of the 1,100 m isohyet, in the intermediate-rainfall zone (IRZ). A comparatively smaller number of monitoring bores are located within the lower lying areas, below 250 m AHD and creek lines.

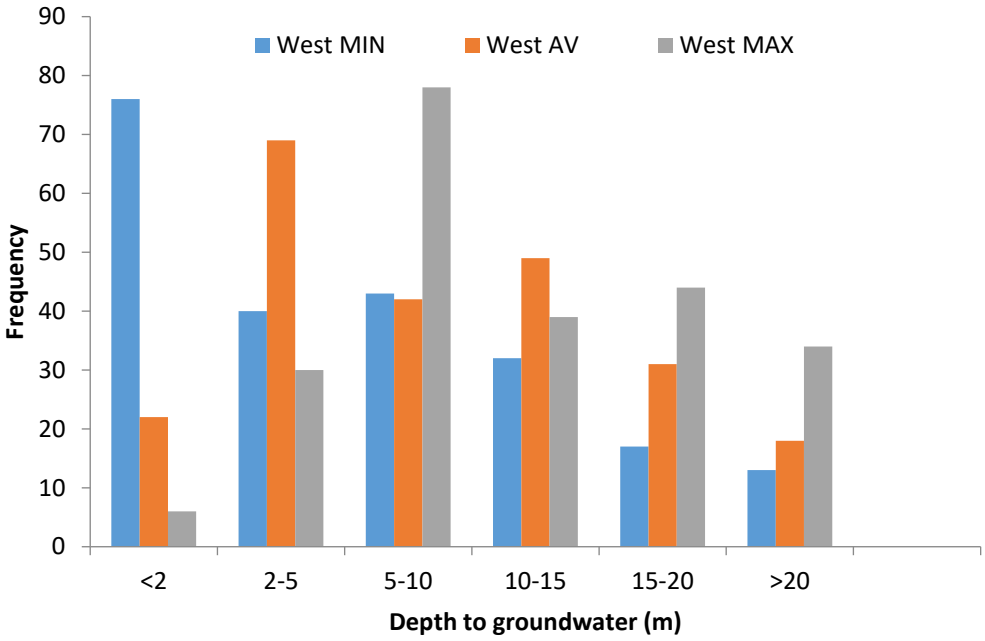
In addition, some of the monitoring bores may also be screened into the aquifer systems which are not connected with the regional groundwater flow system. This may include perched conditions or structurally isolated conditions. As a consequence, the groundwater levels in such bores may not reflect the regional groundwater flow directions.

Depth to water varies from near or at ground surface along the streams and drainage lines to depths over 20 m below ground in the upslope conditions. The majority of average groundwater depths are 2 to 5 m below ground level (Figure 5-7) in both the IRZ and HRZ. Minimum depths to groundwater (less than 2 m below ground level), indicating ready connectivity with surface water or discharge to the surface are present in a number of observations.

Presentation of classes of depth to groundwater shown in Figure 5-7 suggests there are no major differences between HRZ and IRZ (or west and east groups).

Declining rainfall observed over the last two decades has resulted in decline of groundwater levels (GHD, 2020). A number (but not all) of groundwater hydrographs within the Myara North

area and in a wider area show a steady decline in water levels at a rate of about 0.1 to 0.3 m/year.



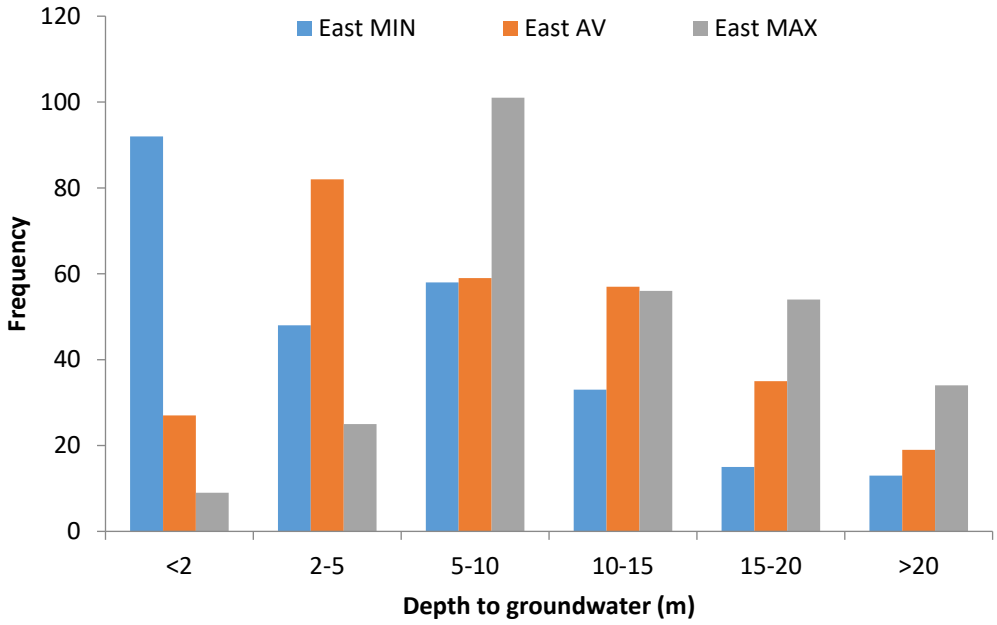


Figure 5-7 Typical depth to groundwater, Myara North

Groundwater quality – Myara North region

Groundwater quality within the Myara North region is typically fresh, with an average salinity of around 450 mg/L though some variability with isolated bores having salinities around 2,000 mg/L. Unlike the widespread decline in groundwater levels, historic monitoring data does not indicate a site wide trend for groundwater salinity, which may be partly due to the more limited salinity data available over the last decade.

Within the limited spatial extent of the data, there does not appear to be a relationship between bore salinity and location, with salinity ranges within each catchment being as variable as those between catchments. This may be partly explained by fewer salinity observations available for the last decade.

GHD (2021) undertook baseline groundwater monitoring at 25 sites within the Myara North region for up to five sampling rounds over September 2020 and February 2021 including two rounds (October and February) with more comprehensive analytes. The results indicate that groundwater is similar across the Myara North region, being fresh and relatively un-impacted by anthropogenic use, with key parameters as follows:

- Consistently fresh (< 500 mg/L TDS) for the majority of bores and sampling rounds.
- Average salinity across bores varied between 260 and 420 mg/L TDS, with an outlier bore having salinity ranging from 1,500 to 2,000 mg/L.
- pH is relatively consistent, averaging 5.3 with average variation of less than 0.5.
- Sampling for other parameters showed no discernible seasonal change in quality.
- Low nutrient levels.
- Metal concentrations typical of natural conditions and representative of the geological setting.
- Low concentrations of perfluoroalkyl and polyfluoroalkyl substances (PFAS) detected in four bores, all of which were significantly below drinking water assessment criteria.
- Minor detection of Total Recoverable Hydrocarbons (TRH) and Polycyclic aromatic hydrocarbons(PAH), with concentrations reducing in the second sampling round, possibly indicating that drilling was the source, or alternatively low levels associated with bush fires.
- Benzene, Toluene, Ethylbenzene And Xylene (BTEX) and explosives at less than laboratory limits of reporting.

Groundwater quality – Holyoake region

Groundwater quality within the Holyoake region is typically fresh, with an average salinity of around 400 mg/L. The limited historic data available suggests a slight rise in salinity concurrent with the decline in groundwater levels.

GHD (2021) undertook baseline groundwater monitoring at 21 sites within the Holyoake region for up to four sampling rounds over October 2020 and February 2021 including two rounds (October and February) with more comprehensive analytes. The results indicate that groundwater is similar across the Holyoake region, being fresh and relatively un-impacted by anthropogenic use, with key parameters as follows:

- Consistently fresh (< 500 mg/L TDS) for the majority of bores and sampling rounds.
- Average salinity across bores of 400 mg/L TDS, with the exception of three bores that had salinity of 1,000 to 1,500 mg/L.
- pH is relatively consistent, averaging 6.3 with average variation of less than 0.5.
- Sampling for other parameters showed no discernible seasonal change in quality.
- Low nutrient levels, albeit marginally higher than in Myara North.
- Metal concentrations marginally higher than Myara North but still typical of natural conditions and representative of the geological setting.
- Low concentrations of PFAS detected in five bores, all of which were below drinking water assessment criteria.
- Low concentrations of TRH in five bores suggest potential cross contamination from sampling sources.

- Low concentrations of PAH (pyrene) detected in most bores, with concentrations reducing in the second sampling round, possibly indicating that drilling was the source, or alternatively the low levels are associated with bush fires.
- BTEX and explosives at less than laboratory limits of reporting.

Groundwater quality – O'Neil region

Groundwater physical parameters were collected for the GHD monitoring wells in April 2024 and June 2024 monitoring rounds. Groundwater ranges from fresh to brackish with an average EC of 1,910 µS/cm, ranging from 248 µS/cm (average DTW; 4.56 m BGL) to 5,450 µS/cm in (average DTW; 24 m BGL). Both bores are located on the western boundary of the O'Neil DE approximately 6km apart.

Similar to Myara North and Holyoake, the results showed low nutrient levels consistent with the land-use type (i.e. lack of applied nutrients or sources). Metal concentrations were typical of 'natural' conditions and representative of the geological setting, with ANZG guideline exceedances reported for zinc and cadmium in limited samples. No concentrations of BTEX or PFAS were detected. TRH and PAH concentrations were noted across the same four bores. No microbiological testing was undertaken as part of the monitoring program.

5.7.4 Knowledge gaps

Information on groundwater levels in Holyoake is limited to four "transect" locations, a period before 1983 and 17 newly established bores. Groundwater quality monitoring will continue until relinquishment of rehabilitated areas.

Long-term observations of streamflow, groundwater level observations and water quality monitoring from the O'Neil mine DE are not available. Despite the lack of historic observational data within the O'Neil mine DE, the nature of and the processes involved in surface water and groundwater connectivity are expected to be comparable to those described for Myara North and Holyoake mine regions.

5.8 Vegetation and flora

The section below summarises the Detailed Flora and Vegetation reports prepared by Mattiske for the Myara North, Holyoake and O'Neil DEs (Mattiske, 2024, 2025a, 2025b) as well as data across the whole Mine.

5.8.1 Regional vegetation

The Mine is located within the Southwest Botanical Province, within the Jarrah Forest bioregion and Northern Jarrah Forest (NJF) subregion as described by the Interim Biogeographic Regionalisation of Australia (IBRA). The NJF subregion comprises approximately 1.90 million ha and is broadly characterised by Jarrah (*Eucalyptus marginata*) forest on ironstone gravels and *Marri-Wando*o (C*orymbia calophylla - Eucalyptus wandoo*) woodlands on loamy soils, with sclerophyll understoreys (Mattiske 2021a).

The NJF subregion retains native vegetation over approximately 1.11 million ha (58 per cent). Approximately 69 per cent of the remaining vegetation is within DBCA managed lands in the west and south.

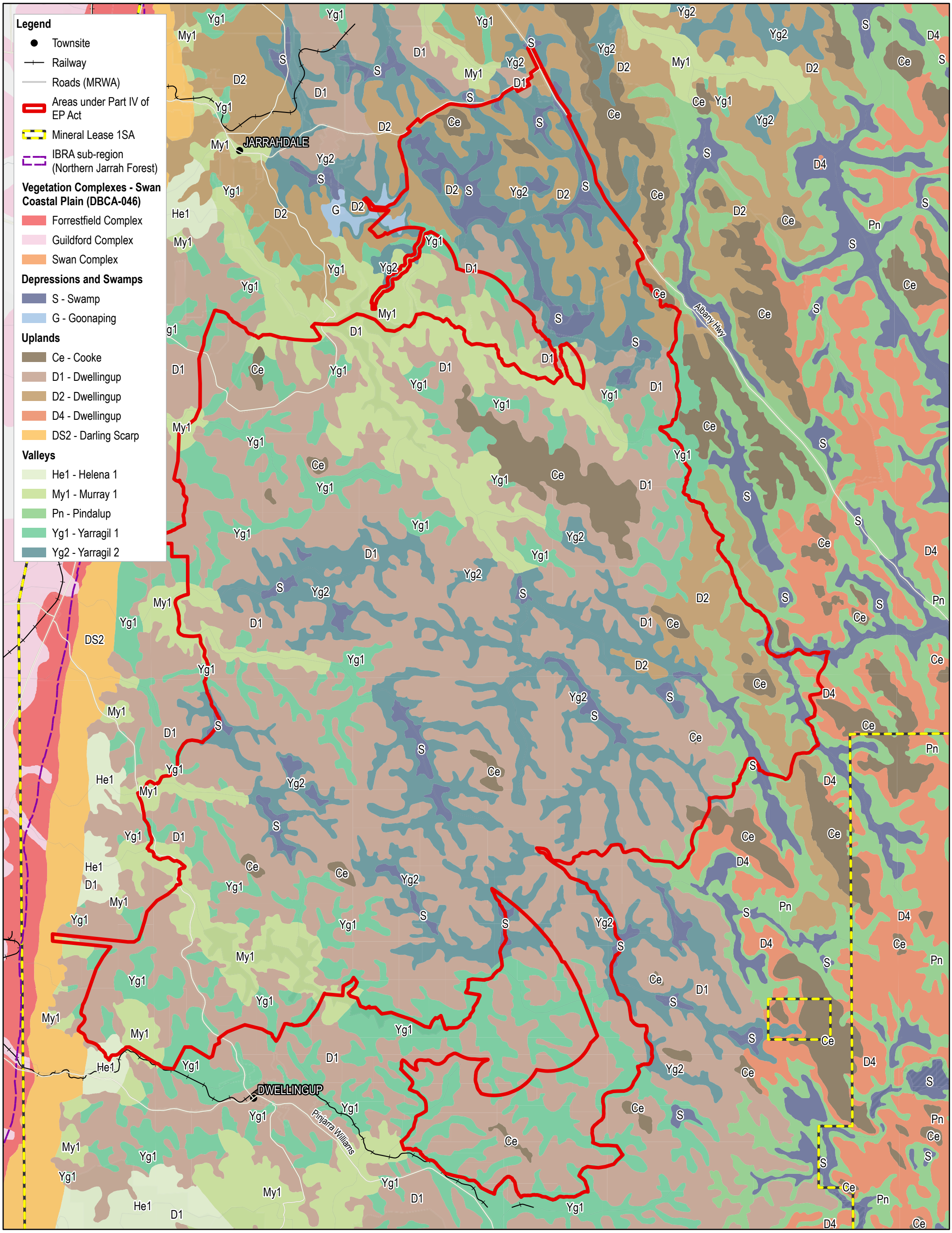
5.8.2 Vegetation complexes

Heddle et al. (1980) defined and described the dominant pre-European vegetation of the Darling System in a series of vegetation complexes, which was updated by Mattiske and Havel (1998) as part of a biodiversity assessment to inform the Regional Forest Agreement.

The Huntly Mine is covered by ten vegetation complexes as presented in Table 5-8 and Figure 5-8. The vegetation complexes are associated with the landforms presented in Section 5.1 and predominantly (84 per cent of total) comprise the Dwellingup and Yarragil complexes of the uplands. It is the uplands and slopes which contain enriched bauxite and are subject to mining. The Murray complex of the major river valleys comprise approximately nine per cent, with Cooke and Swamp complexes totalling approximately six per cent of the Mine.

Table 5-8 Mine Vegetation Complexes

Vegetation Complex	Area within Huntly mine (ha)	Percentage of Huntly mine area (%)
Cooke	2861	3.42
Darling Scarp	13	0.02
Dwellingup	43,654	52.19
Goonaping	64	0.08
Helena 1	73	0.09
Murray 1	7,639	9.13
Pindalup	1,538	1.84
Swamp	2,965	3.54
Yarragil 1	10,567	12.63
Yarragil 2	14,266	17.06
Total	**83,640**	**100**



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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Huntly Mine Closure Plan – Regional vegetation complexes

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FIGURE 5-8

Data source: Light Gray Base: Esri, TomTom, Garmin, Foursquare, METI/NASA, USGS.

5.8.3 Vegetation types

Vegetation mapping has been undertaken across the majority of the Mine, with the exception of Del Park and Huntly 1 & 2 regions. Vegetation mapping has been undertaken in a progressive manner prior to mining and mapping subsequently updated to reflect clearing and rehabilitation, with the resulting current vegetation mapping summarised in Figure 5-9.

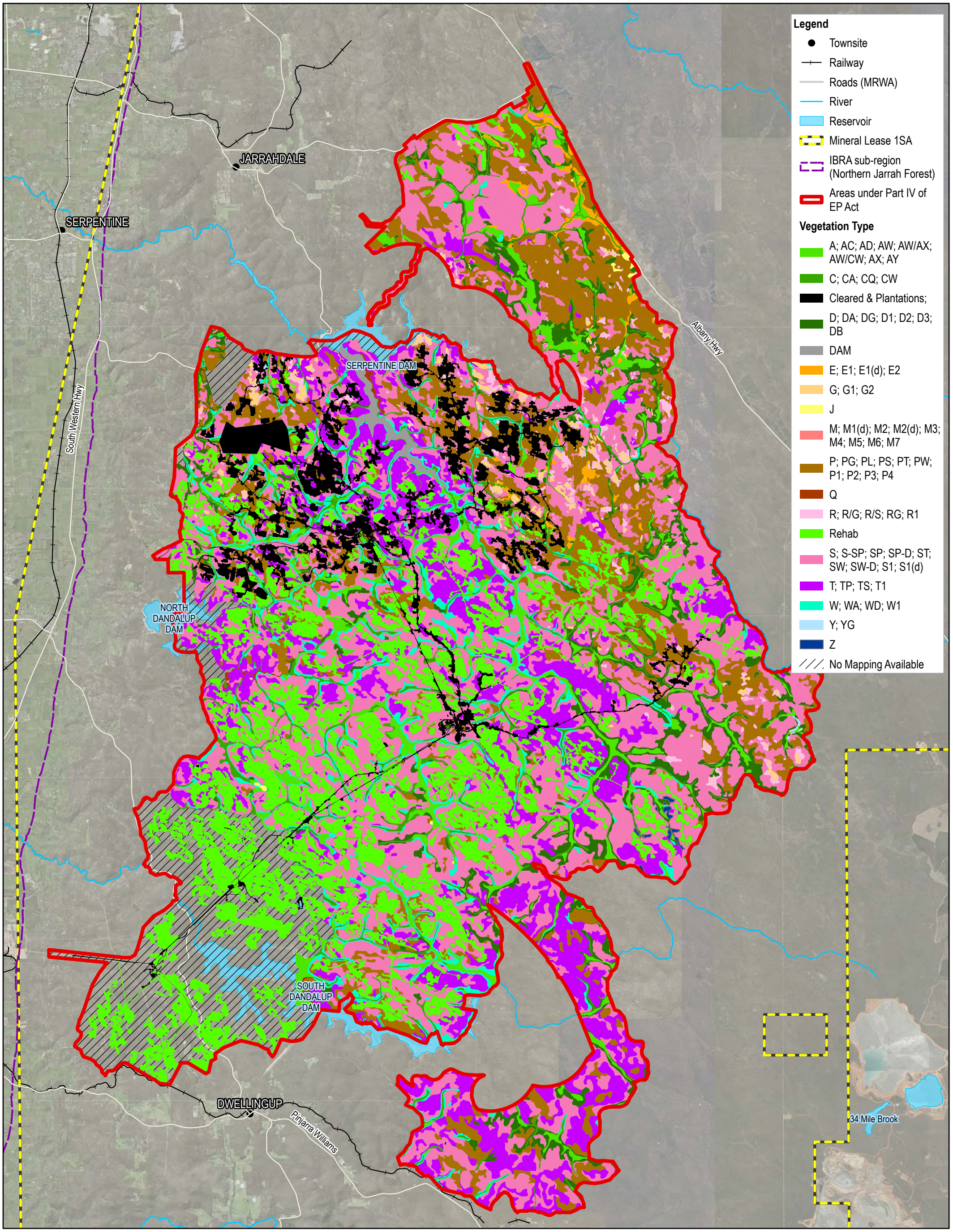
A total of 43 vegetation types (VTs) are present within the Mine boundary. The VTs comprise combinations of 21 site vegetation types (SVTs), with the first letter reflecting the dominant SVT and the second letter the subdominant SVT. The SVTs covering the Mine are presented in Table 5-9 and mapped on Figure 5-9.

Within the mapped portion of the Mine, approximately 75 per cent of the pre-clearing vegetation was mapped as having S, P or T predominant SVTs. These three SVTs reflect the dominant lateritic upland landforms that are covered by a Jarrah-Marri overstorey and varying understorey. These three SVTs have been subject to the majority (more than 90 per cent) of clearing in the Mine to date as they are located on landforms that have enriched bauxite. Accordingly, a substantial portion of the S, P and T vegetation is now mapped as rehabilitated or cleared on Figure 5-9.

Table 5-9 Site vegetation types

Code	Description
	Swamps and Broad Valleys
D	Open Forest of *Eucalyptus marginate* Corymbia calophylla - *Hakea prostrata* on lower slopes with mixed low understorey species, including *Babingtonia camphorosmae* and *Acacia extensa* on clay loams to gravelly clay-loams.
E	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona*, *Kingia australis*, *Leptospermum erubescens* and *Babingtonia camphorosmae* on sandy to sandy-loam soils on slopes.
	Valley Floors and Lower Slopes
C	Woodland to Open Forest of *Eucalyptus patens – Corymbia calophylla - Banksia littoralis* and *Banksia seminuda* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.
W	Open Forest of *Eucalyptus megacarpa - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Acacia extensa* and *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.
	Slopes and Ridges – Sandy Loam Gravels
P	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Styphelia nitens, Grevillea wilsonii, Leucopogon capitellatus* on sandy gravels.
S	Open Forest of *Eucalyptus marginata - Banksia grandis - Allocasuarina fraseriana* with scattered understorey, including *Adenanthos barbiger,* *Leucopogon capitellatus* and *Styphelia tenuiflora* on gravels and sandy- gravels.
	Slopes and Ridges – Loam Gravels
T	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus*, *Pteridium esculentum*, *Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly soils.

Code	Description
	Outcrop Areas
R	Open Woodland of *Eucalyptus marginata - Corymbia calophylla* onfringes of granite outcrops or shallow soils over mixed understorey species reflecting shallow soils over granite.
G	Mosaic of Open Woodland of *Eucalyptus margnata – Corymbia calophylla* on the fringes of outcrops ranging to open heath communities of Proteaceae-Myrtaceae species and lithic complexes on the outcrop areas.



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Horizontal Datum: GDA 1994
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Huntly Mine Closure Plan – Site Vegetation Types

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FIGURE 5-9

Data source: WANow: Landgate / SLIP.

5.8.4 Vegetation condition

Mattiske (2024, 2025a, 2025b) mapped vegetation condition over the Myara North and Holyoake DEs as required under EPA guidance for assessment under Part IV of the EP Act. Vegetation condition was not required to be mapped under the BSEC approvals process and accordingly has not been mapped in the existing or historic regions of the Mine.

Mattiske (2024, 2025a, 2025b) mapped condition in Myara North and Holyoake based on criteria by Keighery (1994) and considering the effects of timber harvesting, mining and rehabilitation, agricultural and residential clearing, tracks and roads, *Phytophthora* dieback and introduced flora species.

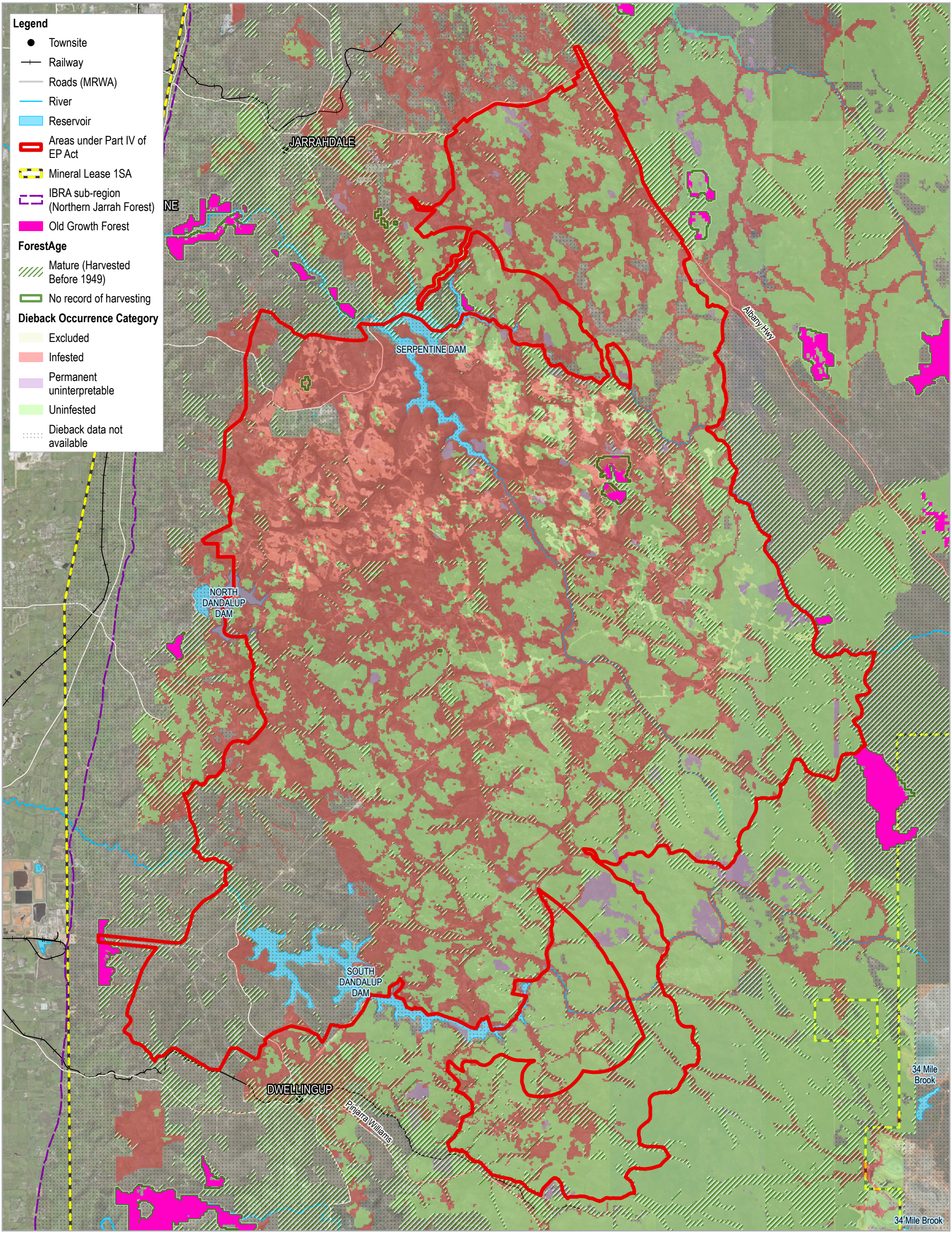
Mattiske (2024, 2025a, 2025b) mapped the un-mined vegetation as predominantly Good to Excellent condition due to varying extent of timber harvesting and *Phytophthora* dieback across the Mine DE, and the presence of a scattered forest track network and limited weed infestation. Areas cleared for agriculture, plantations or mining were mapped as Completely Degraded and historic mine rehabilitation was mapped as Degraded.

Mattiske concluded that the Myara North DE is predominantly (64.42 per cent) in Very Good condition, with approximately 25.40 per cent in Good condition and a small area (3.38 per cent) in Excellent condition. Degraded and Completely Degraded areas comprise a cumulative proportion of 6.81 per cent of the Myara North DE.

The mapping for the Holyoake DE indicates vegetation is in Excellent condition (12.92 per cent), Very Good condition (58.21 per cent) and Good condition (25.53 per cent). A small area (3.10 per cent) is in Degraded condition and an additional minor area is considered Completely Degraded (0.24 per cent).

The O'Neil DE is predominantly (79.29 per cent) in Good or Very Good condition, with approximately 17.64 per cent in Excellent condition, the largest occurrence of Excellent condition vegetation proportionally amongst each of the DEs. Approximately 3.06 per cent is Degraded and less than 0.01 per cent is Completely Degraded.

The wider Huntly Mine has been subject to past timber harvesting, a forest track network and varying *Phytophthora* dieback infestation comparable to the Myara North and Holyoake DEs and is therefore expected to similarly comprise un-mined forest that is predominantly in Good to Excellent condition. Rehabilitation in historic regions with past prescriptions involving introduced species, limited understorey diversity and higher tree densities (e.g. Del Park, Huntly 1&2) may be assessed as Completely Degraded or Degraded condition depending on the extent of native understorey present. More recent rehabilitation (e.g. O'Neil and Myara regions) under contemporary prescriptions has floristic diversity at more than 80 per cent of un-mined forest, with a native overstorey, diverse understorey, limited weed cover and lower tree densities, and may potentially be assessed as Good condition. Currently cleared areas within the Huntly Mine would be assessed as Completely Degraded until rehabilitated.



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Kilometres

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Huntly Mine Closure Plan – Dieback and Forest Age

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FIGURE 5-10

Data source: WANow: Landgate / SLIP.

5.8.5 Conservation significant ecological communities

Mattiske (2024, 2025a, 2025b) assessed the presence of conservation significant ecological communities over the proposed Myara North, Holyoake and O'Neil DEs. Mattiske (2024, 2025a, 2025b) concluded that threatened ecological communities (TEC) were unlikely to occur in the Jarrah forest vegetation within or adjacent to the Mine DE. TECs that were reported in database searches were associated with the highly cleared and fragmented vegetation on the Swan Coastal Plain west of the Jarrah forest.

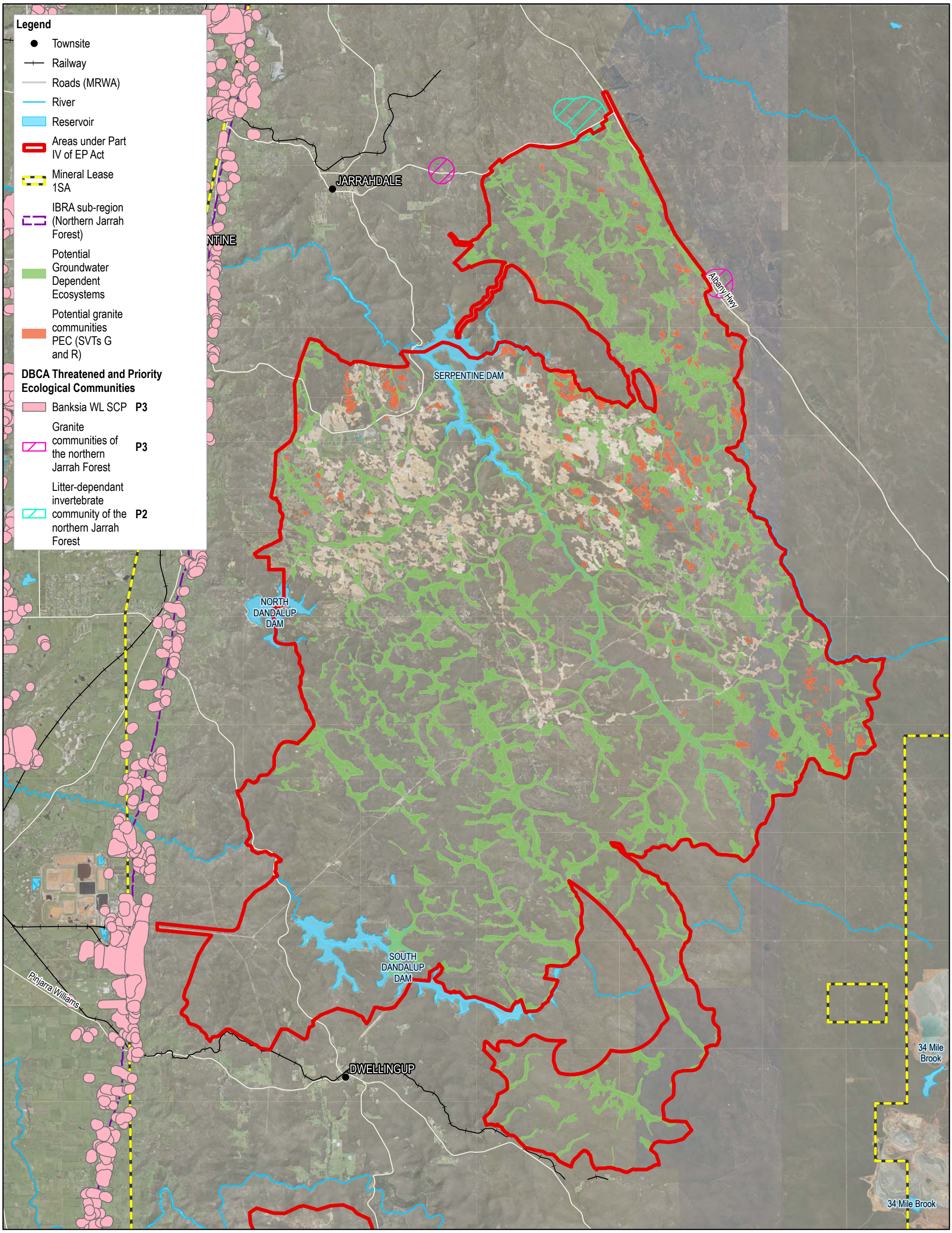
Mattiske (2025a) identified one Priority Ecological Community (PEC) that may occur in the Myara North DE: 'Granite communities of the northern Jarrah forest' (Priority 3). Two areas of this PEC (including buffers) have been mapped by DBCA over the north and east edges of the Myara North DE, in association with Blue Rock (north of Jarrahdale Road) and Sullivan Rock (east of Albany Highway). Consultation with DBCA (J. Pryde, Species & Communities Branch, pers. comm.) indicates that the PEC status is due to the restricted extent of granite communities and poor knowledge base, however, the PEC has not been systematically mapped or assessed.

The two areas of this PEC mapped over Myara North are the only areas of this PEC mapped by DBCA in WA and DBCA does not hold site-specific information for either area (J. Pryde, Species & Communities Branch, pers. comm.). Both these areas are recreational sites readily accessible from public roads and both granite outcrops lie adjacent but outside the Myara North DE, with the buffer of each site extending into the DE. Based on DBCA advice, the lack of site information and the public access, it is expected that the two mapped PEC areas are not distinctive sites but have been nominated as examples of granite communities that are found elsewhere in the NJF, including the Monadnocks Conservation Park.

Locally, granite vegetation communities (outcrops and fringing vegetation) are mapped within the Mine as the SVTs G and R, which are expected to represent the potential conservation values of the PEC (see Figure 5-11). Such vegetation communities do not lie over economic bauxite and are not mined. To date, clearing of G and R SVTs has comprised about 0.5 per cent of total clearing.

Regionally, granite outcrop communities are associated with the Cooke vegetation complex, which is mapped over approximately 30,000 ha of the NJF including large outcrops within the Monadnocks Conservation Park, Mt Solus and Mt Wells.

DBCA has mapped a non-botanical PEC as occurring within the Myara North DE of the Mine: 'Litter Dependant Invertebrate Community of the northern Jarrah Forest' (Priority 2). This PEC is discussed as part of Fauna in Section 5.9.3.



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Map Projection: Transverse Mercator
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Huntly Mine Closure Plan – Potential GDEs and PECs

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FIGURE 5-11

Data source: WANow: Landgate / SLIP.

5.8.6 Conservation significant flora

Mattiske (2024, 2025a, 2025b) assessed the potential and recorded presence and habitat of threatened or priority flora species within the Myara North, Holyoake and O'Neil DE. This included desktop assessment of databases within a 20 km radius of the centroid of each DE and targeted surveys for species. Habitat for conservation significant flora was mapped across the Mine DE and has been inferred across the Huntly Mine based on vegetation type mapping.

Mattiske (2025a) identified a total of two Threatened flora species listed under State or Commonwealth legislation and 24 Priority flora species listed by DBCA as either recorded, likely to occur or potential to occur within the Myara North survey area, based on existing data. A total of seven Threatened flora species and 24 Priority flora species were identified as recorded, likely to occur or with habitat likely to occur within the Holyoake DE (Mattiske 2025b). One Threatened flora species and 20 Priority flora species were identified as recorded, likely to occur or with habitat likely to occur within the O'Neil survey area, based on existing data (Mattiske 2024).

Mattiske (2024, 2025a, 2025b) conducted a likelihood assessment of the conservation significant flora, based on occurrence records, flora habitats and vegetation mapping over the Mine DE. The likelihood assessment concluded:

- One Threatened species (*Andersonia sp*. Saxatilis) is known to occur in the Myara North DE. This species is also considered to have potential to occur in the O'Neil DE.
- One Threatened species (*Morelotia australiensis*) is considered to have potential to occur in the Myara North DE.
- Seven Priority 1 species are known, likely or have potential to occur within the Mine DE.
- Five Priority 2 species are known, likely or have potential to occur within the Mine DE.
- 13 Priority 3 species are known, likely or have potential to occur within the Mine DE.
- Nine Priority 4 species are known, likely or have potential to occur within the Mine DE.

The remaining Threatened flora species and Priority flora species reported by database searches within a 20 km radius of the centroids of the Myara North, Holyoake and O'Neil DEs have a low likelihood of occurring, many of which are found on the Swan Coastal Plain rather than the Darling Plateau.

The eight Threatened flora with a moderate to high likelihood of occurring in the Myara North and Holyoake DEs are presented in Table 5-10.

The Threatened flora species have habitats associated with granite outcrop SVTs (*Andersonia* sp. Saxatilis F. & J. Hort 3324) and with lower valley slopes (*Morelotia australiensis*).

Figure 5-11 presents the potential habitats for conservation significant flora associated with granite outcrops and valleys, as these are associated with potential PECs and GDEs. These have been mapped across the Huntly Mine based on vegetation mapping.

Based on the assessments for Myara North, Holyoake and O'Neil, and the vegetation mapping available for the Huntly Mine, it is expected that the wider Huntly Mine contains similar potential habitats and populations of conservation significant flora, most of which would be associated with granite outcrops and valleys.

Table 5-10 Threatened flora species recorded or with the potential to occur in the Myara North and Holyoake DEs

Species	Status	
	State	EPBC Act
Slender Tailflower *(Anthocercis gracilis)*	Vulnerable	Vulnerable
Tall Donkey Orchid *(Diuris drummondii)*	Vulnerable	Vulnerable
Dwarf Bee-orchid *(Diuris micrantha)*	Vulnerable	Vulnerable
Keighery's Eleocharis *(Eleocharis keigheryi)*	Vulnerable	Vulnerable
Zig Zag Grevillea *(Grevillea flexuosa)*	Vulnerable	Vulnerable
Wing-fruited Lasiopetalum (*Lasiopetalum pterocarpum*)	Critically Endangered	Endangered
Shy Featherflower (*Verticordia fimbrilepis subsp. Fimbrilepis*)	Vulnerable	Endangered
Tufted Plumed Featherflower *(Verticordia plumosa var. ananeotes)*	Critically Endangered	Endangered

5.8.7 Groundwater dependent ecosystems

Potential groundwater dependent ecosystems (GDEs) present within the Mine include:

- Riparian, swamp and lower slope vegetation subject to seasonal inundation and/or waterlogging.
- Seasonal aquatic ecosystems.
- Seasonal saturated sediments in valley floors (hyporheic zone).

Mattiske (2024, 2025a, 2025b) identified potential GDEs within the Myara North, Holyoake and O'Neil DEs based on vegetation types and key indicator species that prefer and occur on seasonally moister and wetter soils on the swamps, valley floors and lower slopes.

Key plant species that are indicative of potential GDEs include *Banksia littoralis, Hakea varia, Acacia divergens, Pultenaea skinneri, Boronia molloyae, Thomasia paniculata, Astartea scoparia, Babingtonia camphorosmae, Calothamnus lateralis, Eucalyptus rudis, Hypocalymma angustifolium, Hypocalymma cordifolium, Melaleuca preissiana, Melaleuca rhaphiophylla, Melaleuca lateritia, Melaleuca viminea, Regelia ciliata* and *Taxandria linearifolia* (Mattiske 2025a).

Mattiske (2025a) identified potential GDEs as the vegetation types A, AC, AD, AW, AW/AX, AW/CW, AX, C, CW, D, DA, DG, E, J, PW, SW, W, and WA. Figure 5-11 presents potential GDEs within the Mine based on the available vegetation mapping and the vegetation types identified by Mattiske.

Seasonal aquatic ecosystems and saturated sediments may be located within seasonal streams presented in 5.6.1. The aquatic fauna values of the seasonal streams are discussed in Section 5.9.2.

There is a lack of groundwater monitoring data for the potential GDEs mapped within the Mine and there is potential for local variability in hydrogeological conditions between the areas. This includes the seasonal and inter-annual depth of the groundwater table within the surrounding weathered rocks, the presence of low permeability strata (e.g. deposited silt and clay) and the duration of saturation in the alluvial/colluvial sediments as the surrounding groundwater table recedes.

5.8.8 Introduced flora

Mattiske (2024, 2025a, 2025b) undertook baseline weed survey and mapping for the Myara North and Holyoake DEs which reported a total of 58 introduced flora. One of the introduced species (**Gomphocarpus fruticosus*) is a Declared Pest pursuant to section 22 of the WA *Biosecurity and Agriculture Management Act 2007* (BAM Act). None of the introduced species recorded are listed as a WoNS (DAWE 2020). Of the 58 introduced species, eight have been ranked as High Ecological Impact and 24 have been ranked as Rapid Invasiveness by DBCA (DPaW 2014, as referenced in Mattiske 2025a).

Many of the 58 introduced flora species are short lived annuals or associated with cleared or plantation areas. **Gomphocarpus fructicosus* is associated with cleared and Degraded land in the north-west of the Myara North mine region where residential landholdings are located. **Leptospermum laevigatum* is associated with areas near previous disturbance and tracks, **Watsonia meriana* is associated with valley floors and creek lines (Mattiske 2025a). The remaining introduced flora species are associated with Degraded and Completely Degraded areas and fringes of road and tracks (Mattiske 2025a).

5.8.9 Knowledge gaps

No knowledge gaps identified; however vegetation monitoring will continue during operations and closure until relinquishment.

5.9 Fauna

The section below summarises the Terrestrial Fauna Desktop Assessment reports prepared by GHD for the Myara North, Holyoake and O'Neil DEs (GHD, 2021a, 2021b, 2024d) as well as a review of potential fauna habitats throughout the Mine.

5.9.1 Terrestrial vertebrate fauna

Fauna communities

GHD (2021a, 2021b, 2024d) undertook detailed and targeted terrestrial fauna surveys of the Myara North, Holyoake and O'Neil DEs, which identified three main fauna communities:

- Granite outcrop.
- Woodlands/forests.
- Damplands/riparian.

These communities align with the major habitat types present and are discussed further below.

The granite fauna community is present within the granite outcrop habitat type. This habitat type provides shelter and foraging for a range of reptile and frog fauna such as the Ornate Crevice-dragon, Barking Gecko, Speckled stone gecko, Gould's hooded snake, Southern Carpet Python, and Black-headed Monitor. Associated water courses provide seasonal breeding for locally common frog species such as Quacking froglet and Moaning frog.

The woodlands/forests fauna community occurs in the Jarrah-Marri forest, Bullich forest, Blackbutt forest and Flooded gum woodland habitat types. The woodland and forest habitat provides habitat for a range of species including birds, such as the three Black Cockatoo species (Forest Red-tailed, Baudin's and Carnaby's) and mammal species such as the Chuditch, Brush-tailed Phascogale and Western Brush Wallaby.

The damplands/riparian fauna community occur in the low dense understory and near creek lines present in the majority of fauna habitat types (Bullich forest, Blackbutt forest, Flooded gum woodland, Melaleuca dampland). Quokka, Quenda, Rakali and several frog and reptile species are present in this community.

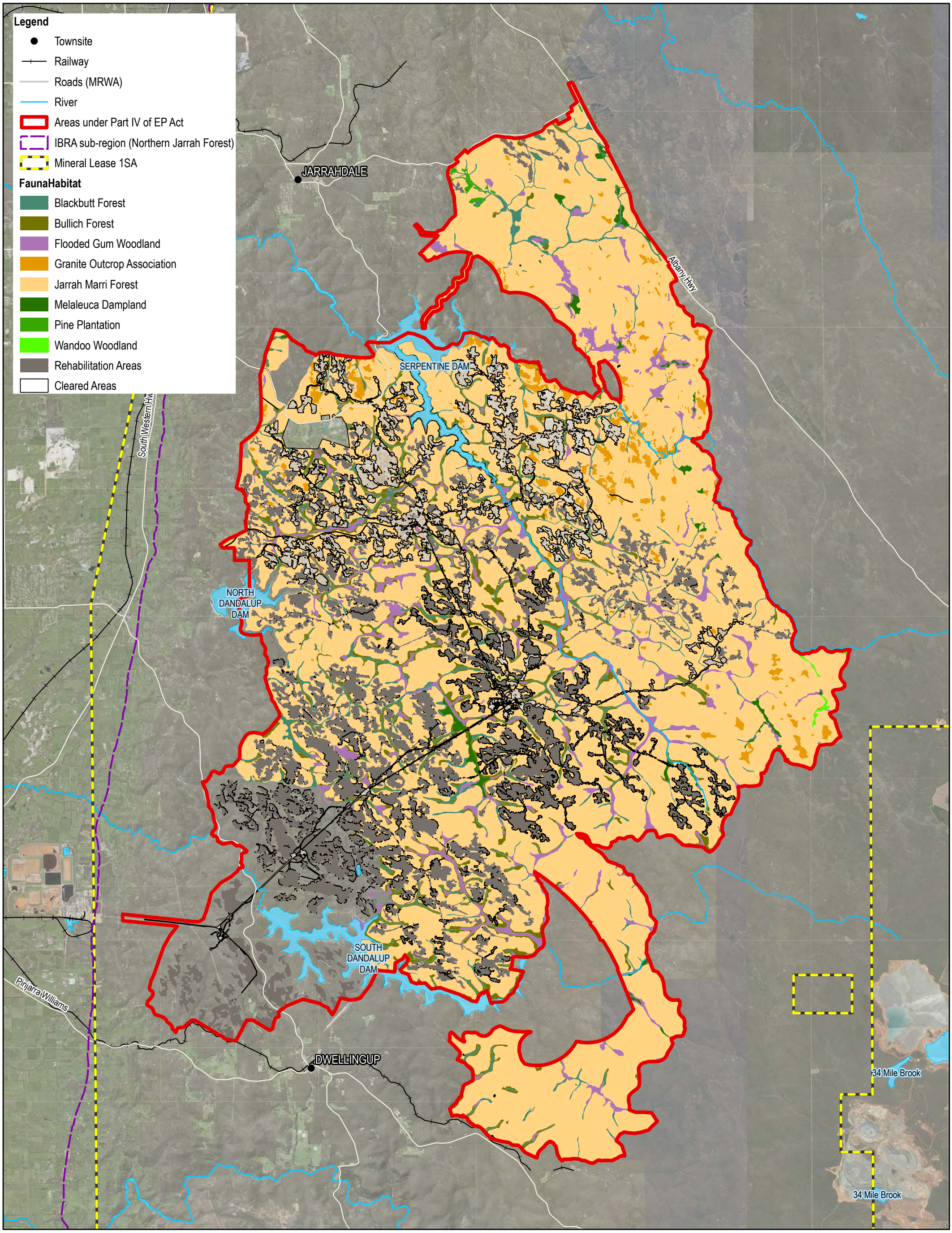
Fauna habitats

GHD (2021a, 2021b, 2024d) identified nine broad habitat types across the Myara North, Holyoake and O'Neil DEs, as presented in Table 5-11. The habitat types were mapped across the Mine DE and have been extrapolated across the Mine based on available vegetation mapping, as presented in Figure 5-12. As presented, the Jarrah-Marri forest is the most prevalent and widespread habitat type across the Mine.

Table 5-11 Fauna habitats present in the Mine DE

Description
Blackbutt Forest Blackbutt open forest with occasional Bullich, and Marri over sparse *Banksia littoralis* over *Trymalium, Macrozamia, Xanthorrhoea preissi*, over *Lepidospermum tetraquetrum*, *Astartea scoparia* and areas of dense Swamp peppermint (*Taxandria linearifolia*). This habitat is limited to localised patches often associated with creeks and drainage lines.
Bullich forest Valleys and drainage areas dominated by Bullich (*Eucalyptus megacarpa*) and with some Blackbutt (*E. patens*), occasional Marri (*Corymbia calophylla*), over Sheoak (*Allocasuarina fraseriana*), *Banksia littoralis* over Grass trees (*Xanthorrhoea preissii*), Bracken fern, patches of dense *Gahnia trifida* shrubland over *Lasiopetalum floribundum*, sedges and herbs. Substrate is dark clayloam soil. These areas are associated with seasonal creeks and drainage areas. This habitat is limited in extent to localised patches in the Mine.
Flooded Gum woodland Flooded Gum (*E. rudis*) open woodland with occasional Blackbutt, over open to open to sparse *Banksia littoralis* over Prickly Moses (*Acacia pulchella*), myrtaceous species such as Swamp peppermint (*Taxandria linearifolia*), *Astertea scoparia*, *Trymalium odoratissimum*, low shrub/sedgeland. Substrate varies from dark grey to grey brown sandy clays. Associated with poorly drained broad valleys forming seasonal swamps and occasionally tall open forest along drainage lines.
Granite outcrop Granite outcrops with associated lithic vegetation complexes and adjacent associated fringing open Jarrah and Marri areas with scattered Sheoak, *Melaleuca*, *Banksia ilicifolia* over occasional Grass trees over mixed open heath communities of *Myrtaceous* and *Proteaceous* low shrubs. Soils are pale grey to yellowish fine sand or sandy clay. Granite outcrops often associated with seasonal watercourse and seasonally damp areas. This habitat found as localised patches in the Myara North DE and Myara region.
Jarrah – Marri forest *E. marginata* and *C. calophylla* open forest over Grass trees (*Xanthorrhoea preissi*), *Lasiopetalum floribundum*, *Macrozamia* mid shrubland. Patches have dominance of understory *Allocasuarina fraseriana* and *Banksia grandis*. Often with complex mosaic of low shrubs such as *Fabaceae, Hibbertia, Leucopogon, Adenanthos*, and *Pteridium*. This is the most extensive habitat identified and comprises a number of vegetation types dominated by Jarrah on upper, mid and low slopes and broad valleys. Soils range from well drained gravely sand to sandy clay loam. Historical logging is a significant disturbance factor: extensive areas of forest are at varying ages of regeneration. Other

Description
disturbances include frequent fire (significant), feral pigs, dieback, trail bike, 4WD and dumped rubbish including weed plants.
Melaleuca dampland. Paperbark (*Melaleuca pressiana*) over sparse isolated *Banksia littoralis* over open *Hakea*, occasional Woody Pear (*Xylomelum*), Grass trees and over mixed shrublayer of *Cyperaceae, Restionaceae, Babingtonia, Jacksonia* and *Acacia*, over low shrubs, sedges and herbs. There are areas of sparse to occasional stunted Jarrah and Marri however these are limited to lowland transitional zones adjacent to slightly higher elevation and drainage open forest areas. Generally limited to areas of poor drainage and subject to winter inundation such as broad valleys and swamps. Substrate is grey gravely clay and clay loam.
Wandoo woodland Tall wandoo woodlands with occasional Jarrah and Marri trees. There is extensive recruitment of young Wandoo dominating the understory due to low level of historical logging. Shrub layers dominated by Grass trees (*Xanthorrhoea preissii*), *Macrozamia riedlei* over mixed low shrubs including Grevillea, *Banksia dallanneyi*, and Hibbertia. Substrates consist of heavy pea-gravel sandy clay loam.
Mine rehabilitation Historic mine rehabilitation (> 20 years old) of the Jarrahdale Mine. This is historic rehabilitation under previous completion criteria and not representative of current or future rehabilitation programs. These areas include either regrowth of native tree species or exotic eucalyptus trees. These areas generally have high value foraging habitat for Black Cockatoo species but lack trees of suitable age (trunk diameter) to have developed hollows of sufficient diameter and depth to be considered potentially suitable breeding trees for Black Cockatoos. These areas do however provide continuity of forest or woodland connectivity allowing fauna movement and foraging habitat for a range of species ground such as terrestrial reptiles, birds, small mammals.
Pine plantation These are monocultures of Pine timber tree species (Pinus). They tend to be devoid of understory and ground layer vegetation.



Scale: 1:160,000 at ISO A3

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Alcoa of Australia Limited
Pinjarra Refinery Revised Proposal - Environmental Review Document

Huntly Mine Closure Plan – Terrestrial Fauna Habitats

Project No. **12633192**
Revision No. **2**
Date **12/03/2025**

FIGURE 5-12

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Print date: 12 Mar 2025 - 14:38

Data source: Alcoa: Refinery Sites, Huntly Mine boundary, Pinjarra Refinery, Development Envelope - 20200403, Holyoake Conveyor Corridor, Conveyor/Haul Road Envelope - 20200605; Landgate: Roads - 20190128, Railway - 20190304, WANow: Landgate / SLIP. Created by: nrama

Fauna diversity

GHD (2021a, 2021b, 2024d) recorded a total of 233 vertebrate fauna species within the Myara North, Holyoake and O'Neil DEs, including 33 mammals, 133 birds, 43 reptiles and 14 amphibians.

Mammals

The Myara North survey recorded 23 mammal species from 12 families including six species of introduced mammals and 17 native mammal species. The most speciose families were the Dasyuridae (Dasyurid mammals) and Vespertilionidae (Simple-nosed Bats) (both with four species), as well as Macropodidae (Kangaroo) (three species). Seven of the mammal species recorded are listed as conservation significant.

The Holyoake survey recorded 22 mammal species from 13 families including 6 species of introduced mammals and 15 native mammal species. The most speciose families were the Vespertilionine and Dasyuridae (three and four species, respectively) and Macropodidae (three species). Six micro-chiropteran bats were positively identified from call analysis and further two species were unconfirmed. Six of the mammal species recorded are listed as conservation significant.

The O'Neil survey recorded 19 mammal species from 9 families include four introduced mammals and 15 native mammal species. The most speciose families were Vespertillonidae (five species) and Muridae (Rodents) (four species). Six of the mammal species recorded are listed as conservation significant.

Birds

The Myara North survey recorded 76 bird species from 36 families. The most speciose families were the Meliphagidae (Honeyeaters) (eight species), Acanthizidae (Weebill/Gerygone) (six species) and Psittaculidae (Parrots) (six species). Five of the bird species recorded are listed as conservation significant.

The Holyoake surveys identified 77 bird species from 29 families. The most speciose families were the Meliphagidae (nine species), Acanthizidae (seven species) and Psittaculidae (six species). Three of the bird species recorded are listed as conservation significant.

The O'Neil survey recorded 68 bird species from 30 families. The most speciose families were the Meliphagidae (seven species) and Acanthizidae (six species). Four of the bird species recorded are listed as conservation significant.

No migratory birds were recorded during the Myara North, Holyoake or O'Neil surveys. The Mine DE lack open water with shallow shorelines for foraging habitat. The creek lines and vegetated dampland areas within the Mine DE are not suitable. Therefore, migratory birds are unlikely to occur within the Mine DE, and any occurrence would be as vagrant visitation due to proximity of man-made drinking water reservoirs to the west and adjacent to the Mine.

Amphibians

The Myara North survey recorded seven amphibians from three families. The most speciose family was Myobatrachidae (Quacking/Bleating Frog) (three species). No conservation significant amphibians were recorded.

The Holyoake survey recorded a total of seven amphibians from three families. The most speciose family was Myobatrachidae (four species). No conservation significant amphibians were recorded.

The O'Neil survey recorded seven amphibians from three families. The most speciose family was Myobatrachidae (four species). No conservation significant amphibians were recorded.

Reptiles

The Myara North survey recorded 26 reptile species from nine families. The most specious family was Scincidae (Skinks) (10 species) followed by Elapidae (Snakes) (four species). One conservation significant reptile was recorded during the survey.

The Holyoake survey recorded a total of 23 reptile species from eight families. The most specious family was Scincidae (eight species) followed by Elapidae (six species). No conservation significant reptile species was recorded during the survey.

The O'Neil survey recorded 27 reptile species from eight families. The most speciose family was Scinidae (13 species). One conservation significant reptile was recorded during the survey.

Introduced Species

GHD (2021a, 2021b, 2024d) recorded eight introduced species in the Myara North, Holyoake and O'Neil DEs that are considered feral, including:

- Feral Pig (*Sus scrofa*)
- European Fox (*Vulpes vulpes*)
- European Rabbit (*Oryctolagus cuniculus*)
- Black Rat (*Rattus rattus*)
- House Mouse (*Mus musculus*)
- Feral Cat (*Felis catus*)
- Rainbow Lorikeet (*Trichoglossus moluccanus*)
- Laughing Kookaburra (*Dacelo novaeguineae*).

Conservation significant fauna

GHD (2025a; 2025b and 2024d) assessed the likelihood of occurrence of conservation significant fauna at the Myara North, Holyoake and O'Neil DEs, concluding that are a total of 17 non-aquatic conservation significant species are known, likely or have potential to occur as presented in Table 5-12.

Six of the species known or likely to occur in the Myara North, Holyoake and O'Neil DEs are listed under the EPBC Act and comprise matters of national environmental significance (MNES). These include the following:

- Three Black Cockatoo species:
    - Baudin's Cockatoo (*Calyptorhynchus baudinii*) - Endangered
    - Carnaby's Cockatoo (*Calyptorhynchus latirostris*) - Endangered
    - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable
- Woylie (*Bettongia penicillata ogilbyi)* - Endangered
- Quokka (*Setonix brachyurus*) - Vulnerable
- Chuditch (*Dasyurus geoffroii*) – Vulnerable.

Two EPBC Act listed species were not recorded in the Myara North, Holyoake and O'Neil DEs but are considered to have potential to occur in the Mine DE. These are:

- Numbat (*Myrmecobius fasciatus*) – Endangered
- Western Ringtail Possum (*Pseudocheirus peregrinus occidentalis*) – Critically Endangered

Table 5-12 Conservation significant fauna likelihood of occurrence in the proposed Myara North, Holyoake and O'Neil DEs

Species	Conservation Status		Likelihood of occurrence
	EPBC Act	BC Act / DBCA	
Birds			
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	Endangered	Endangered	Known (Holyoake, Myara North and O'Neil)
Carnaby's Cockatoo (*Zanda latirostris*)	Endangered	Endangered	Known (Holyoake, Myara North and O'Neil)
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	Vulnerable	Vulnerable	Known (Holyoake, Myara North and O'Neil)
Peregrine Falcon (*Falco peregrinus*)	-	Special Protection under BC Act (Schedule 7)	Known (Holyoake and Myara North)
Masked Owl (southwest) (*Tyto novaehollandiae novaehollandiae*)	-	P3	Known (Myara North) Likely (Holyoake)
Mammals			
Woylie (*Bettongia penicillata ogilbyi)*	Endangered	Critically Endangered	Likely (Holyoake and Myara North)
Chuditch (*Dasyurus geoffroii*)	Vulnerable	Vulnerable	Known (Holyoake, Myara North and O'Neil)
Quokka (*Setonix brachyurus*)	Vulnerable	Vulnerable	Known (Holyoake, Myara North and O'Neil)
Western False Pipistrelle (*Falsistrellus mackenziei*)	-	P4	Known (Holyoake and Myara North)
Western Brush Wallaby (*Notamacropus irma*)	-	P4	Known (Holyoake and Myara North)
Quenda (*Isoodon fusciventer*)	-	P4	Known (Holyoake and Myara North)
Rakali (*Hydromys chrysogaster*)	-	P4	Known (Myara North) Likely (Holyoake)
Brush tailed Phascogale (*Phascogale tapoatafa wambenger*)	-	Conservation Dependent	Known (Holyoake, Myara North and O'Neil)
Numbat (*Myrmecobius fasciatus*)	Endangered	Endangered	Potential
Western Ringtail Possum (*Pseudocheirus occidentalis*)	Critically Endangered	Critically Endangered	Potential
Reptiles			

Species	Conservation Status		Likelihood of occurrence
	EPBC Act	BC Act / DBCA	
Southern Death Adder (*Acanthophis antarcticus*)	-	P3	Known (Myara North) Likely (Holyoake)
Dell's Skink (*Ctenotus Delli*)	-	P4	Likely (Holyoake and Myara North)
Other			
Carter's Freshwater Mussel (*Westralunio carteri*)	Vulnerable	Vulnerable	Possible

5.9.2 Aquatic fauna

WRM (2021) reviewed the aquatic ecology of the Myara North and Holyoake DEs, which include:

- Hyporheic zones known to support stygal species that are potentially short-range endemic species (SRE)
- Aquatic invertebrate species richness often similar between seasonal and perennial reaches of streams in the Jarrah forest
- Aquatic fauna communities typically comprise assemblages of species including those only found in seasonal waters and those that periodically disperse/recolonise from nearby refuges in perennial waters
- Many aquatic invertebrates in south-west WA are found only in temporary waters, are adapted to drying and refilling cycles, and require a period of desiccation in order for further development.

The Serpentine River, Big Brook and Dandalup River and their tributaries that lie within the Mine are seasonal and are subject to drying for a few to several months of the year. Mapping and aerial imagery indicate a lack of large river pools along these water courses that may sustain large resident populations of aquatic fauna. The Mine lies upstream of perennial surface waters, including Serpentine Dam, North Dandalup Dam, South Dandalup Dam, Wungong Dam and the Murray River, which are known or highly likely to support populations of aquatic fauna including native fish, freshwater crayfish and the threatened species Carters Freshwater Mussel (*Westralunio carteri*). The presence of dams is expected to have disrupted aquatic fauna migrations from downstream rivers. Murray River remains un-dammed and has potential to support migrations of aquatic fauna such as native fish and Pouched Lamprey (*Geotria australis*).

The seasonal streamflow within the Mine therefore has potential to support transitory populations of aquatic species dispersing upstream from perennial waterways and reservoirs during winter and spring stream flows, as well as habitat for aquatic invertebrates. The Priority 4 species Rakali (*Hydromys chrysogaster*) has been recorded within the Mine and may use riparian zones as a seasonal food source.

The alluvial/colluvial sediments that lie within streams and swamps are subject to seasonal saturation through surface and groundwater inflows, creating a hyporheic zone that may provide habitat for macroinvertebrates. The hyporheic zone can provide refuge for aquatic fauna that can burrow to avoid desiccation during dry periods and/or high flow events (WRM 2021), including crustaceans, earthworms and insect larvae. Stygal amphipods have been recovered

from the hyporheic zone of streams within the Mine, which may be potential short-range endemic (SRE) fauna (WRM 2021).

Table 5-13 presents the range of aquatic fauna that are known to occur or have the potential to occur in the Myara North and Holyoake DEs based on the results of the WRM (2021) desktop assessment and the GHD (2021a, 2021b) targeted Carter's mussel surveys.

Stream zone monitoring of the O'Neil DE was conducted by WRM in 2019 (WRM 2020). Aquatic fauna of the O'Neil DE was not reviewed due to the absence of, and distance to, permanent water.

However, some records of aquatic fauna, including Minute Freshwater Snail, exist within the O'Neil DE, which are shown in Table 5-13. Similarly, some conclusions about Fauna communities and conservation significant fauna within O'Neil can be made regardless. For example, Freshwater Mussel is unlikely to occur in the O'Neil DE as they require permanent water, none of which is present in O'Neil; and it is thought that Stygal amphipods (*Wesniphargus nicholsi* and *Uroctena* species) may occur in the O'Neil, as well as the Holyoake DE.

Table 5-13 Known and potential aquatic fauna present in the O'Neil, Holyoake and Myara North DEs

Aquatic fauna type	Myara North DE		Holyoake DE		O'Neil DE	
	Known	Potential	Known	Potential	Known	Potential
Fish and crayfish	• Western minnow. • Gilgie. • Koonac. • Yabby (introduced). • Rainbow trout (artificial stocking). • Brown trout (artificial stocking).	• Western pygmy perch (seasonal spawning habitat). • Nightfish (seasonal spawning habitat).	• No records available.	• Pouched lamprey *Geotria australis* (BC Act Priority 1). • Western pygmy perch (seasonal spawning habitat). • Nightfish (seasonal spawning habitat).	• No records available	• Not assessed
Aquatic invertebrates	• Minute freshwater snail *Glacidorbis occidentalis* (BC Act, Priority 3). • *Wesniphargus nichollsi and Uroctena sp*. – stygal amphipods and potential short range endemic fauna (SRE). • Diversity of south-west endemic epigean (stoneflies, alderflies, caddisflies, non-biting midges) and stygal (paramelitid amphipods)	Candidate BC Act listed (Priority) dragonflies and damselflies with rare and/or restricted distributions.	• Moderate diversity of south-west endemic epigean (stoneflies, alderflies, caddisflies, non-biting midges) species, more characteristic of a disturbed upland forest steam.	• Carter's freshwater mussel *Westralunio carteri* (EPBC Act, Vulnerable). • Minute freshwater snail *Glacidorbis occidentalis* (BC Act, Priority 3). • Stygal amphipods (*Uroctena* sp., *Wesniphargus nichollsi*) and isopods (*Hyperoedesipus plumosus*) that are potential SREs. • Candidate BC Act listed (Priority)	• Minute Freshwater Snail *Glacidorbis occidentalis*	• Not assessed

Aquatic fauna type	Myara North DE		Holyoake DE		O'Neil DE	
	Known	Potential	Known	Potential	Known	Potential
	species characteristic of an undisturbed upland forest steam.			dragonflies and damselflies with rare and/or restricted distributions.		

5.9.3 Short-range endemic invertebrate fauna

A desktop assessment completed as part of the short-range endemic (SRE) fauna survey (Phoenix 2021a) of the Myara North and Holyoake DEs identified a total of 228 SRE taxa located within 40 km of the DEs. Of these records, 37 are confirmed SRE taxa, 10 are likely SRE taxa and 182 are potential SRE taxa. The desktop assessment also identified four Priority listed (2 and 3) potential SRE taxa. The desktop review identified that three potential SRE fauna species have been previously recorded in the Myara North DE, while one potential SRE fauna species has been previously recorded in the Holyoake DE.

A desktop assessment, carried out by Phoenix (2024), was also completed as part of the SRE fauna survey for the O'Neil mine DE. The assessment identified 395 SRE taxa, of which 39 are confirmed SRE taxa, 17 are likely SRE taxa and 237 are potential SRE taxa. The assessment also identified three Priority 3 listed potential SRE taxa but returned no desktop records of SREs within the study area.

The two season SRE fauna field surveys carried out by Phoenix, in the Myara North and Holyoake DEs in 2021 (Phoenix 2021a) and the O'Neil DE in 2024 (Phoenix, 2024), collected a total of 144 taxa from groups known to include SREs. Of the 144 taxa, 113 taxa (78 per cent) were from families classified as SREs as follows:

11 confirmed SREs, represented by ten millipedes and one scorpion.

Eight likely SREs, all represented by seven isopods and 1 millipede.

94 potential SREs, represented by:

- 42 taxa of mygalomorphs (trap-door spiders)
- 15 species of isopods (slaters)
- nine species of diplopods (millipedes)
- 12 species of opiliones (harvestmen spiders)
- seven species of land snail
- one species of scorpion
- seven species of pseudoscorpions.
- one species of araneomorph spider (true spiders).

Of the 113 SRE taxa, 88 SRE taxa have been confirmed to have wider distributions than the Mine DE

The remaining 25 SRE taxa are only known from sites within the Mine DE, comprising of 15 mygalomorph spiders, seven millipedes, two isopods and one land snail. 14 of the SRE taxa were recorded only from Myara North DE, three from Holyoake DE, and two from O'Neil DE. The remaining six SRE taxa were collected from Myara North, infrastructure corridor (which lies within the Myara DE). The remaining six SRE taxa were common to the Myara North and Holyoake DE.

DBCA's TEC/PEC database records a Priority 2 PEC over the north-east portion of the Myara North DE: *Litter-dependent invertebrate community of the northern Jarrah Forest*. The PEC was listed following a study (Abbott et al. 1984) into the effect of long-term exclusion of fire on physical and chemical properties of litter and soil and on some associated invertebrate fauna. The study did not identify any unique invertebrate community at the location but instead appears to be a study of the effect of fire on invertebrate communities within the jarrah forest as a whole. The area mapped by DBCA as the PEC comprises SRE habitat 4, which has a Low SRE potential habitat rating and is regionally represented by the Dwellingup vegetation

complex, a widespread habitat within the NJF. Due to the general nature of the Abbott et al. (1984) study and the widespread habitat values of the location, the DBCA mapped Litter-dependent invertebrate community PEC is not considered further in this MCP.

5.9.4 Knowledge gaps

No knowledge gaps identified, but fauna monitoring will continue during operations and closure until relinquishment.

5.10 Social environment

5.10.1 Local community

The Mine is located in the shires of Murray, Serpentine-Jarrahdale, Boddington and Wandering. The Mine lies within the eastern portion of the Peel Region of Western Australia. The Peel Region is located 75 km south of Perth and covers an area of approximately 5,500 km^2.

The Peel Region has an economy based mainly on mining and mineral processing, largely associated with Alcoa's operations. In addition, manufacturing, retail trade, agriculture and construction are the main areas of employment for residents.

The region benefits from good transport and communication links, diverse natural resources, access to relatively affordable housing and comprehensive community, retail and commercial facilities and services. The natural environment is a strong drawcard for the Peel as it gives this region its distinctive, attractive character. It is also a critical component of the regional economy, particularly mainstream, experiential and environmental tourism (REMPLAN, 2021).

The 2019 estimated residential population for the Peel Region was 142,960. This represented a 9.7 per cent increase from 2016 when the population on Census night was 130,331. In 2011, the population was 107,608. The annualised population growth rate for Peel Region is 2.9 per cent (DPIRD 2020).

Alcoa plays a critical role in sustaining the Peel Region's workforce as a major employer in the region and a contributor to the Peel Region's Gross Regional Product (Alcoa 2016).

Alcoa has a multi-level community investment program, which includes partnerships and sponsorships at national, state, regional and local level. Significant partnerships and sponsorships that cover communities associated with the Mine include support for restoring local waterways; protecting endangered species; improving educational and life outcomes for at-risk students, addressing ear health issues in Aboriginal and at-risk children; boosting local infrastructure; and hosting local events.

Alcoa is a major contributor to the national, state and local economy. In 2022, it invested $2.5 billion with 11,560 Australian suppliers; paid $763 million in wages, salaries and associated benefits to its more than 4,850 direct employees; paid $425 million in state and local taxes and royalties; and made $4.9 million to in community contributions.

5.10.2 Aboriginal heritage

Surveys of heritage sites are carried out prior to any proposed changes to the Mine footprint. These surveys have been conducted pursuant to the *Aboriginal Heritage Act 1972* (WA) and associated guidelines and involved the relevant Aboriginal Traditional Owners.

Consultation with local Aboriginal communities will take place before any land changes regarding mining and mine closure, particularly regarding works within 100m of cultural significant waterways or the reservoirs that feed them.

There is wide-spread evidence of historic Aboriginal activity throughout the region. Aboriginal groups from as far as Esperance and the Southwest gathered for trade and ceremonial purposes. The higher ground was utilised for camping purposes, evidenced by typically small artefact scatters with very few formal tool types. Most artefact scatters are located within 400 m of a water source (Alcoa 2014).

There are a number of Aboriginal heritage sites throughout the Mine, including the Serpentine River listed as a Registered mythological site on DPLH-001. As highlighted by ethnographic consultations and surveys undertaken by Alcoa with Gnaala Karla Booja Aboriginal Corporation (GKBAC), these places represent not just sites of archaeological or cultural interest, but rather exist within a broader living cultural landscape , connecting Noongar people to their ancestors, to lore, to kaartijin (knowledge) and to deep time cultural heritage.

Alcoa has conducted heritage surveys at mining areas since 2001 (Alcoa 2014). Alcoa conducts ethnographic and archaeological surveys using consultants and Aboriginal custodians. Sites that are identified during the Aboriginal Heritage Surveys are registered with the Department of Aboriginal Affairs and protected from mining impacts. Such areas of significance to Aboriginal people are excised from the mine plans. Significant areas can include areas of stone arrangements, stone chippings, or other artifacts, lizard traps, gnamma holes, significant historical campsites (usually near watercourses), and granite outcrops. Identified Aboriginal heritage sites are shown on Figure 5-13.

In 2021, Alcoa commissioned a review of existing cultural heritage surveys for the Mine area to identify any potential gaps in past practices to current day standards. The review found that further surveys were required within the Myara North, Holyoake and O'Neil DEs to identify any additional sites prior to the extension of the Mine into the Mine DE. This is because, while the number of registered and lodged sites in the Mine DE were known (see Table 5-13), there was considered to be potential for further documentation of heritage places, and the potential discovery of new places of Aboriginal heritage concern. As a result, both additional archaeological and additional ethnographic investigations and surveys have been undertaken by Alcoa within these regions, with heritage research and consultation with GKBAC still ongoing in the regions. An additional 71 potential heritage places have been identified as part of the surveys undertaken to date (see summary at the bottom of Table 5-13). These 71 finds were consistent with the patterns identified by previous archaeological findings in the area and the wider Northern Jarrah Forrest, and ethnographic findings, both from the 2021 consultation and previous consultations, taking place since the early 1980s. The consistent pattern in finds reflect the Noongar land use within the forest, that focussed on resource rich areas that were comfortable for camping.

In 2020, Alcoa published its first Reconciliation Action Plan (RAP), which covers all its Australian operations including the Mine. The RAP commits Alcoa to further developing its knowledge of and relationships with Traditional Owners and increasing economic participation rates.

Table 5-14 Heritage Places located in proximity to the Mine DE

Aboriginal Heritage Place Identified	Myara North		Holyoake		O'Neil	
	Number of Places	Nature of Places	Number of Places	Nature of Places	Number of Places	Nature of Places
Registered Archaeological Place/Site within DE	0	N/A	0	N/A	0	N/A
Lodged Archaeological Place/Site within DE	5	Artefact Scatters and a Quarry Site	1	Artefact Scatters	3	Artefact Scatters
Historic Archaeological Place/Site within DE	0	N/A	0	N/A	0	N/A
Registered Ethnographic Place/Site within DE	1	Ritual / Ceremonial and Creation / Dreaming Narrative – Serpentine River	1	Creation / Dreaming Narrative, Hunting Place, Landscape / Seascape Feature, Plant Resource and Water Source - Dandalup River	1	Ritual / Ceremonial and Creation / Dreaming Narrative – Serpentine River
Lodged Ethnographic Place/Site within DE	0	N/A	0	N/A	0	N/A
Historic Ethnographic Place/Site within DE	0	N/A	0	N/A	0	N/A
Registered Archaeological Place/Site within 5km of the DE	4	Artefact Scatters	0	N/A	0	N/A

Aboriginal Heritage Place Identified	Myara North		Holyoake		O'Neil	
	Number of Places	Nature of Places	Number of Places	Nature of Places	Number of Places	Nature of Places
Lodged Archaeological Place/Site within 5km of the DE	17	Artefact Scatters, a Traditional Structure and Grindings Areas	29	Artefact Scatters, a Quary and Modified Trees	37	Artefact Scatters, Grinding Areas, Traditional Structures, Camps and Modified Trees
Historic Archaeological Place/Site within 5km of the DE	0	N/A	2	Artefact Scatters	0	N/A
Registered Ethnographic Place/Site within 5km of the DE	3	Ritual / Ceremonial, Creation / Dreaming Narrative, Water Source and Ochre (Turtle Pool, South Canning – Turtle Pool, South Canning Pools and Canning River	1	Creation / Dreaming Narrative – Murray River	1	Creation / Dreaming Narrative, Hunting Place; Landscape / Seascape Feature, Plant Resource and Water Source - Dandalup River
Lodged Ethnographic Place/Site within 5km of the DE	1	Creation / Dreaming Narrative - Sullivan Rock	0	N/A	0	N/A
Historic Ethnographic Place/Site within 5km of the DE	0	N/A	0	N/A	0	N/A
Alcoa Identified Archaeological Heritage Sites within the DE	31	Artefact Scatters, a Reduction Area, a Culturally Modified Tree and a Stone Structure	1	-	39	-

5.10.3 European heritage

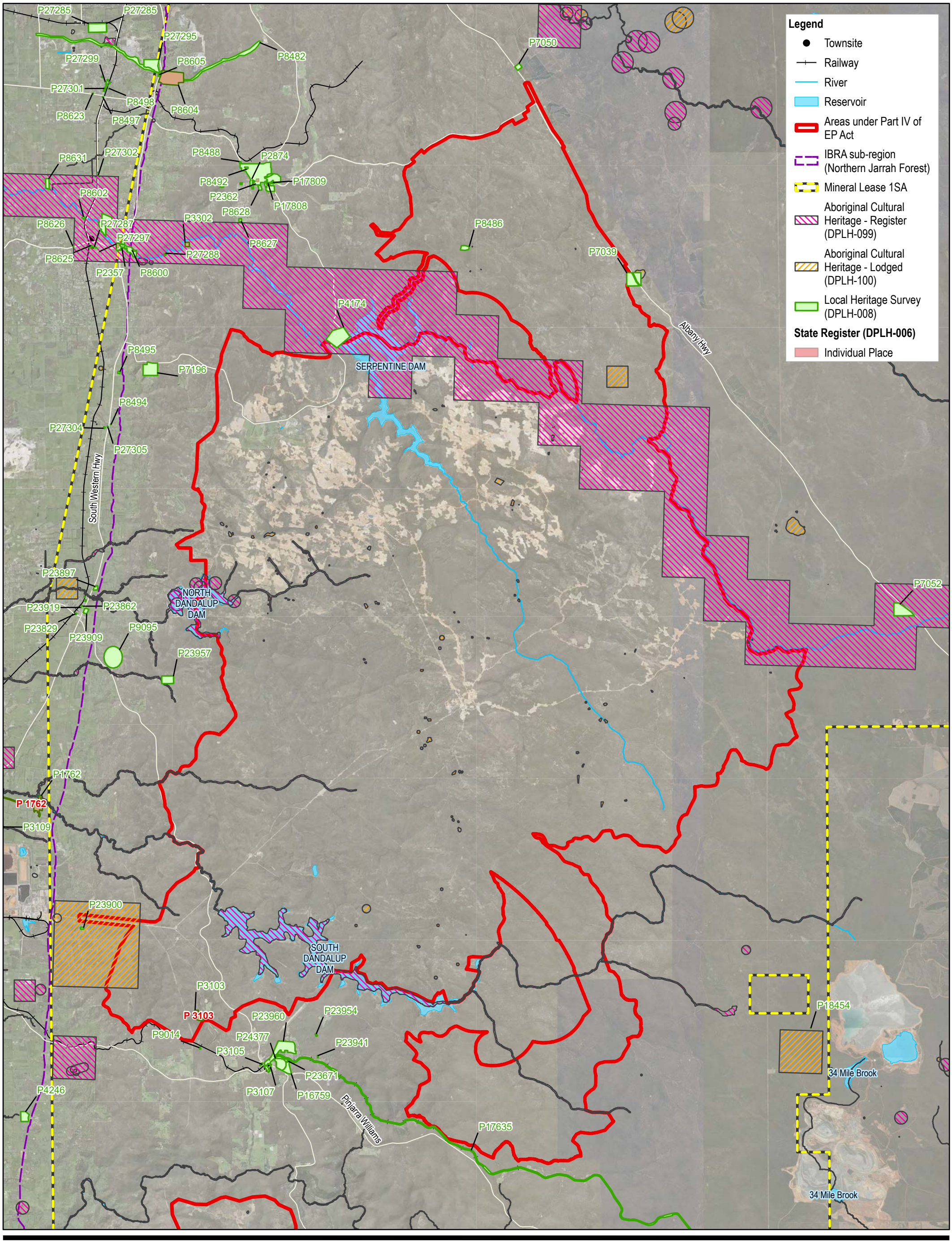
The Peel Region also has a history of European heritage. European heritage sites identified through observation, State Register and Municipal Inventory within the Mine are also protected. These are shown on Figure 5-13.

5.10.4 Knowledge gaps

Local community: Socio-economic impact of mine closure. A social impact assessment to determine the economic impact of the Mine closure and potential mitigation strategies has not yet been conducted.

Aboriginal heritage: Gaps in heritage surveys. Surveys by Alcoa, in accordance with a Noongar Standard Heritage Agreement, to address any gaps in heritage surveys in the Myara North and Holyoake DEs, are still ongoing. The knowledge gathered by surveys carried out to date is reflected in this MCP. Information will be updated in the future as appropriate when new knowledge becomes available.

European heritage: No knowledge gaps identified.



Scale: 1:160,000 at ISO A3

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Alcoa of Australia Limited
Pinjarra Refinery Revised Proposal - Environmental Review Document

Huntly Mine Closure Plan – Aboriginal and European Heritage

Project No. **12633192**
Revision No. **2**
Date **12/03/2025**

FIGURE 5-13

Data source: WANow: Landgate / SLIP.

5.11 Data analysis and implications for mine closure

A summary of the baseline data, the relevance for closure and any potential knowledge gaps are summarised in Table 5-14.

Table 5-15 Baseline data gap analysis

Aspect	Summary description	Relevance for closure	Knowledge gap and actions
Natural landforms and topography	The Mine is situated within the Darling Plateau, at 240 m AHD to 370 m AHD above sea level. The area is characterised by lateritic profiles (>30 m depth), formed from the in-situ weathering of basement rock. The laterite surface is flat to undulating, dissected by streams and extending through a zone of variable thickness to weathered bedrock. Natural landforms have been described and mapped as part of vegetation complexes of the South West forest region. Table 5-1 presents the landform descriptions and mapped extent over the Mine.	Natural landforms and topography influence the progressive and final rehabilitation to the extent that the final rehabilitated landforms blend with the surrounding landscape.	No knowledge gaps identified.
Climate	Western Australia's south-west region has a 'Mediterranean' type climate characterised by typically high winter rainfalls and an intense summer drought. The mean monthly maximum temperature ranges from 15.8°C in July to 30.9°C in January. Average annual evaporation (1520 mm) typically exceeds average annual rainfall (1153 mm). In summer, the predominant winds are moderate to strong east-southeasterly moderate to strong east-southeasterly winds and moderate southwesterly winds. For the winter months, the winds are predominantly north-northeasterly, due to prevailing synoptic patterns and katabatic winds.	The area has been experiencing a significant decreasing annual rainfall trend since the late 1960s and this decrease has further accelerated since 1993. Decreasing rainfall could impact revegetation success over time.	Impact of climate change. Revegetation monitoring to continue to determine adaptions (if any) required due to climate change.
Existing land uses	The Mine is present within State Forest, which is multiple-use and managed for water catchment protection, timber production, recreation and conservation. There are also areas where infrastructure such as dams, mining infrastructure, transmission lines, pipelines, roads and telephone lines have been erected.	Existing land uses are to be taken into account during progressive and final rehabilitation to ensure that the rehabilitated areas comply with the PMLU.	No knowledge gaps identified.

Aspect	Summary description	Relevance for closure	Knowledge gap and actions
Geology	The Mine is underlain by the Archaean granitoid basement that forms the Darling Range and Plateau. The crystalline bedrock rock types comprise Yilgarn Craton granites. Bauxitisation is especially pronounced along the flanks and tops of ridges. In the lower lying valleys, the occurrence of bauxite is very limited due to erosion. The lateritic (bauxite) horizon is on average 3.5 m thick for granite-derived bauxite.	A number of bauxite exploration bores were established in the Myara North region, but they are generally too shallow to inform an understanding of the lithological profile.	Although the site-specific information on the thickness of the weathering zone and how it changes spatially within the Myara North region area is not available, it does not present a knowledge gap for closure.
Soils	Soils typically comprise gravels, sands and loams including a discontinuous cemented layer or duricrust mostly in mid- to upper-slopes, merging with underlying mottled and pallid clays of the saprolitic zone. Coarse gravels can be found on the upper slopes, trending to finer gravels downslope and sands near the valley floor, dominated by loams and clay loams. The gravelly soils generally have low concentrations of available nitrogen, phosphorous and potassium and are thus nutrient poor.	Naturally nutrient-deficient soils along with a range of plant species adapted to these conditions indicates application of fertilisers at closure should be approached with caution.	Fertiliser application requirements to be continually reassessed and soil monitoring (soil texture / erodibility of mine pit areas will continue during operations and closure).
Surface water	The Myara North region drains into three catchment areas namely the Serpentine Dam and Gooralong Brook catchment areas, and the Chandler Road and Cobiac subcatchments. A large portion of the Holyoake area lies within the South Dandalup Dam catchment. Surface water within the mining areas drains to public drinking water reservoirs. The drying climate has caused a significant reduction in streamflow, leading to a shift from perennial to ephemeral streams in recent decades At Myara North, surface water is classified as fresh in the surface water tributaries west of the 1,100 mm isohyet. For tributaries east of the 1,100 mm isohyet, the maximum TDS typically exceeds 500 mg/L. Results of	There are large areas of the mining catchment in which no flow gauging data exists. The surface water resources in the vicinity of the mine support a wide range of social and environmental values and these have to be preserved during rehabilitation and closure.	A number of additional gauging stations are planned for installation as part of the mine extension into Myara North and Holyoake. More comprehensive surface water monitoring is required in the Holyoake DE. Surface water quality monitoring, including turbidity and toxicants will continue over the life of the mine and post closure until relinquishment.

Aspect	Summary description	Relevance for closure	Knowledge gap and actions
	limited surface water testing in the Holyoake DE indicates higher salinity		
Groundwater	The groundwater host rocks of the Mine predominantly comprise the weathered and fresh Archaean basement crystalline rocks. The Mine has an extensive groundwater monitoring network. The majority of average groundwater depths are 2 to 5 m below ground level. The majority of sampled bore locations within the Myara North and Holyoake DEs have low TDS values, below 500 mg/L and mostly within the 200 to 500 mg/L range.	Declining rainfall observed over the last two decades has resulted in partial decline of groundwater levels which could have implications for long term sustainability of revegetation.	Information on groundwater levels in Holyoake is limited to four “transect” locations, a period before 1983 and 17 newly established bores. Groundwater quality monitoring will continue until relinquishment.
Vegetation and flora	The Mine is located within the Southwest Botanical Province, within the Jarrah Forest bioregion and NJF. There are 10 vegetation complexes within the Mine, of which the Dwellingup complexes and Yarragil complexes dominate. Vegetation mapping identified 73 VTs. A total of 1454 vascular plant taxa, representative of 411 genera and 108 families, have the potential to occur within the Myara North DE and a total of 489 vascular plant taxa, representative of 210 genera and 74 families, have the potential to occur within the Holyoake DE. A total of 459 vascular plant taxa, representative of 168 genera and 59 families, have the potential to occur within the O’Neil survey area. Surveys indicate that two Threatened flora species listed under State or Commonwealth legislation and 24 Priority flora species listed by DBCA as either recorded, likely to occur or with habitat likely to occur within the Myara North DE. A total of seven Threatened flora species and 24 Priority flora species were identified as recorded, likely to occur or with habitat likely to occur within the Holyoake	Progressive and final revegetation must take cognisance of baseline vegetation complexes, VTs, condition, species diversity, Threatened and Priority flora species, and introduced species to the extent that the PMLU can be achieved.	No knowledge gaps identified; however vegetation monitoring will continue during operations and closure until relinquishment.

Aspect	Summary description	Relevance for closure	Knowledge gap and actions
	DE. One Threatened flora species and 20 Priority flora species were identified as recorded, likely to occur or with habitat likely to occur within the O'Neil survey area. A baseline weed survey and mapping for the Myara North and Holyoake DEs reported a total of 59 introduced flora. No TECs are known or likely to occur within or adjacent to the Mine. One PEC has been mapped by DBCA in proximity to the Myara North and O'Neil DEs of the Mine. The PEC may potentially be associated with granite outcrops within the Mine. Dieback findings within Myara North, Holyoake and O'Neil mine DEs indicate that approximately 43 per cent of the assessed area was infested and approximately 64 per cent uninfested, with a small area (1 per cent) uninterpretable or excluded.		
Fauna	Three main fauna communities are present across the mine, namely: granite outcrops, woodlands/forests and damplands/riparian. Nine broad fauna habitat types have been identified within the Mine. In total, 17 non-aquatic conservation significant species are known or likely to occur in the Myara North, Holyoake and O'Neil DEs. These include the following endangered species: Three Black Cockatoo species: Baudin's Cockatoo (*Calyptorhynchus baudinii*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*), along with Woylie (*Bettongia penicillata ogilbyi),* Quokka (*Setonix brachyurus*) and Chuditch (*Dasyurus geoffroii*).	Progressive and final revegetation must take cognisance of baseline fauna conditions to ensure that the post rehabilitated landscape will again be able to provide the required fauna habitats.	No knowledge gaps identified, but fauna monitoring will continue during operations and closure until relinquishment.

Aspect	Summary description	Relevance for closure	Knowledge gap and actions
	Table 5-13 presents the range of aquatic fauna that are known to occur or have the potential to occur in the Myara North, Holyoake or O'Neil DEs. EPBC Act listed species Carter's freshwater mussel (*Westralunio carter*) (Vulnerable) is not known to occur within the Myara North DE. A desktop assessment identified four Priority listed (2 and 3) potential SRE taxa. The desktop review identified that three potential SRE fauna species have been previously recorded in the Myara North DE, while one potential SRE fauna species has been previously recorded in the Holyoake DE. DBCA has mapped a non-botanical PEC as occurring within the Myara North DE of the Mine: 'Litter Dependant Invertebrate Community of the northern Jarrah Forest' (Priority 2).		
Local community	The Mine is located in the shires of Murray, Serpentine-Jarrahdale, Boddington and Wandering and lies within the eastern portion of the Peel Region of Western Australia. The Peel Region has an economy based mainly on mining and mineral processing, largely associated with Alcoa's operations.	The closure of the Mine is likely to have an impact on the local economy.	Socio-economic impact of mine closure. A social impact assessment to determine the economic impact of the Mine closure and potential mitigation strategies has not yet been conducted.
Aboriginal heritage	There is wide-spread evidence of historic Aboriginal activity throughout the general area. The Serpentine River Registered site lies within the Mine, as well as archaeological sites most of which lie close to streams.	Progressive and final revegetation should ensure that adjacent and downslope Aboriginal heritage values are protected in accordance with survey and consultation outcomes.	Gaps in heritage surveys. Alcoa will undertake surveys in accordance with a Noongar Standard Heritage Agreement to address any gaps in heritage surveys in the Myara North and Holyoake regions.
European heritage	The Peel Region also has a history of European heritage. European heritage sites identified through observation,	Protected areas will not be disturbed by progressive rehabilitation and closure.	No knowledge gaps identified.

Aspect	Summary description	Relevance for closure	Knowledge gap and actions
	State Register and Municipal Inventory within the Mine area are also protected.		

6. Post-mining land use

The closure vision for the Mine is discussed below and takes cognisance of the closure Guiding Principles.

6.1 Closure outcome

The closure outcome for the Mine is to leave behind a site that is physically safe to humans and animals, geo-technically stable, geo-chemically non-polluting/non-contaminating, and capable of sustaining an agreed post-mining land use.

6.2 Post-mining land use classification

In accordance with *The Western Australian Biodiversity Science Institute (WABSI) - A framework for developing mine-site completion criteria in Western Australia* (Young 2019), post-mining land use (PMLU) needs to be:

- Relevant to the tenure and the surrounding environment that mining has, is and/or will operate in.
- Considerate of historical commitments at the site and at a regional scale.
- Achievable in the context of post-mining land capability.
- Acceptable to key stakeholders.
- Ecologically sustainable in the context of the local and regional environment.
- Within legislative constraints.

Furthermore, the Australian Land Use and Management (ALUM) classification framework (ABARES 2016) defines six primary classes of PMLUs namely:

1. Conservation and Natural Environments.
2. Production from Relatively Natural Ecosystems.
3. Production from Dryland Agriculture and Plantations.
4. Production from Irrigated Agriculture and Plantations.
5. Intensive Users.
6. Water.

Since 1988, rehabilitation of Alcoa mining areas has involved the re-establishment of only native species with Jarrah and Marri as dominant tree species, with the aim to re-establish a self-sustaining Jarrah forest ecosystem that fulfils forest land uses that include conservation, timber production, water catchment and recreation (Alcoa 2020). Rehabilitated areas must become amenable to similar management practices employed in the surrounding Jarrah forest.

In accordance with the above aim, closure outcome, the WABSI framework, and the State Forest objectives under the FMP it is proposed that the ALUM classification for the PMLU Mine should be as per Table 6-1.

Table 6-1 Proposed PMLU

Domains	Primary class	Definition	Secondary class
Mining support infrastructure domain Mining and rehabilitation domain.	Production from relatively natural ecosystems.	Primary production with limited change to the native vegetation.	Production native forests: • Conservation • Recreation • Tourism • Water catchment

7. Closure risk assessment

7.1 Identification of closure risks

This MCP identifies closure risks for the Mine and proposes workable management mechanisms to manage the risks in relation to the completion criteria. This allows closure strategies, mitigation measures and closure designs to be developed and refined, assessed and reviewed in the years leading up to closure. Standard and site-specific management of inherent risks have been captured and actions for continuous improvement were identified.

Risks are presented for the proposed closure domains with an additional 'all domains' site wide category to catch risks that do not fall into any of the described domains:

- Mining support infrastructure.
- Mining and rehabilitation.
- All domains.

7.2 Risk management process

The risk assessment process that was adopted aligns with DMIRS 2020 Guidance as well as with the WABSI 2019 framework. The objectives of the mine closure risk assessment are to identify risks, rank and prioritise risks, develop management options for risk events that could compromise closure objectives, and assist with managing uncertainty.

Likelihood was assessed against a five-level matrix ranging from Rare (one) to Almost Certain (five) as indicated in Table 7-1. Consequence for each risk was assessed against a five-level matrix ranging from Insignificant (one) to Catastrophic (five) across eight factors as indicated in Table 7-2. The consequence and likelihood ratings were then used to determine a qualitative risk ranking using a five-by-five matrix (Table 7-3). All risks were assessed initially without applying any treatment or mitigation criteria and then reassessed post application of treatment and mitigation criteria.

Table 7-1 Likelihood matrix

Rating		Basis of rating		
		Judgement	Frequency	Experience
A	Almost certain or Frequent	Expected to occur	Very high, may occur at least several times per year	A similar outcome has arisen several times per year in local operations
B	Likely of Probable	More likely to occur than not occur	High, may occur about once per year	A similar outcome has arisen several times per year in Alcoa operations worldwide or broader industry
C	Possible or Occasional	As likely to occur as not to occur	Possible, may occur at least in a one to ten year period	A similar outcome has arisen at some time previously in local operations
D	Unlikely of Remote	No impossible, more likely not to occur than occur	No impossible, likely to occur during the next ten to twenty five years	A similar outcome has arisen some time previously in Alcoa operations worldwide or broader industry
E	Rare or Improbable	Very unlikely to occur	Very low, very unlikely to occur during the next twenty five years	No experience of this happening in the broader industry but is theoretically possible

Table 7-2 Consequence matrix

	Health & Safety	Environment	Regulatory	Image & Reputation	Financial Impact	Facility Integrity	Project Performance	Employees
5 Critical	Fatality of staff, contractor or the public	Long term environmental damage (5 years or longer) requiring >$5 million to study or correct in penalties	Regulatory intervention and prosecution possible	Damage to corporate reputation at international level, raised international media Major loss of shareholder, political or community support	Direct loss or increased cost >$20 million Estimating error or capital loss >$20 million Fraud >$1 million	Major unacceptable system, asset, integrity or condition problem Failure to achieve critical system, asset or performance goals	Time-critical project misses major milestone or deadline > 6 months Failure to achieve critical system, asset or performance goals	A large number of senior managers or experienced employees leave the company
4 Major	Serious injury or occupational illness (non-recoverable) or permanent major disabilities (acute or chronic)	Medium term environmental damage (1-5 years) requiring $1 to $5 million to study or correct	Breach of licences, legislation, regulation or corporate-mandated standards	Damage to corporate reputation at national level, raised in national media Significant decrease in shareholder, political or community support	Direct loss or increased cost of $5 -20 million Estimating error or capital loss of $5 to 20 million Fraud $0.5 to 1 million	Failure to achieve some system, asset, integrity or condition targets Failure to achieve some system, asset or performance goals	Time-critical project misses major milestone or deadline by 3- 6 months Failure to achieve some performance goals	Some senior managers or experienced employees leave the company High turnover of experienced employees Company not perceived as an employer of choice
3 Moderate	Lost time or restricted injury or occupational illness (recoverable)	Short term environmental damage (<1 year) requiring up to $1 million to correct	Breach of standards, guidelines or impending legislation, or subject raised as a corporate concern through audit findings or voluntary agreements	Adverse news in state or regional media Decrease in shareholder, political or community support	Direct loss or increased cost of $1- 5 million Estimating error or capital loss of $1 -5 million Fraud $0.25 - 5 million	Some reduction in system, asset, integrity or condition Some reduction in performance	Time-critical project misses major milestone or deadline by 1-3 months Some reduction in performance	Poor reputation as an employer Widespread employee attitude problems High employee turnover
2 Minor	Medical treatment or first aid injury No lost time or occupational illness	Environmental damage requiring up to $250,000 million to correct	Breach of internal procedure or guidelines	Adverse news in local media Concerns on performance raised by shareholders or the community	Direct loss or increased cost of $0.25 -5 million Estimating error or capital loss of $0.25 -5 million Fraud $0.1 0.25 million-	Minor system, asset, integrity or condition degradation Minor performance degradation	Time-critical project misses major milestone or deadline< 1 months Minor performance degradation	General employee morale and attitude problems Increase in employee turnover
1 Insignificant	No injury	Negligible environmental impact, managed within operating budgets	No breach or licences, standards, guidelines or related audit findings	Reference to community consultation group Public awareness may exist, but there is no public concern	Direct loss or increased cost below $0.25 million Negligible estimating error or capital loss negligible fraud	Negligible system, asset, integrity or condition degradation Negligible performance impact	Milestone or deadline delay Negligible performance impact	Negligible or isolated employee dissatisfaction

Table 7-3 Qualitative risk ranking matrix

		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Rare	Low	Low	Moderate	High	High
	Unlikely	Low	Low	Moderate	High	Very high
	Possible	Low	Moderate	High	Very high	Very high
	Likely	Moderate	High	High	Very high	Very high
	Almost certain	Moderate	High	Very high	Very high	Very high

7.3 Qualitative risk ranking

Two risk assessments were conducted. The first assessed the pre-treatment risks at planned closure and the residual post-treatment risks when all the planned treatments and closure tasks have been implemented. This risk assessment thus indicates the potential residual risks remaining when the Mine is ready for relinquishment.

The second risk assessment was performed for early closure where the mining and infrastructure areas are in their current state. Risks were also assessed pre- and post-treatment. Some early closure pre-treatment likelihoods and consequences are higher than planned closure as the risks were assessed taking cognisance of the current state whereas at final closure further progressive rehabilitation would have been completed, thereby reducing the pre-treatment risks.

The outcomes of the risk assessment processes have been used to inform the development of closure work plans for relevant domains (Section 9.1). The Mine will progressively update the mine closure risk assessments and will engage relevant stakeholders in the update of the risk assessment over the remaining life of operation.

The closure risk assessments for final closure and early closure are reflected in Table 7-4 and Table 7-5.

Table 7-4 Closure risk assessment

Domain	Risk ID	Phase	Activity /Facility	Pathway	Receptor / Environmental Factor	Impact	Likelihood	Consequence	Raw Risk	Treatment	Likelihood	Consequence	Treated Risk (2)
Mining and rehabilitation	1	Closure - Final	Mining areas and pits	Windblown dust from mining areas and area under rehabilitation (TSP, PM10 & PM2.5).	Air Quality - community	Nuisance dust on human receptors (TSP) Short term (4 months out of a year) environmental impact	Possible	Moderate	High	- Revegetation of all mining areas according to achieve the rehabilitation completion criteria. - Topsoil management and scheduling.	Unlikely	Moderate	Moderate
						Potential health impact on human receptors (PM10, PM2.5)	Rare	Minor	Low		Rare	Minor	Low
Mining and rehabilitation	2	Closure - Final	Sediment runoff from mining areas and pits	Rainfall events exceeding the design capacity of surface water controls. Rehabilitation is not adequate to a certain rainfall event.	Social - Community and culture (water users)	Sedimentation (short term) impacting on beneficial use by human receptors.	Possible	Moderate	High	- Landscaping to contain water within the cleared areas. - Landscaping rehabilitated pits and haul roads to retain water during rainfall events. - All newly rehabilitated areas are inspected during the first winter to ensure water retention is occurring effectively and that there are no erosion problems. - Turbidity monitoring - Ripping of pit floor to improve infiltration of water - Dieback hygiene during operations. - Ongoing dieback management systems. - Contour ripping to help improve infiltration of water and soil stability. - Drainage management framework - Minimum buffer between water streams - Dieback free accreditation from imported nurseries.	Unlikely	Moderate	Moderate
					Biodiversity terrestrial Ecosystems.	Infection of growth media due to Phytophthora dieback resulting in permanent localised environmental damage (long term).	Possible	Minor	Moderate		Rare	Minor	Low
					Biodiversity / aquatic ecosystem	Increased sediment load to surface water causing environmental impact.	Possible	Moderate	High		Unlikely	Moderate	Moderate
Mining and rehabilitation	3	Closure - Final	Mining area and pits.	Rainfall events leading to erosion.	Biodiversity /Fauna / Flora / Ecosystems.	Erosion negatively impacts long term growth/ resilience of revegetation.	Possible	Major	Very high	- Revegetation of all mining areas according to achieve the rehabilitation completion criteria. - Primary water retention occurs in the contour rip lines, where rainfall is trapped while it infiltrates into the soil. - Ripping of pit floor to	Rare	Major	High
					Community	Impeded trafficability for forest management (Major deviation from standard - facility integrity).	Unlikely	Major	High		Rare	Major	High

Domain	Risk ID	Phase	Activity /Facility	Pathway	Receptor / Environmental Factor	Impact	Likelihood	Consequence	Raw Risk	Treatment	Likelihood	Consequence	Treated Risk (2)
										improve infiltration of water - Contour ripping to help improve infiltration of water and soil stability			
All Domains	4	Closure - Final	Contaminated sites at sewage plant, workshops, refuelling areas, conveyors, chemical, fuel and oil storage area (e.g. hydrocarbons in soils, other contaminated sites).	Soil contamination and seepage of contaminants to groundwater and/or contamination of surface water run-off.	Social - Community and culture (water users)	Groundwater contamination impacting on beneficial use by human receptors.	Possible	Insignificant	Low	- Remediate any contaminated soils where possible and dispose of those that cannot be remediated to waste facility that is appropriately licenced for the class of waste being disposed. - Test residual soil material post demolition for contamination. - Import internal fill where required. - Monitor surface and groundwater quality. - Removal of new PFAS sources and treatment of PFAS contaminated water prior to use in mines - Minimum buffer between water streams. - Infrastructure area located outside of reservoirs protection zones. - Minimise number of infrastructure areas.	Unlikely	Insignificant	Low
					Social - Community and culture (water users)	Surface water contamination (PFAS, hydrocarbons and turbidity) impacting on beneficial use by human receptors	Possible	Minor	Moderate		Unlikely	Minor	Low
All domains	5	Closure - Final	Mining areas and infrastructure areas	Visual/recreational amenity	Social - Community and Culture (Amenity)	Perception in landscape character of unrehabilitated/partially rehabilitated mining and infrastructure areas.	Possible	Minor	Moderate	- Integrate post-mining profile into surrounding landscape. - Revegetate all disturbed areas to meet rehabilitation completion criteria. - Community and stakeholder engagement - Progressive rehabilitation to meet the rehabilitation completion criteria. - Mine plan sequencing to enable visual buffers.	Unlikely	Minor	Low

Domain	Risk ID	Phase	Activity /Facility	Pathway	Receptor / Environmental Factor	Impact	Likelihood	Consequence	Raw Risk	Treatment	Likelihood	Consequence	Treated Risk (2)
Mining support infrastructure	6	Closure - Final	Infrastructure (e.g. roads and hardstand, conveyors, water dams and reticulation, crushers, plant, offices, etc.)	Infrastructure not removed	Biodiversity / Flora / Fauna / Ecosystem	Inability to meet PMLU (e.g. excessive weed occurrence, erosion of rehabilitated surfaces, rehabilitation materials have low water holding capacity).	Possible	Moderate	High	- Decommissioning and rehabilitation plan - Community and stakeholder engagement on potential infrastructure to be retained.	Rare	Moderate	Moderate
					Social - Community and culture	Unable to meet PMLU (loss of opportunity)	Possible	Minor	Moderate		Rare	Minor	Low
All Domains	7	Closure - Final	Bushfires	Bushfires due to people, activities and/or lightning	Revegetation	Revegetation affected to the extent that it will require additional rehabilitation	Possible	Moderate	High	- Monitor after rehabilitation to assess the cover flora species diversity, flora species abundance and percent coverage. - Consultation with DBCA. - Compliance with forest enhancement agreement.	Unlikely	Moderate	Moderate
All Domains	8	Closure - Final	Heritage Sites	Inadvertent impacts to heritage listed sites during decommissioning and closure activities.	Social - Community and culture	Loss of access to heritage sites, leading to reputation damage	Possible	Moderate	High	- Ongoing consultation with traditional owners and other communities. - Aboriginal cultural heritage management plan - Compliance to legislation requirements.	Rare	Moderate	Moderate
All Domains	9	Closure - Final	Rehabilitation across site	Failure of rehabilitation due to drying climate.	Biodiversity /Fauna / Flora / Ecosystems.	The rehabilitated ecosystem does not have equivalent functions and resilience as the surrounding ecosystem.	Unlikely	Moderate	Moderate	- Rehabilitate all areas to achieve rehabilitation completion criteria (adaptive rehabilitation criteria).	Unlikely	Moderate	Moderate
All Domains	10	Closure - Final	Clearing of areas and leaving areas open for an extended period of time	Change in groundwater regime due to change in evapotranspiration effecting surface water flows	Human beneficial use of water	Increased stream flow during operations and decreased stream flows after closure creating community concern regarding stream flow.	Possible	Minor	Moderate	- Rehabilitation criteria supported by agency agreement supported by hydrological evidence - Community consultation and engagement.	Unlikely	Minor	Low
All Domains	11	Closure - Final	Clearing of areas and leaving areas open for an extended period of time	Change in groundwater regime due to change in evapotranspiration transporting salt in the IRZ (intermediate rainfall zone)	Human beneficial use of water	Increase salinity effecting beneficial use of water	Possible	Minor	Moderate	- Minimising duration of open areas within IRZ and shallow ground water.	Unlikely	Minor	Low
All Domains	12	Closure - Final	Homogenisation of vegetation types and fauna habitats	Revegetated forest	Biodiversity /Fauna / Flora / Ecosystems.	Lack diversity in landscape and distinct vegetation communities	Possible	Moderate	High	- Planting of stream zone species. - Review and update	Unlikely	Moderate	Moderate

Domain	Risk ID	Phase	Activity /Facility	Pathway	Receptor / Environmental Factor	Impact	Likelihood	Consequence	Raw Risk	Treatment	Likelihood	Consequence	Treated Risk (2)
										completion criteria with DBCA.			
All Domains	13	Closure - Final	Lack of appropriate topsoil	No fresh topsoil with sufficient seeds due to no new clearing.	Biodiversity /Fauna / Flora / Ecosystems.	Flora diversity does not meet completion criteria for end of mine	Possible	Major	Very high	- Rehabilitation strategy to maximise topsoil use during operations to minimise open areas at final closure	Unlikely	Major	High

Table 7-5 Early closure risk assessment

Domain	Risk ID	Operational Phase	Activity/Facility	Pathway	Receptor / Environmental Factor	Impact	Likelihood	Consequence	Raw Risk	Treatment	Likelihood	Consequence	Treated Risk
Mining and rehabilitation	1	Closure - Early	Mining areas and pits	Windblown dust from mining areas and area under rehabilitation (TSP, PM10 & PM2.5).	Air Quality - community	Nuisance dust on human receptors (TSP) Short term (4 months out of a year) environmental impact	Possible	Moderate	High	- Revegetation of all mining areas according to achieve the rehabilitation completion criteria. - Topsoil management and scheduling.	Unlikely	Moderate	Moderate
						Potential health impact on human receptors (PM10, PM2.5)	Rare	Minor	Low		Rare	Minor	Low
Mining and rehabilitation	2	Closure - Early	Sediment runoff from mining areas and pits	Rainfall events exceeding the design capacity of surface water controls. Rehabilitation is not adequate to a certain rainfall event.	Social - Community and culture (water users)	Sedimentation (short term) impacting on beneficial use by human receptors.	Likely	Moderate	High	- Landscaping to contain water within the cleared areas. - Landscaping rehabilitated pits and haul roads to retain water during rainfall events. - All newly rehabilitated areas are inspected during the first winter to ensure water retention is occurring effectively and that there are no erosion problems. - Turbidity monitoring. - Ripping of pit floor to improve infiltration of water - Dieback hygiene during operations . - Ongoing dieback management systems. - Contour ripping to help improve infiltration of water and soil stability. - Drainage management framework. - Minimum buffer between water streams - Dieback free accreditation from imported nurseries.	Unlikely	Moderate	Moderate
					Biodiversity terrestrial Ecosystems.	Loss of growth media due to dieback resulting in permanent localised environmental damage (long term).	Possible	Moderate	High		Rare	Moderate	Moderate
					Biodiversity / aquatic ecosystem	Increased sediment load to surface water causing environmental impact.	Possible	Moderate	High		Unlikely	Moderate	Moderate
Mining and rehabilitation	3	Closure - Early	Mining area and pits.	Rainfall events leading to erosion.	Biodiversity /Fauna / Flora / Ecosystems.	Erosion negatively impacts long term growth/ resilience of revegetation.	Likely	Major	Very high	- Revegetation of all mining areas according to achieve the rehabilitation completion criteria. - Primary water retention occurs in the contour rip lines, where rainfall is trapped while	Rare	Major	High
					Community	Impeded trafficability for forest management (Major deviation from standard - facility integrity).	Unlikely	Major	High		Rare	Major	High

Domain	Risk ID	Operational Phase	Activity/Facility	Pathway	Receptor / Environmental Factor	Impact	Likelihood	Consequence	Raw Risk	Treatment	Likelihood	Consequence	Treated Risk
										it infiltrates into the soil. - Ripping of pit floor to improve infiltration of water - Contour ripping to help improve infiltration of water and soil stability.			
All Domains	4	Closure - Early	Contaminated sites at sewage plant, workshops, refuelling areas, conveyors, chemical, fuel and oil storage area (e.g. hydrocarbons in soils, other contaminated sites).	Soil contamination and seepage of contaminants to groundwater and/or contamination of surface water run-off.	Social - Community and culture (water users)	Groundwater contamination impacting on beneficial use by human receptors.	Possible	Insignificant	Low	- Remediate any contaminated soils where possible and dispose of those that cannot be remediated to waste facility that is appropriately licenced for the class of waste being disposed. - Test residual soil material post demolition for contamination. - Import internal fill where required - Monitor surface and groundwater quality - Removal of new PFAS sources and treatment of PFAS contaminated water prior to use in mines. - Minimum buffer between water streams . - Infrastructure area located outside of reservoirs protection zones. - Minimise number of infrastructure areas.	Unlikely	Insignificant	Low
					Social - Community and culture (water users)	Surface water contamination (PFAS, hydrocarbons and turbidity) impacting on beneficial use by human receptors.	Possible	Minor	Moderate		Unlikely	Minor	Low
All domains	5	Closure - Early	Mining areas and infrastructure areas	Visual/recreational amenity	Social - Community and Culture (Amenity)	Perception in landscape character of unrehabilitated/partially rehabilitated mining and infrastructure areas.	Possible	Minor	Moderate	- Integrate post-mining profile into surrounding landscape. - Revegetate all disturbed areas to meet rehabilitation completion criteria. - Community and stakeholder engagement. - Progressive rehabilitation to meet the rehabilitation completion criteria. - Mine plan sequencing to enable visual buffers.	Unlikely	Minor	Low

Domain	Risk ID	Operational Phase	Activity/Facility	Pathway	Receptor / Environmental Factor	Impact	Likelihood	Consequence	Raw Risk	Treatment	Likelihood	Consequence	Treated Risk
Mining support infrastructure	6	Closure - Early	Infrastructure (e.g. roads and hardstand, conveyors, water dams and reticulation, crushers, plant, offices, etc.)	Infrastructure not removed	Biodiversity / Flora / Fauna / Ecosystem	Inability to meet PMLU (e.g. excessive weed occurrence, erosion of rehabilitated surfaces, rehabilitation materials have low water holding capacity).	Possible	Moderate	High	- Decommissioning and rehabilitation plan. - Community and stakeholder engagement on potential infrastructure to be retained.	Unlikely	Moderate	Moderate
					Social - Community and culture	Unable to meet PMLU (loss of opportunity).	Possible	Minor	Moderate		Unlikely	Minor	Low
All Domains	7	Closure - Early	Bushfires	Bushfires due to people, activities and/or lightning	Revegetation	Revegetation affected to the extent that it will require additional rehabilitation.	Likely	Moderate	High	- Monitor after rehabilitation to assess the cover flora species diversity, flora species abundance and percent coverage. - Consultation with DBCA. - Compliance with forest enhancement agreement.	Possible	Moderate	High
All Domains	8	Closure - Early	Heritage Sites	Inadvertent impacts to heritage listed sites during decommissioning and closure activities.	Social - Community and culture	Loss of access to heritage sites, leading to reputation damage.	Possible	Moderate	High	- Ongoing consultation with traditional owners and other communities. - Aboriginal cultural heritage management plan. - Compliance to legislation requirements.	Rare	Moderate	Moderate
All Domains	9	Closure - Early	Rehabilitation across site.	Failure of rehabilitation due to drying climate.	Biodiversity /Fauna / Flora / Ecosystems.	The rehabilitated ecosystem does not have equivalent functions and resilience as the surrounding ecosystem.	Possible	Major	Very high	- Rehabilitate all areas to achieve rehabilitation completion criteria (adaptive rehabilitation criteria).	Unlikely	Major	High
All Domains	10	Closure - Early	Clearing of areas and leaving areas open for an extended period of time.	Change in groundwater regime due to change in evapotranspiration effecting surface water flows.	Human beneficial use of water.	Increased stream flow during operations and decreased stream flows after closure creating community concern regarding stream flow.	Possible	Minor	Moderate	- Rehabilitation criteria supported by agency agreement supported by hydrological evidence - Community consultation and engagement.	Unlikely	Minor	Low
All Domains	11	Closure - Early	Clearing of areas and leaving areas open for an extended period of time.	Change in groundwater regime due to change in evapotranspiration transporting salt in the IRZ (intermediate rainfall zone).	Human beneficial use of water.	Increase salinity effecting beneficial use of water.	Possible	Minor	Moderate	- Minimising duration of open areas within IRZ and shallow ground water.	Unlikely	Minor	Low

Domain	Risk ID	Operational Phase	Activity/Facility	Pathway	Receptor / Environmental Factor	Impact	Likelihood	Consequence	Raw Risk	Treatment	Likelihood	Consequence	Treated Risk
All Domains	12	Closure - Early	Homogenisation of vegetation types and fauna habitats.	Revegetated forest	Biodiversity /Fauna / Flora / Ecosystems.	Lack diversity in landscape and distinct vegetation communities.	Possible	Moderate	High	- Planting of stream zone species. - Review and update completion criteria with DBCA.	Unlikely	Moderate	Moderate
All Domains	13	Closure - Early	Lack of appropriate topsoil.	No fresh topsoil with sufficient seeds due to no new clearing.	Biodiversity /Fauna / Flora / Ecosystems.	Flora diversity does not meet completion criteria for end of mine.	Likely	Major	Very high	- Rehabilitation strategy to maximise topsoil use during operations to minimise open areas.	Rare	Major	High

7.3.1 Residual risks

No ‘very high’ post-treatment risks for early or planned closure were identified but several risks for early and planned closure with high and moderate impacts post-treatment were identified. These are summarised in Table 7-6 together with the ongoing actions to reduce the residual risks.

Table 7-6 Risks with high and moderate impact post treatment

Risk	Impact	Actions
Rainfall events leading to erosion.	Erosion negatively impacts long term growth/ resilience of revegetation. (High) Impeded trafficability for forest management. (High)	Engineered rehabilitation landform design. Inspections of all newly rehabilitated areas during the first winter to ensure water retention is occurring effectively and that there are negligible erosion problems. Soil characterisation used to guide landform design to reduce erosion potential.
Bushfires due to people, activities and/or lightning.	Revegetation affected to the extent that it will require additional rehabilitation. (Moderate)	Additional rehabilitation implemented as required.
Failure of rehabilitation due to drying climate.	The rehabilitated ecosystem does not have equivalent functions and resilience as the surrounding ecosystem. (Moderate)	Consultation with relevant agencies.
Lack of appropriate topsoil at the end of mining (no fresh topsoil with sufficient seeds due to no new clearing).	Flora diversity does not meet completion criteria for end of mine. (High)	Clearing scheduled to maximise fresh topsoil. Research program to identify alternative approaches to meeting diversity targets.
Windblown dust from mining areas and areas under rehabilitation.	Deterioration of air quality and nuisance dust deposition on human receptors. (Moderate)	Target rehabilitation activities at certain times of year and during certain weather conditions.
Sediment runoff from mining areas and pits.	Turbidity (short term) impact on beneficial use by human receptors. (Moderate) Increased sediment load to surface water causing environmental impact. (Moderate)	Engineered rehabilitation landform design. Inspect all newly rehabilitated areas during the first winter to ensure water retention is occurring effectively and that there are negligible erosion problems.

Risk	Impact	Actions
		Soil characterisation used to guide landform design to reduce erosion potential.
Infrastructure not removed.	Inability to meet PMLU. (Moderate)	Engage with stakeholders at least 5 years pre-mine closure.
Homogenisation of vegetation types and fauna habitats.	Lack diversity in landscape and distinct vegetation communities. (Moderate)	Incorporate fauna habitats and continual improvement to revegetation prescriptions.
Inadvertent impacts to heritage listed sites during decommission and closure activities	Loss of access to heritages sites, leading to reputational damage (Moderate).	Temporarily demarcate and fence where appropriate at sensitive heritage areas.

7.4 Contaminated sites

A review of DWER's contaminated sites database indicates there are two known contaminated sites within the Mine, both of which are located in the western portion of the Myara region:

- 55155: Rubbish dump adjacent to Karnet Prison Farm: contaminated – remediation required.
- 77309: Rubbish dump east of Karnet Prison Farm: remediated for restricted use.

The Myara and McCoy mine facilities have been classified by DWER as '*possibly contaminated - investigation required*' due to the use of aqueous film forming foams (AFFF) containing PFAS. PFAS contamination may be present in soils or water through use of AFFF in fire response events, as well as treatment and reuse of washwater from AFFF system tests. Alcoa has commenced detailed site investigation (DSI) for PFAS at both mine facilities in accordance with the *Contaminated Sites Act 2003*.

In addition to potential PFAS contamination, the Mine activities and facilities have potential to result in soil and water contamination as presented in Table 7-7. As presented hydrocarbon contamination may occur at mine facilities, haul road sumps and scattered locations at mine pits and haul roads, primarily due to the storage and handling of diesel fuel and to a lesser extent hydraulic and lubricant oils. Pathogen contamination is unlikely to persist following departure of the mine workforce at mine closure.

Alcoa has commenced a DSI of contamination within the Mine including mine facilities, sumps and surface water points. Contaminated sites identified in the DSI will be reported and managed in accordance with the *Contaminated Sites Act 2003*.

Alcoa is committed to implementing the requirements of the *Contaminated Sites Act 2003*, in line with DWER Contaminated Sites guidelines, as agreed between Alcoa and the DWER.

There is a specific closure objective (see Section 8.1) to identify and remediate all contaminated areas as per the *Contaminated Sites Act 2003* prior to relinquishment of the site post-closure.

Table 7-7 Potential contamination at Huntly Mine

Possible origin of contamination	Potential contaminant	Possible contamination source	Potential locations of contamination
Construction and operations workforce	Pathogenic microorganisms	Use of bushland for toileting and vomiting by workforce remote from ablutions. Failure of on-site sewage treatment systems, discharge of un-treated effluent. Sewage pump out tanker spill / crash.	Scattered locations across mine pits. Mine facilities (sewage treatment plants / effluent irrigation areas) and downgradient / downgradient. Note: pathogen contamination is unlikely to persistent long term (more than several months).
Construction and operations equipment and vehicles	Hydrocarbons, metals, detergents	Diesel and oil spills/leaks from equipment and vehicles during crashes, refuelling or maintenance/repair. Equipment and vehicle washing, disposal of un-treated washwater.	Scattered spill / leak locations across mine pits and haul roads, haul road sumps. Mine facilities (fuel bays, wash bays, workshops) and downgradient / downstream.
Construction and operations power supply	Hydrocarbons	Diesel spills/leaks from fuel tanks supplying power plant.	Mine facilities (fuel farm) and downgradient / downstream.
Fuel, waste and chemical storage	Hydrocarbons, nutrients, metals, acidity	Generation of solid and liquid wastes at mine facilities. Spills/leaks at fuel farm and chemical stores at mine facilities. Leaks and overflows from oily wastewater storage ponds.	Mine facilities (fuel farm, stores, oily wastewater ponds) and downgradient / downstream.
Blasting	Explosives	Explosive residues.	Scattered / diffuse across mine pits.
Rehabilitation	Nutrients, pesticides	Application of fertiliser and herbicides onto rehabilitation areas.	Diffuse across rehabilitated pits.

Possible origin of contamination	Potential contaminant	Possible contamination source	Potential locations of contamination
Clearing, mining	Salinity	Secondary salinisation from rising groundwater in cleared areas.	Localised to clusters of mine pits in pockets of shallow, saline groundwater
Fire-fighting foam	PFAS	Use of such foams may cause PFAS to contaminate soil and infiltrate groundwater.	Scattered fire response locations and downgradient / downstream. Mine facilities (AFFF test locations, wastewater treatment system) and downgradient / downstream. Scattered water reuse locations in haul roads, stockpiles, crushers and mine pits Haul road sumps.

8. Closure outcomes and completion criteria

8.1 Closure objectives and attributes

Closure objectives provide the basis against which closure performance will be measured. Closure objectives define the closure outcomes and should be realistic and achievable; developed based on proposed PMLUs; and be as specific as possible to provide a clear indication of what the proponent commits to achieve at closure (DMIRS, 2020). Initial closure objectives (Table 8-1) have been developed and these will be further refined over the remaining life of operation based on the outcomes of ongoing investigations and stakeholder engagement.

An attribute is a specific parameter that can be quantified or a task that can be verified to have been achieved. Attributes should be measurable and their metrics comparable to targets derived from specific reference areas where applicable. While attributes are generally grouped relative to aspects, certain attributes may be relevant to more than one aspect. Consequently, a single attribute may provide evidence towards multiple closure objectives, whilst several attributes may be required to demonstrate progress towards a single closure objective. Attributes for the Mine closure objectives have been identified and are listed in Table 8-1.

Table 8-1 Closure objectives and attributes

Aspect	Closure objective	Attributes
Social	The visual impact of the rehabilitated site is compatible with surrounding landscape.	Aesthetics (visual amenity).
	Access requirements have been agreed with stakeholders.	Access and safety.
	Heritage and social values protected, where practicable.	Heritage and social values protected.
	Recreational values protected and/or reinstated on closure, in consultation with key stakeholders.	Recreation and access.
Physical and surface stability	The mine pit areas are landscaped to be stable and to blend in with the surrounding forest.	Surface resistance to disturbance.
Wastes and hazardous materials	No above surface infrastructure left on site, unless agreed to remain in consultation with DBCA.	Infrastructure removed.
	Contaminated areas identified and remediated as per the *Contaminated Sites Act 2003*.	Contaminated areas remediated.
	All non-mineral hazardous waste removed from site and appropriately disposed.	Hazardous materials removed.
Water and drainage	No uncontrolled surface water runoff or unacceptable erosion in or adjoining rehabilitated pits.	Construction and integrity of final landforms.

Aspect	Closure objective	Attributes
	Rehabilitated areas conform to water catchment management guidelines.	Quality, quantity and fate of surface water flow.
Soil	There is adequate cover of topsoil across rehabilitated areas.	Soil profile as designed.
Resilience of vegetation and land use (12 years and older)	Resilience of fire affected rehabilitation: Vegetation in rehabilitated areas is capable of persisting at the required standard following bushfire. *Phytophthora* dieback: Tree species (e.g. Marri) less susceptible to dieback are present at adequate stocking rate. Other forest diseases: Rehabilitation is not preferentially attacked by non-dieback forest diseases. Insects: Rehabilitation not preferentially attacked by insects. Drought: Rehabilitation not showing evidence of being preferentially affected by drought. Timber production: There is adequate density of both Jarrah and Marri to meet timber production requirements - only applicable to areas where timber production was a land use prior to mining and for post 1988 rehabilitation. Note: Rehabilitation objectives to be reviewed in consultation with DBCA with regard to the State Government's ban on logging from 2024. Management of understorey: There is adequate understorey layer diversity in the rehabilitation.	Presence of recalcitrant species. Plant growth, survival, rooting depth, physiological function. Vegetation cover. Species richness. Key threats absent or managed (e.g. weeds, pathogens).
Fauna	Rehabilitated areas provide appropriate habitat for fauna.	Constructed habitat features (breeding and refuge).
Ecosystem function and sustainability	Restore a self-sustaining ecosystem in all rehabilitated areas.	Connections with nearby systems in place and functioning. Resilience to disturbance. Capability for self-replacement.

8.2 Establishing references

Once the PMLUs, aspects and closure objectives have been identified, it is necessary to select the reference against which completion criteria will be defined. Data collected from references is used to inform the attributes and standards required for the development and achievement of the completion criteria.

According to the WABSI guideline (Young 2019), appropriate references may include:

- Baseline conditions: Conditions present at the site prior to mine use.
- Analogue sites – adjacent or near-by sites from which the necessary attributes to can be quantified to develop completion criteria for the sites agreed upon PMLUs.
- Leading-practice outcomes – conditions that most closely define the values desired for the site and that can be realistically achieved. Such conditions are defined based on laboratory trials, on-site trials, basis of design, industry standards and demonstrated effective leading-practice techniques.
- Other alternative sites – example sites for alternate PMLUs, such as renewable energy farm or residential development.
- Conceptual model – synthesis of several data-based references including existing sites, field indicators and historical and predictive records.

The following references have been selected against which the completion criteria will be defined:

- Analogue sites.
- Leading-practice outcomes.
- Baseline conditions. For flora there are a number of plots surveyed (refer to Mattiske 2021a and Mattiske 2021b) that will inform baseline vegetation attributes. The Mine will also establish additional analogue plots through the life of Myara North, Holyoake and O'Neil.

The detail of how these link to the completion criteria is illustrated in Table 8-3.

8.3 Completion criteria

8.3.1 Background

It has been recognised by the mining industry, regulators and the public that criteria are needed to determine when mine rehabilitation is agreed as complete. For the mining industry, completion criteria facilitate the determination of when liability for mined and rehabilitated areas ceases. Regulators seek successful rehabilitation to ensure the State does not inherit liability requiring input of extraordinary resources. The wider community also desires rehabilitation that will be successful and that restores a sustainable land use.

Alcoa's rehabilitation has been subject to completion criteria developed with and approved by the BSEC (formerly known as the MMPLG) to meet the agreed objective of a self-sustaining jarrah forest ecosystem that meets multiple forest uses. The completion criteria have evolved over time, being informed by interactions in research and practice.

Rehabilitated areas established up to 1987 reflect the agreed Post Mining Land Use (PMLU), which at that time was to support the establishment of a non-jarrah forest ecosystem, with species chosen for their resilience to the soil borne pathogen *Phytophthora cinnamomi*. These are collectively termed *Early Era rehabilitation*.

Since the introduction of a fully native species overstorey in 1988, Alcoa has undertaken rehabilitation with respect to three successions of completion criteria:

- 1988 – 2004
- 2005 – 2015
- 2016 to present.

Each completion criterion has an associated standard, including quantitative targets, against which Alcoa monitors and reports the rehabilitation performance. Alcoa's current rehabilitation completion criteria (2016 to present) are published on Alcoa's website[5].

Alcoa's rehabilitation practices and procedures have developed over decades and completion criteria are subject to periodic review. Alcoa's rehabilitation areas are thus assessed against differing criteria and expectations depending on the year of establishment (Table 8-2). Over these three successions, key completion criteria have related to the establishment of a native species overstorey, which is the primary indicator of vegetation cover and primary productivity in a forest ecosystem, and understorey species, which are the predominant floristic diversity in the Jarrah forest.

Improved rehabilitation outcomes have been achieved through improved rehabilitation methods, such as enhanced site preparation; improved topsoil management (direct-return); direct seeding of native species; propagation and planting of nursery-grown recalcitrant species; seed germination treatments; reduction in tree and legume densities and optimisation of fertiliser application.

Alcoa acknowledges the WA Government's announcement to cease timber harvesting from 2024 onwards and the update of the FMP in 2024, which is expected to change the future land use of objectives for State Forest, which may accordingly affect Alcoa's rehabilitation objectives and the completion criteria relating to overstorey establishment.

Table 8-2 Rehabilitation areas and associated completion criteria that are applicable to each period

Period	Key characteristics	Huntly (ha)	Jarrahdale (ha)	Willowdale (ha)	Total (ha)	Proportion (%)
1966-1975	Exotic overstorey, rudimentary understorey	73	428	-	501	2
1976-1987	Exotic overstorey, native understorey (mostly legumes)	1,695	1,278	102	3,075	15
1988-1999	Native overstorey ~3000 stems/ha, flora species richness > 60% of un-mined forest	1,909	1,601	894	4,404	21
2000-2015	Native overstorey ~1400 stems/ha, flora species richness > 80% of un-mined forest	6,878	723	2,908	10,509	50
2016-present	Native overstorey ~1000 stems/ha, flora species richness > 80% of un-mined forest	1,854	-	654	2,508	12
Total		**12,408**	**4,030**	**4,559**	**20,997**	**100**

[5] https://www.alcoa.com/

8.3.2 Closure completion criteria

The development of the completion criteria involved assigning attributes to objectives and then utilised a risk-based attribute prioritisation process to determine which attributes should be prioritised to define completion criteria and ranking the criticality of selected attributes. The WABSI risk ranking matrix was used to prioritise the risk-based attributes. Priority will be given to improving and refining closure and rehabilitation strategies for those attributes that pose the greatest risk at closure.

The aspects, objectives, attributes, completion criteria and measures required to assess closure performance relate to each other as follows:

Aspects are the elements that need to be considered for closure.

- Objectives describe the intent of the mine closure program in relation to each aspect.
- Attributes are specific parameters that can be quantified or tasks that can be verified to have been achieved.
- Completion criteria describe agreed standards or levels of performance that indicate the success of the rehabilitation and enable an operator to determine when liability for an area can cease.
- Measures may be either an agreed value that is assessable and is regarded as the minimum that must be achieved, or a certification that closure works comply with an agreed design.
- Threshold values are included for selected standards and represent the level at which further investigation and mitigation works may be required.
- Completion criteria may be progressively refined over the life of the Mine.

The completion criteria for the Mine have been developed in accordance with the guidance described in the WABSI guideline (Young 2019) and taking into consideration the Alcoa approved Current Era Rehabilitation (2016 onwards) completion criteria (Alcoa 2015)[6]. Alcoa acknowledges the WA Government's cessation of native timber harvesting from 2024 onwards and the adoption of the 2024 FMP, which will change the future land use of objectives for State Forest, influence Alcoa's future rehabilitation objectives and the completion criteria relating to overstorey establishment.

It is noted that in terms of vegetation establishment the closure completion criteria specifically only include criteria for vegetation 12 years and older. The vegetation establishment completion criteria for the first five years after revegetation are not described in this section as at relinquishment all revegetated areas will at least be 12 years or older. The early vegetation establishment completion criteria (first 5 years) are noted in Section 9.2 under progressive rehabilitation.

It is furthermore noted that the completion criteria described in this MCP are for the Mine and do not replace the Alcoa Current Era Rehabilitation completion criteria for other Alcoa mines, e.g. Willowdale.

The existing Mine completion criteria for all closure objectives are summarised in Table 8-3. These completion criteria include extracts from the Current Era Rehabilitation (2016 onwards) completion criteria as applicable to mine closure planning. These completion criteria have been developed with the latest information available at the time of writing the MCP and could be amended following further details for the PMLU and other regulatory limitations.

[6] https://www.alcoa.com/australia/en/pdf/mining-operations-rehabilitation-program-completion-criteria.pdf

Closure performance will be measured against agreed closure objectives and completion criteria and will be reported to relevant stakeholders as evidence to support lease relinquishment.

Table 8-3 Existing completion criteria (2016 – present)

PMLUs	Aspect	Closure objective	Completion criteria	
			Standard	Guidance for acceptance
Production from relatively natural ecosystems	Social	The visual impact of the rehabilitated site is compatible with surrounding landscape.	Programs to manage the visual aspects of the mining, where relevant, are included in the annual MMPs for approval through the BSEC during operations. BSEC acceptance of final landscape and revegetation.	The visual aspects of mining have been considered in Mine Planning, specifically the view of mining operations from public access areas. The Minister for State Development, on advice from the BSEC, approves on an annual basis the MMPs i.e. the Five Year Mine Plans that contain mining and rehabilitation programs.
		Access requirements have been agreed with stakeholders.	Agreed access requirements have been implemented and the forest road network has been established in accordance with DBCA Road Standards.	Access plans are reviewed and agreed with DBCA and Water Corporation and discussed with neighbours and local government as appropriate.
		Recreational values protected and/or reinstated on closure, in consultation with key stakeholders.	Demonstrate that recreational values have been protected and/or reinstated.	Recreational values to be protected and/or reinstated are reviewed and agreed with DBCA and Water Corporation and discussed with neighbours and local government as appropriate.
		Heritage and social values protected.	Demonstrate that significant Indigenous and European heritage values identified in pre-mining surveys have been managed appropriately.	Summary of assessments from pre-mining Indigenous and European heritage sites (both internal and external consultant reports). Documentation and GIS maps of all Indigenous and European heritage sites and the management actions taken to protect them.
	Physical and surface safety and stability	The mine pit areas are landscaped to be stable and to blend in with the surrounding forest.	Slopes to always be less than 18 degrees and no landscaped pit is to have a slope greater than 15 degrees for more than 20 m unless it is on contour of the surrounding forest floor No area greater than 0.1 of a hectare has unbroken caprock.	Landscaping completed to ensure effective surface water management. Landscape management does not cause an impediment to access for DBCA or be an ongoing financial or management liability. Self-certification by Alcoa annually and /or inspection by DBCA confirm landscape design is acceptable. Landform design that meets the standard will be deemed acceptable unless DBCA writes to Alcoa within three months of self-declaration to advise otherwise. Waste islands will have caprock shattered and topsoil spread and scarified to prevent impeding vehicular or rubber tyre machines for fire access.
	Wastes and hazardous materials	All non-mineral hazardous waste removed from site and appropriately disposed.	All non-mineral hazardous waste removed from site.	No non-mineral hazardous waste remaining on site.
		No above surface infrastructure left on site, unless agreed to remain in consultation with DBCA.	Demonstrate that all infrastructure has been demolished and removed as per outlined in the Decommissioning Plan. All areas where infrastructure have been removed have been rehabilitated to the agreed PMLU. No unsafe areas where infrastructure has been removed (e.g. caused by subsidence, trenches and culverts). All roads and services not required post closure removed.	Decommissioning Plan in place for each infrastructure area. Decommissioning Plan implemented.

PMLUs	Aspect	Closure objective	Completion criteria	
			Standard	Guidance for acceptance
		Contaminated areas identified and remediated as per the *Contaminated Sites Act 2003*.	All contaminated sites remediated in terms of applicable legislation.	Contaminated site report by independent consultant.
	Surface water and catchment protection	Rehabilitated areas conform to water catchment management guidelines.	Turbidity monitoring is carried out according to the Water Working Arrangements. Rehabilitated areas will be stable with no evidence of recent erosion which would compromise stream water quality. There are no areas greater than 0.1 ha with less than 0.5 native plants per square metre.	Rehabilitated surfaces are stable and water quality standards are met.
		No uncontrolled surface water runoff or unacceptable erosion in or adjoining rehabilitated pits.	The pit areas have been contour ripped and there is no uncontrolled surface water runoff or unacceptable erosion. Unacceptable erosion is that which: • is unstable and degrading or will compromise PMLU objectives; or • exceeds 30 cm in depth and width; or • exceeds 100 m in length • areas of unintended deposition of >0.1 m depth. Gully erosion will not exceed: • 30 cm depth, and 30 cm width • 100 m in length • areas of unintended deposition greater than 0.1 ha.	Self-certification by Alcoa annually and inspection by DBCA (where applicable) confirms rehabilitation ripping is acceptable. Ripping that meets the standard will be deemed acceptable unless DBCA writes to Alcoa within three months of self-declaration to advise otherwise
	Fauna	Rehabilitated areas provide appropriate habitat for fauna.	Rehabilitation will include one constructed fauna habitat per 2 ha.	Self-certification by Alcoa annually and inspection by DBCA confirms rehabilitation has adequate ground habitat material.
	Soil	There is adequate cover of topsoil across the rehabilitated area.	Topsoil is spread over the rehabilitated area. No area greater than 0.1 ha has no topsoil coverage. The cumulative area without topsoil does not exceed 10 per cent of the rehabilitated pit or infrastructure area.	Topsoil return and coverage is uniform within each individual rehabilitated pit.
	Resilience of vegetation and land use (12 years and older).	Resilience of fire affected rehabilitation: Vegetation in rehabilitated areas is capable of persisting at the required standard following bushfire.	A minimum of 300 stems/ha including: • a minimum of 150 stems/ha Jarrah • a minimum of 45 stems/ha Marri.	Sufficient stems are available following the fire to provide a stocked stand.
		Dieback: Tree species (e.g. Marri) less susceptible to dieback are present at adequate stocking rate	Minimum 200 Marri stems/ha at 9 months monitoring.	Tree species not susceptible to dieback are present at adequate stocking rate

PMLUs	Aspect	Closure objective	Completion criteria	
			Standard	Guidance for acceptance
		Other forest diseases: Rehabilitation is not preferentially attacked by non-dieback forest diseases.	The disease expression in rehabilitation is no greater than in the unmined forest.	An assessment has been made of the extent and severity of any damage from non-dieback or forest disease (crown or bole damage) and whether rehabilitation is being selectively damaged
		Insects: Rehabilitation not preferentially attacked by insects.	The infestation of rehabilitation by insects is no greater than in the unmined forest.	An assessment has been made of the extent and severity of any insect damage (crown or bole damage) and whether rehabilitation is being selectively damaged.
		Drought: Rehabilitation not showing evidence of being preferentially affected by drought.	There is no obvious differentiation or variation to unmined forest. Mining rehabilitation areas are not showing evidence of being preferentially affected by drought.	Mining rehabilitation areas are not showing evidence of being preferentially affected by drought. There is no obvious differentiation or variation to unmined forest.
		Timber production: There is adequate density of both Jarrah and Marri to meet timber production requirements - only applicable to areas where timber production was a land use prior to mining. **Note: the objective will be reviewed to reflect the 2024 cessation of native forestharvesting**	The average number of stems/ha: Minimum: 500 eucalypt stems/ha Maximum: 1,300 eucalypt stems/ha Target: 900 eucalypt stems/ha (except haul roads and pits <2 ha) Minimum: 200 marri stems/ha Minimum: 150 jarrah stems/ha No rehabilitated sites (>2ha) have areas >0.5 ha with less than 100 stems/ha. At the time of hand back the subject region has a minimum of 250 stems/ha combined total Jarrah/Marri with the potential to produce a straight bole with a minimum of 3 m of potential future sawlog.	Areas capable of producing sawlogs.
		Management of understorey: There is adequate understorey layer diversity in the rehabilitation.	Evidence from permanent monitoring plots and research trials that understorey cover density and richness are within the respective ranges observed in forest reference sites.	Understorey meets the expected species richness, density and cover.
	Ecosystem function and sustainability	Restore a self-sustaining ecosystem in all rehabilitated areas.	Target range for overstorey stocking achieved as described in Attachment 1, Figure 1 in the 2016 Completion Criteria document (Alcoa, 2015).	The stand stocking (expressed in stems per hectare) of restored overstorey needs to be high enough to satisfy timber production values, but not so high as to exclude understorey species, or compromise health of overstorey through competition effects. A target range of overstorey stocking is used in recognition that it is acceptable to have some areas that are understocked or overstocked. When rehabilitated areas are accepted back by the State, the accepted area may contain a mosaic of varying rehabilitation ages. For this reason, the target stocking range decreases over time to account for natural attrition.

No extreme risks on the attributes risk rating were identified in the completion criteria. Three high risks and four moderate risks based on the attribute risk ratings were identified. The attribute and the action to be taken to mitigate these risks are summarised in Table 8-4. The actions to reduce these risks are based on the completion criteria and will be implemented as required during the closure phase as per the closure implementation plans in Section 9.

Table 8-4 Relevant actions based on attribute risk rating

Attribute	Action
Aesthetics (visual amenity).	Continued progressive rehabilitation of mined-out areas to agreed PMLU.
Heritage and social values protected where practicable.	Ongoing visual assessment of items to ensure that they have not been impacted through mine closure activities.
Recreation and access.	Ongoing protection of recreational values (where possible) and reinstatement of recreational values during rehabilitation.
Design, construction and integrity of final landforms.	Check compliance between design and as constructed of final landforms.
Connections with nearby ecosystems in place and functioning. Ecosystem resilience to disturbance.	Continued monitoring of plant biodiversity parameters confirms mean values reflect a functional community.
Constructed fauna habitat features (breeding and refuge).	Assessment of rehabilitated areas that completion criteria have been met and self-certification by Alcoa.
Presence of recalcitrant species. Plant growth, survival, rooting depth, physiological function. Vegetation cover Species richness Key threats absent or managed (e.g. weeds, pathogens).	Ongoing revegetation monitoring.

9. Closure implementation

This section presents the background information and closure work program for each domain, and a closure work program describes the tasks that will be undertaken for each domain. The identification and management of closure knowledge gaps and scheduling of closure works are also discussed in this section. It is envisaged that active closure implementation will be completed within five years post-production followed by a monitoring and maintenance period until closure objectives and completion criteria have been met.

At closure, many of the impacts arising during operations will no longer be significant, for example dust generation due to mining and crushing activities and water use, although there may be dust generation during active rehabilitation activities. Key additional considerations at closure relate to the final rehabilitation and revegetation of the mining area, management of water runoff and final land use.

9.1 Closure work program

The closure work program for all the domains are presented in this section. The work programs are described with associated completion criteria. Items specifically related to the two closure domains are described below as well as an additional “all domains” where closure objectives, work programs and completion criteria are common to both closure domains.

9.1.1 Mining support infrastructure domain

These areas include current and redundant mine facilities located at Myara, McCoy, Del Park, Huntly, White Road and storage areas as well as the future mine facilities at the proposed new Myara North, new Holyoake and reopened O’Neil mine regions.

In preparation for closure all non-fixed assets and mobile equipment will be removed, as will all consumables, wastes and hazardous materials.

The closure work program for all infrastructure will involve removing all above and below ground assets and infrastructure (up to 0.5 m for below ground infrastructure), managing surface water drainage, and rehabilitating each area.

Power and water to all services will be isolated prior to commencing any dismantling or demolition activities. Material will be salvaged for recycle or reuse where possible. All material that cannot be salvaged will be removed and disposed of according to existing regulations or guidelines.

If identified, impacted soil will be remediated and revegetated to the requirement of the PMLU. All inert wastes not disposed on site as well as hazardous materials will be removed and disposed of according to existing regulations or guidelines.

Some roads at the Mine may be required after closure to provide access for post closure monitoring and maintenance. DBCA requires that agreed access State Forest roads and tracks present prior to mining (e.g. for timber harvesting, prescribed burns and apiaries) are restored at closure. Apart from State Forest roads and tracks it is assumed that all Mine roads will be completely removed at the end of the post closure monitoring and maintenance period. It is likely however that stakeholders may want some Mine roads left intact permanently. Alcoa will only leave roads intact permanently if:

- The roads have an agreed owner who is responsible for their maintenance and roads have a viable future use.
- The owner accepts responsibility for removing the roads, if required, to a standard nominated by Alcoa and the relevant regulator.

- The State agrees with the proposal.
- Alcoa is indemnified against future liability.

The specific closure work programs for this domain with their related closure objectives and completion criteria are presented in Table 9-1.

9.1.2 Mining and rehabilitation domain

These areas include the mining areas, haul roads, conveyor corridors and rehabilitation areas at Huntly 1 & 2, Del Park, McCoy, White Road, Myara and the proposed, new Myara North and Holyoake regions, and the reopened O'Neil region. Impacted soil will be remediated if any is identified and revegetated to the requirement of the PMLU. At closure, much of the rehabilitation would have been completed or will be ongoing as the operation does concurrent rehabilitation as mining progresses. The specific closure work programs for this domain with their related closure objectives and completion criteria are presented in Table 9-2.

9.1.3 All domains

The 'all domains' section describes the closure work programs across the above two domains where the objectives, work programs and completion criteria are common to both domains. These are presented in Table 9-3.

Table 9-1 Mining support infrastructure domain closure work program

Mining support infrastructure domain		
Description: These areas include current and redundant mine facilities that are located at Huntly Bauxite Mine within ML1SA This includes the previous and current regions of Del Park, Huntly, White Road, McCoy, O'Neil, and Myara, and the proposed extension to the future mine regions of Myara North and Holyoake and reopening of O'Neil. These facilities include crushers, conveyors, roads, heavy and light vehicle refuelling bays, heavy and light vehicle wash bays, heavy and light vehicle maintenance sheds, fire stations, oily wastewater treatment systems, fuel and oil storage facilities, waste oil storage facilities, equipment and chemical stores, administrative offices and car parks, general stores, laydown areas and hardstand, workshops, substations, domestic wastewater treatment and irrigation, ancillary buildings, lighting towers, fencing and storage areas.		
Area: 3,372 ha		
Closure outcome: Re-establish a self-sustaining Jarrah forest ecosystem that fulfils forest land uses that include conservation, timber production, water catchment and recreation.	**Rationale:** As these mining support infrastructure areas are dispersed within the State Forest the intention is to rehabilitate these areas to the same prescription of the mining areas.	**PMLU:** Production native forests: • Timber production • Conservation • Recreation • Water catchment
Closure objectives	**Closure work program**	**Completion criteria**
No above surface infrastructure left on site.	Roads, services, buildings, crushers, conveyors, water reticulation and other structures: • Identify which roads are to remain and those to be removed. • Remove all roads not required by post-closure landowner. • Remove all signage and road furnishings. • Remove culverts, flood ways and other drainage structures where no longer required. • Remove all above ground services and pipes. • Remove all below ground services and pipes up to 0.5 m below surface. • Remove HDPE liners from dams (where applicable). • Drain dams, remove dam walls and profile to be free draining. • Remove all below ground foundations up to 0.5 m below surface. • Break-up hardstand and other concrete and remove from site or bury in situ unless otherwise agreed. • Remove all buildings and structures down to bare earth to allow for rehabilitation. • Decommission redundant bores. • Deep rip compacted surfaces. • Apply topsoil (0-15 cm) • Plant and seed indigenous species. • If necessary, apply fertiliser • If necessary, control weeds.	Demonstrate that all infrastructure has been demolished and removed as per outlined in the Decommissioning Plan. All areas where infrastructure have been removed have been rehabilitated to the agreed PMLU. No unsafe areas where infrastructure has been removed (e.g. caused by subsidence, trenches and culverts). All roads and services not required post closure removed.

Table 9-2 Mining and rehabilitation domain closure work program

Mining and rehabilitation domain		
Description: These areas include previous, current and future Myara North, Holyoake and O'Neil mine regions, haul roads, conveyor corridors and rehabilitation areas.		
Area: Huntly **12,599** ha; (current); Myara North 5,138 ha, O'Neil 2,998 ha and Holyoake 4,463 ha (future**)**		
Closure outcome: Re-establish a self-sustaining Jarrah forest ecosystem that fulfils forest land uses that include conservation, timber production, water catchment and recreation.	**Rationale:** As all the mining areas fall within the State Forest the intention is to rehabilitate these areas to self-sustaining Jarrah forest.	**PMLU:** Production native forests: • Timber production • Conservation • Recreation • Water catchment.
Closure objectives	**Tasks**	**Completion criteria**
The mine pit areas landscaped to be stable and to blend in with the surrounding forest.	Reprofile pits to required completion criteria. Shatter caprock at waste islands, redistribute, spread topsoil and scarify.	Slopes to always be less than 18 degrees and no landscaped pit is to have a slope greater than 15 degrees for more than 20 m unless it is on contour of the surrounding forest floor No area greater than 0.1 of a hectare has unbroken caprock.
No uncontrolled surface water runoff or unacceptable erosion in, or adjoining, rehabilitated pits.	Contour rip pit areas. Landscape rehabilitated areas to contain water. Landscape rehabilitated pits and rehabilitated haul roads to retain water during rainstorms (primary water retention occurs in the contour rip lines, where rainfall is trapped while it infiltrates into the soil). Inspect all newly rehabilitated areas are during the first winter to ensure water retention is occurring effectively and that there are no erosion problems. Monitor turbidity according to Water Working Arrangements. Monitor native plant density.	The pit areas have been contour ripped and there is no uncontrolled surface water runoff or unacceptable erosion. Unacceptable erosion is that which: • is unstable and degrading or will compromise PMLU objectives; or • exceeds 30 cm in depth and width; or • exceeds 100 m in length • areas of unintended deposition of >0.1 m depth. Gully erosion will not exceed: • 30 cm depth, and 30 cm width • 100 m in length • areas of unintended deposition greater than 0.1 ha.
No above surface infrastructure left on site.	Haul roads, services, and conveyors: • Identify which roads are to remain and those to be removed. • Remove all roads not required by post-closure landowner. • Remove all signage and road furnishings. • Remove culverts, flood ways and other drainage structures where no longer required. • Deep rip compacted surfaces. • Apply topsoil (0-15 cm) • Plant and seed indigenous species. • If necessary, apply fertiliser	Demonstrate that all infrastructure has been demolished and removed as per outlined in the Decommissioning Plan. All areas where infrastructure have been removed have been rehabilitated to the agreed PMLU. No unsafe areas where infrastructure has been removed (e.g. caused by subsidence, trenches and culverts). All roads and services not required post closure removed.

Mining and rehabilitation domain		
	• If necessary, control weeds.	
There is adequate cover of topsoil across rehabilitated areas.	• Spread conserved topsoil (or agreed surrogates) over the rehabilitated areas.	• Topsoil is spread over the rehabilitated area. • No area greater than 0.1 ha has no topsoil coverage. • The cumulative area without topsoil does not exceed 10 per cent of the rehabilitated pit or infrastructure area.

Table 9-3 All domains closure work program

All domains		
Description: All domains closure work program describes the closure work that is common to both the mining infrastructure support domain and the mining and rehabilitation domain.		
Closure outcome: Re-establish a self-sustaining Jarrah forest ecosystem that fulfils forest land uses that include conservation, timber production, water catchment and recreation.	**Rationale:** As all the mining and infrastructure support areas fall within the State Forest the intention is to rehabilitate these areas to self-sustaining Jarrah forest.	**PMLU:** Production native forests: • Timber production • Conservation • Recreation • Water catchment.
Closure objectives	**Tasks**	**Completion criteria**
The visual impact of the rehabilitated site is compatible with surrounding landscape.	Integrate post-mining profile as well as areas where infrastructure have been demolished into the surrounding landscape. Revegetate all disturbed areas	Programs to manage the visual aspects of the mining, where relevant, are included in the annual MMPs for approval through the BSEC during operations. BSEC acceptance of final landscape and revegetation.
Access requirements have been agreed with stakeholders.	Implement access control in accordance with DBCA Road Standards.	Agreed access requirements have been implemented and the forest road network has been established in accordance with DBCA Road Standards.
Recreational values protected and/or reinstated on closure, in consultation with key stakeholders.	Review and agree on recreational values to be protected and/or reinstated with DBCA and Water Corporation and discuss these with neighbours and local government as appropriate.	Demonstrate that recreational values have been protected and/or reinstated.
Heritage values protected.	Demarcate and / or fence-off remaining significant Indigenous and European heritage values identified in pre-mining surveys during decommissioning and rehabilitation.	Agreed access requirements have been implemented and the forest road network has been established in accordance with DBCA Road Standards.
Rehabilitated areas conform to water catchment management guidelines.	Landscape rehabilitated areas to reinstate percolation of infiltrated rainfall and contain any surface water in newly rehabilitated areas. Inspect all newly rehabilitated areas during the first winter to ensure water retention is occurring effectively and that there are no erosion problems.	Turbidity monitoring is carried out according to the Water Working Arrangements. Rehabilitated areas will be stable with no evidence of recent erosion which would compromise stream water quality. There are no areas greater than 0.1 ha with less than 0.5 native plants per square metre.
All non-mineral hazardous waste removed from site and appropriately disposed.	Remove all non-mineral hazardous materials from site. Dispose these materials in appropriate licenced off-site landfills or incinerate if required.	All non-mineral hazardous waste removed from site. No non-mineral hazardous waste remaining on site.
Restore a self-sustaining ecosystem in all rehabilitated areas.	Monitor re-established vegetation until completion criteria for a self-sustaining ecosystem has been achieved. Implement further corrective action prior to relinquishment if required.	Target range for overstorey stocking achieved as described in Attachment 1, Figure 1 in the 2016 Completion Criteria document (Alcoa, 2015).
Rehabilitated areas provide appropriate habitat for fauna.	Place waste timber and rocks in the restored areas to provide habitat for both vertebrate and invertebrate fauna.	Rehabilitation will include one constructed fauna habitat per 2 ha. Habitat requirements are detailed in the Alcoa/DBCA Working Arrangements.

All domains		
Vegetation resilience and land use (12 years and older): Vegetation in rehabilitated areas is capable of persisting at the required standard following bushfire Overstorey tree species not susceptible to dieback. Rehabilitation is not preferentially attacked by non-dieback forest diseases. Rehabilitation not preferentially attacked by insects. Rehabilitation not showing evidence of being preferentially affected by drought. There is adequate density of both Jarrah and Marri to meet timber production requirements - only applicable to areas where timber production was a land use prior to mining. There is adequate understorey layer diversity in the rehabilitation.	Pre-rip areas to be vegetated after landscaping to relieve mining-related compaction and to create a friable rooting zone to 1.5 m depth. Return topsoil and overburden. Rip area again to 0.8 m on contour using a bulldozer with three tines to remove compaction caused by the soil return operation and to produces contour furrows, which allow water infiltration and provide rainfall erosion protection until the vegetation develops. Apply seed of locally native plant species (seed to be collected within a defined zone up to about 20 km from each mine region to ensure that local genetic material is used for restoration). Apply the seeds at an appropriate rate. Apply appropriate germination treatments (such as hot water or smoke) to each species as required before sowing. Plant recalcitrant species that do not return from the soil seed bank. If necessary, apply fertiliser to newly restored areas.	A minimum of 300 stems/ha including: • a minimum of 150 stems/ha Jarrah • a minimum of 45 stems/ha Marri. Minimum 200 Marri stems/ha at 9 months monitoring. The disease expression in rehabilitation is no greater than in the unmined forest. The infestation of rehabilitation by insects is no greater than in the unmined forest. The average number of stems/ha: • Minimum: 500 eucalypt stems/ha • Maximum: 1,300 eucalypt stems/ha • Target: 900 eucalypt stems/ha (except haul roads and pits <2 ha) • Minimum: 200 marri stems/ha • Minimum: 150 jarrah stems/ha No rehabilitated sites (>2ha) have areas >0.5 ha with <100 stems/ha. At the time of hand back the subject region has a minimum of 250 stems/ha combined total Jarrah/Marri with the potential to produce a straight bole with a minimum of 3 m of potential future sawlog. Evidence from permanent monitoring plots and research trials that understorey cover density and richness are within the respective ranges observed in forest reference sites.

9.2 Progressive rehabilitation

Alcoa maintains a progressive rehabilitation program. Concurrent with rehabilitation, Alcoa has developed rehabilitation methods, technologies and completion criteria for the Jarrah Forest over a period of more than 45 years. Early rehabilitation consisted of *Eucalyptus* or pine plantations selected for their resistance to *Phytophthora* dieback, then evolved to include ground preparation treatments (e.g. deep ripping) and restoring native understorey species. Since 1988, rehabilitation has involved the re-establishment of only native species with Jarrah and Marri as dominant tree species, with the aim to re-establish a self-sustaining Jarrah forest ecosystem that fulfils forest land uses that include conservation, timber production, water catchment and recreation (Alcoa 2020). Rehabilitated areas must become amenable to similar management practices employed in the surrounding Jarrah forest.

Alcoa maintains a rehabilitation monitoring program, with evaluation against Rehabilitation Completion Criteria (Alcoa 2015) developed in consultation with the BSEC, including standards for plant densities, plant species richness, erosion and weeds in the early establishment phase and standards for longer-term ecosystem development and integration with standard forest management such as prescribed burns. The longer-term ecosystem revegetation and ecosystem development completion criteria for relinquishment are described in Section 8.3.2. The early vegetation establishment (first five years) completion criteria are presented in Table 9-4 as it relates to progressive rehabilitation and not final relinquishment criteria.

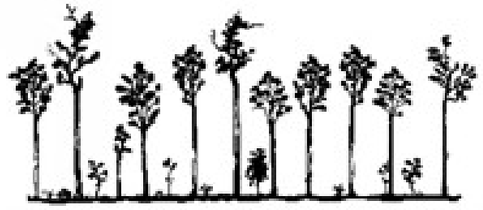
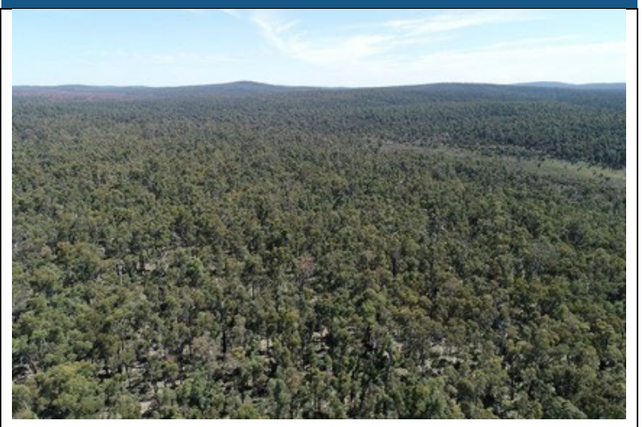
An overview of the progressive rehabilitation and vegetation establishment is provided in Table 9-5.

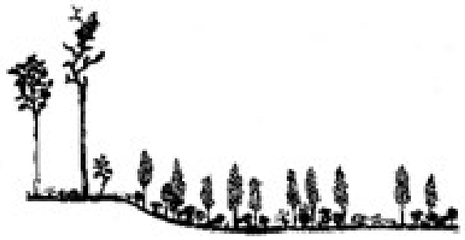
Table 9-4 Early vegetation establishment completion criteria

Objective	Completion criteria	
	Standard	**Guidelines for acceptance**
Establishment of overstorey (a) The overstorey stocking of both jarrah and marri meet standards.	The average number of stems/ha with in a pit (9 month monitoring data): • Minimum: 600 eucalypt stems/ha • Maximum: 1400 eucalypt stems/ha • Target: 1000 eucalypt stems/ha (except haul roads and pits <2 ha) • Minimum: 200 marri stems/ha • Minimum: 150 jarrah stems/ha. No rehabilitated sites (>2ha) have areas >0.5 ha (as identified from either 9 –month monitoring or subsequent review of aerial imaginary at 5-yrs of age) with <100 stems/ha.	Target range for overstorey stocking achieved as described in Attachment 1, Figure 1 in the 2016 Completion Criteria document (Alcoa 2015).
Establishment of understorey (a) There is adequate legume density in early regeneration.	Minimum legumes 0.5 m^2 averaged over a pit assessed at 9-months.	Alcoa must submit 9-month monitoring data to DBCA who must review and advise Alcoa of acceptance or request corrective action.
(b) There is adequate plant species richness.	The species richness in monitoring plots in rehabilitated areas to be >=60 per cent of the average species richness in monitoring plots established in unmined forest. The assessment in rehabilitated areas is based on monitoring at 15 months.	Areas to have adequate number of forest species present. Alcoa must submit 15-month species richness and density monitoring to DBCA annually. DBCA must review and advise Alcoa of acceptance or request corrective action.

Objective	Completion criteria	
	Standard	**Guidelines for acceptance**
(c) There is an adequate density of resprouter species.	Minimum number of surviving resprouter species will be 200 plants/ha.	Monitoring at 15 months.
Resilience of vegetation Weeds	Weeds are assessed at the 9 month monitoring at the same time as the legume and eucalypt density assessment.	Alcoa must submit 9 month monitoring data and maps of weed presence, including any new or Declared environmental weeds to DBCA annually. Alcoa must seek DBCA advise on appropriate treatment, if any, and indicate where the treatment has occurred. DBCA must review and advise Alcoa of acceptance or request corrective action.

Table 9-5 Overview of progressive rehabilitation and early vegetation establishment

Rehabilitation establishment stage and key characteristics	Vegetation structure diagram	Ground level photograph	Aerial photograph
Pre-mining • Predominantly immature forest (21-70 years since last harvest). • Some mature trees retained. • Mosaic of varying regeneration, compaction and recovering biodiversity from previous harvesting. • Prescribed burning on a rotation of approximately 10 years.			
Completed rehabilitation (3-4 years from clearing) • Black Cockatoo critical habitat trees retained. • Landscaped, deep ripped pits. • Friable, permeable, furrowed substrate. • Topsoil, seeding and planting. • Tree stocking to meet biodiversity and timber production objectives. • Fauna habitats installed at one per ha. • State Forest access tracks re-instated. • Open ground noticeably distinct from surrounding canopy as viewed from distant highpoints.			

Rehabilitation establishment stage and key characteristics	Vegetation structure diagram	Ground level photograph	Aerial photograph
Establishment stage (1-5 years from completion) • Dominant shrub layer. • Emerging tree saplings. • Mesh guards around 'recalcitrant' re-sprouter species. • Exotic ephemeral species peak. • Early development of ground cover and fauna refuge. • Developing litter layer, low fuel levels. • Opportunity to prescribe burn surrounding forest. • Ground cover reduces visual effect of mining as viewed from distant highpoints.			
Juvenile stage (6-15 years from completion) • Canopy layer developing into pole form up to 14 m height. • Proteaceous understorey provides Black Cockatoo feeding habitat. • Establishing native vegetation outcompetes ephemeral exotic species. • Prescribed burning excluded as canopy is low and trees vulnerable to fire damage. • Growing canopy further reduces visual effect of mining as viewed from distant highpoints.			

Rehabilitation establishment stage and key characteristics	Vegetation structure diagram	Ground level photograph	Aerial photograph
Immature stage (16-30 years from completion) • Jarrah and Marri young pole form up to 20 m height, dominate the forest structure. • 'Recalcitrant' re-sprouter species spread laterally from original plantings. • Myrtaceous overstorey provides Black Cockatoo feeding habitat. • Increasing vertebrate and vertebrate fauna diversity. • Opportunity to prescribe burn rehabilitation and surrounding forest. • Canopy blends with surrounding forest as viewed from distant highpoints.			

9.3 Schedule of investigative tasks

Alcoa's forest rehabilitation prescriptions are regularly reviewed. These reviews form a basis for future research directions aimed at meeting the objective of establishing a self-sustaining Jarrah forest ecosystem. Any improvement in restoration practices require:

- A clear specific objective.
- Management commitment.
- Research and experimentation.
- Quantitative monitoring and feedback processes.

9.3.1 Research programs

Alcoa maintains an environmental research program, internally and through collaborative arrangements with tertiary institutions, other mining companies, state government departments and research groups such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Kings Park and Botanic Gardens. Research into returning a sustainable ecosystem with a diverse flora to rehabilitation areas has been long-standing encompassing the value of topsoil (Koch 2007, Tacey and Glossop 1980), seed treatment (Bell et al 1993), propagation of resprouting species (Willyams 2015), the performance of resprouting species when planted in rehabilitation (Stanton-Clements et al. 2013; Daws and Koch 2015), appropriate fertiliser application rates for rehabilitated areas (Daws et al. 2013, 2015, 2019ab), successional trajectories of rehabilitation (Norman et al. 2006) and tree growth (Grigg and Grant 2009, Walters et al. 2021). A range of research papers have also been published that demonstrate the effect of clearing for mining on stream flows and groundwater levels. These include:

- Grigg, AH and Kinal, J, 2020, *On the contribution of groundwater to streamflow in laterite catchments of the Darling Range, south-western Australia*, Hydrological Processes, DOI: 10.1002/hyp.13928
- Grigg, AH and Hughes, J, 2018, *Non-stationarity driven by multi-decadal change in catchment groundwater storage: a test of modifications to a common rainfall-runoff model*, Hydrological Processes, DOI: 10.1002/hyp.13282.
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Climate change

Although Alcoa manages a portfolio of rehabilitation trials through research programs, a key issue pertinent to the long-term sustainability of the rehabilitation is climate change. A drying climate identified for southwest Australia potentially poses threats to the success of Alcoa's rehabilitation program.

In a research paper (Standish *et al*. 2015) discusses a structural equation model developed to discriminate the relative effects of climate, restoration practice, and their interactive effects on three response variables including species richness of the restored plant assemblages. Climate variability had a significant negative effect on richness, but the effect size was relatively small,

being less than half that of varying restoration practice. Standish *et al*. (2015) suggested this is due, in part, to the reliability of rainfall (i.e. no change in the coefficient of variation, seasonality or evenness, between recent and historical climates) despite a threefold difference in the absolute amount of wet-season rainfall. Importantly, there was no evidence that restoration practices were compromised by interacting effects of increased climate variability. The paper concluded that Jarrah-forest establishment in a restoration context appears resistant to recent changes in climate. The research highlighted the importance of deriving multiple metrics of climate change to understand community responses. In particular, rainfall reliability should be a focus of future research to determine its broader significance to seedling establishment in forests subject to a drying climate.

A further project established with Murdoch University used Alcoa's long-term record of rehabilitation species richness monitoring to determine how a drier future climate could influence botanical diversity (Standish et al. 2018). The study investigated seedling establishment of jarrah forest species under wet (> 1,200 mm), moderate (1,000–1,200 mm) and dry (< 1,000 mm) rainfall years that occurred between 1992 and 2010, and the effect of different soil management practices used during rehabilitation. The study also tested how the effects of both these treatments varied among plant groups defined by three different traits - life-form, seed size, and native or non-native.

The study found that a small group of species, dominated by native annual forbs, were intolerant of dry rainfall years, although it was noted that these species were only rarely observed across all years. The majority of plant species recruited regardless of rainfall at the time of seedling establishment. Furthermore, the study found that the effects of dry years can be offset by best practice rehabilitation processes (these processes also tend to reduce the establishment of non-native or weed species).

Erosion

Another key element pertinent to the long-term sustainability of the rehabilitation is erosion of re-established landforms. Alcoa has done extensive research and trials to enable the design of erosion resistant landforms for steep slopes in rehabilitation of bauxite mines in Western Australia.

In a study by Mengler (2006) it was concluded that a combination of the following major triggers cause gully erosion on steep slopes:

- Excess off-site water supply directed into the eroding area.
- Poor surface completion resulting in concentrated flow and/or poor infiltration.
- Insufficient depth of returned topsoil and overburden (less than ~20 cm combined).
- Minor gully erosion triggers were found to include:
- Remnant forest islands within pits.
- Fauna habitats displacing contour lines.
- Irregular upslope pit boundaries.
- Non-ripped caprock at pit edge.
- Shallow groundwater.

Mengler (2006) found that steeper slopes and longer slope lengths intensified the severity of erosion where they combined with one or more major or additional minor erosion triggers. Most

gully erosion initiated at the upper parts of rehabilitated hillslopes, either at the base of a shoulder or on backslopes.

Area-slope relationships show that no gullies or small gullies (less than 20 m³ volume) occur at slopes from 0 to 14° where the catchment area is less than 0.4 ha. Beyond 0.6 ha catchment area, and beyond 10° slope, large gullies (>100 m³ of volume) can occur but not in all cases. For slopes less than 10°, even for relatively large areas of catchment draining through a point (>1 ha) gullies are usually small (less than 20 m³ of volume). Soil erodibility values for rehabilitated surface soils were found to be low to very low. However, more-erodible media occurred where: mine floor material mixed with topsoil/overburden; and/or the topsoil/overburden layer was thin or its coverage was patchy, resulting in slaking subsoil, hardsetting soil and surface crusts.

Gully development was greatly intensified when erodible surface media were combined with steeper (>8º) or longer (>50 m) slopes or with any major erosion trigger being present. It was postulated that erosion rates for gullied sites should decline two or three years after rehabilitation and that additional remediation to repair small gullies may not be necessary if they have reached stasis. At sites that have crossed a threshold from low to high-state erosion, rates may not reduce much in the first years of rehabilitation. Active gullies at sites with high-state erosion usually requires additional rehabilitation. Alcoa is applying these learnings in their current rehabilitation practices.

9.3.2 Revegetation monitoring

When the restored areas are nine months old, the areas are monitored to check that the number of established plants meets targets agreed in the completion criteria. Areas of erosion or weeds are also identified at this stage and treated if required. In the second spring after establishment (15 months old), the plant species richness is determined using 80 m^2 plots located randomly in the restored areas. A subset of these plots is permanently pegged and re-monitored to become part of a long-term vegetation monitoring program (Koch, 2007).

9.3.3 Forward work plan

In conjunction with the above residue research programs some knowledge gaps pertaining to sustainable closure of the operation must be resolved during the remaining life of the mine. The forward work plan for these is reflected in Table 9-6.

Table 9-6 Forward work plan

Knowledge gap	Rationale	Task	Schedule
Climate	The area has been experiencing a significant decreasing annual rainfall trend since the late 1960s and this decrease has further accelerated since 1993. Decreasing rainfall could impact revegetation success over time.	Revegetation monitoring to continue to determine adaptions (if any) required due to climate change.	Ongoing during operations and post closure until relinquishment.

Knowledge gap	Rationale	Task	Schedule
Soil	Naturally nutrient-deficient soils along with a range of plant species adapted to these conditions indicates application of fertilisers at closure should be approached with caution.	Fertiliser application requirements to be continually reassessed and soil monitoring (soil texture / erodibility of mine pit areas will continue during operations and closure).	Ongoing
Surface water	There are large areas of the proposed mining catchment in which no flow gauging data exists. The surface water resources in the vicinity of the proposal area support a wide range of social and environmental values and these have to be preserved during rehabilitation and closure.	A number of additional gauging stations are planned for installation as part of the mine extension into Myara North, Holyoake and O'Neil. More comprehensive surface water monitoring is required in the Holyoake region. Surface water quality monitoring, including turbidity and toxicants will continue until relinquishment.	Gauging stations to be installed prior to commencement of mining. Surface water monitoring for Holyoake to be expanded. Surface water monitoring to continue until relinquishment.
Groundwater	Declining rainfall observed over the last two decades has resulted in partial decline of groundwater levels which could have implications for long term sustainability of revegetation.	Increased coverage of groundwater monitoring in the Holyoake area as groundwater levels are limited to four "transect" locations, for a period before 1983 and 17 newly established bores.	Groundwater quality monitoring will continue until relinquishment.
Social impact of closure	The eventual closure of the Mine will have a social and economic impact in the region.	Conduct a social impact assessment to determine the economic impact of the Mine closure and potential mitigation strategies.	At least five years prior to closure.

Knowledge gap	Rationale	Task	Schedule
Aboriginal heritage	Progressive and final revegetation should ensure that adjacent and downslope Aboriginal heritage values are protected in accordance with survey and consultation outcomes.	Gaps in heritage surveys. Alcoa will undertake surveys in accordance with a Noongar Standard Heritage Agreement to address any gaps in heritage surveys in the Myara North, O'Neil and Holyoake DEs.	Ongoing
Topsoil	Lack of appropriate topsoil at the end of mining (no fresh topsoil with sufficient seeds due to no new clearing) leading to lack of flora diversity.	Clearing scheduled to maximise fresh topsoil. Research programme to identify alternative approaches to meeting diversity targets.	Ongoing
Closure cost estimate	Although closure provisions are raised for the Mine, a closure cost estimate based on a specific MCP has not yet been conducted as this this the first MCP for the Mine.	Conduct closure cost estimate for the Mine taking into account the closure outcome, objectives, completion criteria and implementation tasks outlined in this MCP (See Section 11).	2022

9.4 Early closure

In the event of early or unplanned closure, agreement will be sought with key stakeholders on whether to place the site in care and maintenance or to commence with rehabilitation of the site (if there is no prospect of future commercial viability).

If early closure occurs due to a planned ramp down of the business the closure tasks as outlined in this MCP will be executed and a detailed closure execution plan (CEP) will be developed for approval and subsequent implementation. If rehabilitation is to commence due to early closure, Alcoa undertakes to commence with planning for the implementation of the closure tasks to ensure that the closure objectives and completion criteria as outlined in this MCP are met. Implementation of the closure tasks and subsequent monitoring will commence as soon as practicably possible after unplanned closure.

In the event of temporary closure, a care and maintenance (C&M) plan will be developed in consultation with relevant regulatory departments. The C&M plan will take cognisance of any potential risks which might change due to the C&M period as per the risk assessment.

All closure objectives and completion criteria as identified in this MCP will be met before the site is relinquished. It is envisaged that the decommissioning and rehabilitation as well as the active monitoring period will take at least ten years before the site can be relinquished regardless of whether due to early or planned closure.

9.5 Decommissioning

A detailed plan for infrastructure decommissioning and demolition will be developed at least two years prior to closure. The plan will detail how: process infrastructure will be decommissioned, with any infrastructure with value repurposed or put up for sale; any hazardous waste will be disposed of; and how any contaminated sites will be remediated. High-level requirements to be addressed in detail in the decommissioning plan are discussed below.

9.5.1 Infrastructure inventory

For decommissioning and demolition planning purposes, site infrastructure will be divided into the domains outlined in Table 2-2. An infrastructure inventory will be prepared to identify and list all assets. The infrastructure inventory will include the surface area of all fixed infrastructure by domain. Location plans will be developed to identify the assets and work scopes will be developed for decommissioning and demolition activities with associated cost estimates. The infrastructure inventory will include the following for each structure:

- Construction methods.
- Existing building condition.
- Quantification of volumes of material in the interiors and exteriors of structures.
- As-built drawings.
- A structural and derelict conditions audit.
- A visual review of structural and access (stairs, handrails, elevated walkways) elements.

9.5.2 Hazardous materials assessment

Existing HAZMAT registers will be reviewed to confirm location and volumes of hazardous materials to confirm suitability of proposed demolition methodologies and waste strategies.

9.5.3 Decommissioning and demolition sequencing

An initial review of major laydown areas for material and equipment storage will be conducted to assess the requirements for material sorting, processing and disposal. The proposed approach to decommissioning and demolition for all buildings and infrastructure will follow a specific sequence of events. This will involve the deployment of specialised teams equipped with appropriate demolition and processing equipment to isolate, confirm a zero-energy state, structurally demolish, remove foundations, process waste streams and grade the site to a self-draining condition for future revegetation. Consideration must also be given to site services that will be impacted during the decommissioning and demolition. Specific tasks will include:

- Delineation of specific work areas (e.g. fencing) to provide a working environment delineated from the other site activities.
- Removal of dangerous goods and flammable liquids (fuels, greases and oils). These items may be used for other purposes, resold back to the provider or disposed at licensed waste facilities.
- Removal of salvageable materials.

- Removal of other contents that could be reused or sold.
- Ensuring each area is in a zero-energy condition through positioning equipment in a zero potential energy state, electrical service isolation and air-gapping of in-feed conductors at transformers, switch gear and/or pull boxes outboard of the work scope.
- Cutting and capping of water services and sewer services.
- Isolation of storm water management infrastructure around the project/work scope.
- Removal/isolation of communications networks.
- Removal/isolation of other site services such as air, process water.
- Removal of inert interior contents from buildings prior to demolition without damaging or disturbing potential asbestos containing materials (if applicable) or other designated substances identified.
- Removal of all hazardous building materials once inert materials have been removed.
- Executing structural demolition of buildings and structures using cranes or excavators.
- Removal/demolition of slabs and foundations to a depth of 500 mm to allow for backfilling and grading of the site to a self-draining condition to minimise the risk of long-term ponding post-closure.
- Final clean-up by removal of any debris before revegetation commences.
- Amelioration of dust generation during demolition and rehabilitation activities.

9.5.4 Waste Management, disposal and transport

A waste management, disposal and transport strategy will be prepared to account for the waste resulting from the demolition of infrastructure associated with the mine closure.

Waste streams will be segregated at the site of each demolition to facilitate management and/or disposal. All waste categories that have been deemed not feasible to recycle shall be disposed of as non-recyclable wastes. It is anticipated that all categories of waste are likely to be generated throughout the demolition of the mine infrastructure. It is also anticipated that waste transportation and segregation shall occur throughout this work and that stockpiling of waste will be temporary and minimised. The sequencing of the demolition activities and handling of resultant waste materials will be carefully planned to maximise productivity and minimise overall costs.

9.5.5 Key risks

Key risks associated with decommissioning are listed below. These will be assessed in the preparation of the decommissioning plan:

- Failure to de-energise equipment prior to the commencement of demolition activities.
- Exposure to contaminants (hazardous or other) during decommissioning and demolition activities.
- On-site waste category segregation to avoid cross-contamination not practised.
- Presence of unknown buried services.
- Dust and noise generation during demolition and rehabilitation activities.
- Loss of knowledge/experienced personnel.

- Changing work environment due to change in work scopes and redundant employment positions.
- New personnel/contractors on-boarded may have less site experience and differing safety culture.

9.5.6 Decommissioning forward work plan

To ensure that a Decommissioning Plan for infrastructure decommissioning and demolition can be developed, two years before closure some key forward works and decisions must be completed. These include:

- Determine the split between owner operated and contracted third party demolition.
- Develop plan to align safety culture of existing workforce with specialist contractor personnel.
- Develop a knowledge retention strategy in the pre-demolition phase to ensure knowledge retention is maximised during transition of operations.
- Liaise with regulators to ensure licencing is in place for on-site disposal of the waste types, if required.
- Plan detailed scheduling and staging of demolition activities and associated scheduling of equipment and personnel to transport waste on- and off-site.
- Plan for on-site laydown and stockpiling areas should demolition scheduling change such that progressive demolition is not feasible.
- Investigate road transport risks for demolished materials to be disposed, sold, or reused.
- Engage with demolition contractor to pursue practical and appropriate options for contractor-driven recycling of waste.
- Communication with key stakeholders about the activities to be undertaken.

10. Closure monitoring and maintenance

10.1 Post-closure monitoring

Once the closure tasks have been implemented for each domain as described in Section 9.1, closure performance will be measured against agreed completion criteria. Post closure performance will be reported to relevant stakeholders as evidence to support lease relinquishment.

During the post closure period, it is intended to continue some operational monitoring and supplement it with additional monitoring. A summary of the monitoring plan is included in Table 10-1. Monitoring will continue until all completion criteria have been achieved.

After the closure tasks have been completed, rehabilitated areas will be maintained until completion criteria relevant to the area have been met. Maintenance may involve tasks such as reinstating surface water controls, repairing erosion gullies, weed management and replanting. The requirement for maintenance of rehabilitated areas will diminish with time, as vegetation establishes and assists to minimise erosion.

10.2 Close-out reporting

The information listed in Table 10-2 is to be provided in the Final Submission Report to demonstrate and provide evidence that the infrastructure areas are ready to be handed back to the DBCA. These are applicable for completion criteria for 2016 onwards.

Table 10-1 Proposed closure monitoring plan

Aspect	Location	Frequency during closure process	Parameters	Target
Surface/ groundwater *	To be determined.	Annually until relinquishment.	pH, electrical conductivity or total dissolved solids, turbidity.	As per relevant water quality criteria.
Vegetation (including weeds)	Either belt transects (9 month monitoring) or plots in rehabilitated areas (plot sizes 80 m2).	1. March each year – 9 months after rehabilitation. 2. 15 months after rehabilitation. 3. 12 years of age or greater to assess ecosystem development	Species richness, and weed cover as per completion criteria.	To achieve PMLU vegetation completion criteria.
Erosion	All rehabilitated domains.	Two years post completion of rehabilitation.	Surface erosion (e.g. gullies).	No gullies or eroded areas that compromise PMLU.
Heritage values	All domains	Ad-hoc as required until relinquishment.	Monitor integrity of heritage values during closure process.	No mine disturbance to heritage values.
Recreational values	All domains	Ad-hoc as required until relinquishment.	Recreation opportunities provided and maintained.	Recreational values have been protected and/or reinstated.
Contaminated sites	All rehabilitated contaminated sites.	As per remediation plan requirements.	Monitor remediated contaminated sites for seepage or other potential environmental impacts.	In accordance with remediation plans.
Drainage	All pits and rehabilitated areas.	Two years post completion of rehabilitation.	Inspection of remaining drainage controls at pits and other rehabilitated areas.	Drainage intact and operating as designed.
Stability	All pits and rehabilitated areas.	Two years post completion of rehabilitation.	Inspections to determine if all areas are stable.	Agreed and accepted factor for safety.
Safety and asset integrity	All domains	Ad-hoc as required until relinquishment.	Inspections of retained roads or other infrastructure prior to handover.	Acceptance by regulator and landowner.

Table 10-2 Final submission report content

Factor	Objective	Supporting documentation
Accessibility	Demonstrate that the Mine complies with all DEMIRS safety criteria.	• Evidence that the final Forest Access Plan has been progressively (on a forest block basis) signed off by Parks and Wildlife. • DBCA and Water Corporation sign off that Forest Access Plan has been implemented to their satisfaction. • BSEC approved Decommissioning Plan. • Annual sign off of inspection sheets on all road to be re-instated through rehabilitation. • Erosion identified at 9 month inspections will be field inspected. • Implementation report of corrective actions agreed with Parks and Wildlife. • Surface rock issues identified at annual pit inspection and Implementation report of agreed corrective actions.
Mine infrastructure	Demonstrate that the Mine has removed all infrastructure as outlined in the Decommissioning Plan.	• Evidence that the Decommissioning Plan has been progressively signed off by BSEC. • BSEC approval of the Decommissioning Plan. • Evidence of the final Decommissioning Plan implementation. Signed-off by BSEC.

Factor	Objective	Supporting documentation
		• GIS coverage of all identified mine infrastructure contaminated Site report by external consultant. • Contaminated Site report by independent consultant.
Mine safety	Demonstrate that the Mine complies with all DMIRS safety criteria.	• Evidence that a mine safety report has been signed-off – inspection required by DMIRS to provide this report. • A formal letter from DEMIRS to BSEC indicating that Alcoa has met its safety obligations with the decommissioning of the Mine .
Integrated fire management	Demonstrate that the fire management plans for the Mine have been agreed to and / or implemented, and that integration with DBCA's fire management practices has been achieved, OR that rehabilitation has had one controlled burn or is capable of being burnt in a mosaic pattern with surrounding forest.	• Controlled burn and fire history map of the Mine. • Research results showing evidence of stand recovery and resilience to fire. These results to include photos. • Aerial photographs and satellite imagery of the Mine. • GIS map identifying all areas previously burnt, either controlled or uncontrolled. • Documentation of unburnt rehabilitated areas for which financial liability is retained.
Dieback forest rehabilitation (DFR)	Demonstrate that the DFR program has been completed to the standard prescribed within the Mine.	• Summary of DFR records and treatment outcomes. • Map showing areas of treatment. • Letter from Parks and Wildlife indicating that Alcoa's DFR responsibilities have been met. • DFR sign-off sheets (signed by both Parks and Wildlife and Alcoa) • Summary of history of meeting minutes of all DFR within the area for submission.
Weeds	Demonstrate that mining activities in the Mine have not led to the introduction or spread of weeds* in either rehabilitation or unmined forest areas. *A naturalised non-indigenous plant species that adversely affects the health, survival or regeneration of local provenance-indigenous plant species in Alcoa's rehabilitation and unmined forest.	• GIS map showing weed areas identified at 9-month monitoring and treated. • Findings and actions resulting from the aerial photography weed inspection. • Sigh off annual inspections and corrective actions with Parks and Wildlife. • Letter from Parks and Wildlife indicating Alcoa's weed management responsibilities have been met. • Report on trials and monitoring.
Biodiversity conservation values of significance	Demonstrate that the species management for the Mine have been implemented and that key biodiversity conservation values have been adequately managed.	• Summary of key biodiversity conservation values identified from pre-mining surveys (both flora and fauna) including tree islands and granite outcrops. • Alcoa provided evidence of actions taken to protect key biodiversity conservation values. • Report on trials and monitoring. • GIS map coverage of all trials. • Remote sensing imagery of all rehabilitation.
Overstorey	Demonstrate that rehabilitation stands of jarrah and marri are capable of producing saw logs. Note, subject to review post native logging ban.	• Evidence of trial results, monitoring and post-fire assessments that stand stocking and bole length meet completion criteria standards. • Remote sensing imagery of all rehabilitation areas including identifying areas affected by drought. • Management plans, as agreed with Parks and Wildlife, for areas identified as requiring corrective action. • GIS map coverage of all trials. • Establishment or management history. • Monitoring data undertaken prior to handback, provided GIS coverage, showing current stocking of overstorey, and average or top height of overstorey.

Factor	Objective	Supporting documentation
Understorey	Demonstrate that rehabilitation of understorey is capable of perpetuating a range of legumes and re-sprouting species and as adequate plant species richness.	• Evidence provided from plot monitoring data for the understorey density and species richness in the rehabilitation is within prescribed completion criteria target ranges at age 9 and 15 months. • Evidence provided from plot monitoring data for the understorey density and species richness in the rehabilitation from post fire assessments demonstrate that rehabilitation is acceptable. • Evidence from trials and monitoring. • Reports of 15 month data, included in Annual Completion Reports. • GIS map coverage of all trials. • Photo history of rehabilitation. Established photo points, 1 per 50 ha, recorded on GIS, and revisited on a rotation (approx. 4 yearly). Photos to be stored electronically and supplied with final submission. • Provide random sampling data and reference data. • Remote sensing imagery of all rehabilitation.
Forest diseases, insects and droughts	Demonstrate that rehabilitation stands have targeted number of main stems per hectare and that disease, insect infestation or drought expression is no greater than in the unmined forest.	• Reports depicting dieback areas pre and post mining within the Mine/by pit. • Annual Completion Reports to include dieback status of pits. • GIS status of all rehabilitation, summarising dieback/dieback free recorded at the time of the rehabilitation. • Field verification, assessment and agreed management plans for areas of rehabilitation affected more than surrounding forest. • Records and maps showing identified insect distress and other forest diseases over the life of the Mine and at the time of hand back. • Remote sensing imagery identifying selective areas affected by drought, insects or disease. • Management plans, as agreed with Parks and Wildlife, in areas identified to be affected. • Ensure consideration is given, and data shown, to identify other forest diseased (e.g. Myrtle rust).
Heritage	Demonstrate that significant Indigenous and European heritage values identified in pre-mining surveys within the Mine have been managed appropriately.	• Summary assessments from pre-mining Indigenous and European heritage sites (both internal and external consultant reports). • Documentation and GIS maps of all Indigenous and European heritage sites and the management actions taken to protect them.
Habitat	Demonstrate that rehabilitation has targeted number of constructed fauna habitats as defined in the Working Arrangements.	• Summary of records from Annual Rehabilitation Inspections and sign off sheets of constructed habitats. • Provide summary report of fauna and trials for rehabilitation areas, and adjacent forests.
Visual amenities	Demonstrate high value view-sheds from within the Mine.	• Summary report together with pre- and post-mining photographic records of landscape values at risk from mining activities and infrastructure.

11. Financial provisioning for closure

Adequate financial provisioning is required to ensure that Alcoa is able to meet the cost of its closure responsibilities, to ensure the community and government is not left with any liability. The broad principles of financial provisioning are that:

- Closure costs, once developed, should be reviewed regularly to reflect changing circumstances.
- The financial provision for closure should reflect the real cost.
- Accepted accounting standards should be used for financial provision throughout the life of the project.

In compliance with Australian Accounting Standards Board (AASB) 137 Provisions, Contingent Liabilities and Contingent Assets & AASB 116 Property, Plant and Equipment, Alcoa recognises on its financial statements the obligations associated with the costs of rehabilitation and reclamation, plant closure and subsequent monitoring of the environment.

A closure cost estimate will be developed based on this MCP. The closure cost estimate will include the total cost associated with rehabilitation of all existing facilities, as well as all those facilities not yet constructed, disturbed or rehabilitated that have been forecast to be developed within the life of mine. It will also include monitoring and maintenance costs over the anticipated post-closure period until relinquishment.

The process, methodology and assumptions used to determine the updated closure cost estimate will be included in the next MCP. The level of accuracy of the cost estimate will also be specified.

It is expected that closure costs will be refined over the remaining life of the mine as knowledge is gained throughout the operations, designs and studies are advanced and site-specific experience is developed. This includes experience gained through field trials and progressive closure.

11.1 Rehabilitation and environmental provisions

For asset retirement obligations the estimated costs of rehabilitating areas and restoring operating sites are fully provided for. These provisions are carried at the present value of the future obligations. All other environmental rehabilitation costs are recognised on the occurrence of the contamination.

The amount of obligations recognised includes the costs of reclamation, plant and waste site closure and subsequent monitoring of the environment. Costs, other than of a capital nature, associated with other environmental matters are expensed as incurred.

Costs are estimated on a basis of current costs, legal requirements or where there is a past practice that has created a constructive obligation and technology. Changes in estimated costs are dealt with on a prospective basis.

The structure asset retirement obligations have been estimated to be in line with the Mining Licence in Western Australia. The provisions have been estimated using existing technology, at current prices inflated by 2.0 per cent annually and using the applicable discount rates based on the useful life of each asset retirement obligation. Table 11-1 summarises the useful life and discount rate assumptions of each class of asset retirement obligation:

Table 11-1 Discount rate assumptions

	Closure dates	2020 Discount rates	2019 Discount rates
Mine reclamation Western Australia	2020 – 2045	0.35% - 1.85%	0.79% - 1.65%
Structures	2045	0.045% - 1.85%	0.675% - 1.65%

11.3 Decommissioning

This section is left intentionally blank. Further information will be provided closer to closure.

12. Management of information and data

Information and records relating to the operation, rehabilitation and closure of the Mine will be retained for future use by Alcoa, government agencies and if applicable any future land users.

Much of the information is spatial and Alcoa currently uses a geographical information system (GIS). This information includes:

- Location of Monitoring Points.
- Rehabilitation Records.
- Research Trials.
- Heritage Sites.
- Recreational Areas.
- Dieback Forest Rehabilitation.
- Dieback Hygiene Information.

Relevant documentation would be initially filed at Alcoa's Huntly Administration and then archived. This would include:

- Records of Decommissioning.
- Reports to Government Agencies.
- Records of Removal of Contamination.
- Environmental and rehabilitation records and monitoring data.
- Records relating to any equipment or infrastructure sold or sent to other sites will be transferred to the new owners. This would include such information as tank inspections, transformer PCB oil analysis results and maintenance records.

12.1 Document control

Alcoa's Controlled Document System (CDS) is a web-based program that holds current (most up to date) versions of all controlled documents used across Alcoa operations.

The Environmental Department is responsible for the documents that make up the EMS framework and accompanying operational processes. Environmental personnel are accountable for maintaining documents within their area of responsibility.

Documents are periodically reviewed to ensure that the organisation's needs continue to be met under both legal requirements and the elements of the EMS. The review and drafting of changes in documents will be completed in consultation with relevant standards, codes, and stakeholders. The document maintainer will establish review frequency and ensure the accuracy and quality of such periodic reviews.

Documentation relating to the EMS is controlled to ensure that:

- Appropriate current information is available as soon as required.
- Documents are periodically reviewed, revised and approved by an authorised person.
- Obsolete and outdated documents are removed.

12.2 Records Management

A key characteristic of a record is that it is permanent and typically not revised. A record is any piece of information that is created, received or maintained as information relating to the running of the business.

Records may be electronic or paper based and may include:

- Correspondence.
- Transactional records (such as forms, cheques and invoices).
- Project records, relating to a specific project, and may include correspondence, notes, maps, plans and reports.
- Case files, relating to insurance, a supplier or a compensation claim.
- Administrative Functional Records, such as housekeeping records, purchasing records, operational records, equipment records and training records.

External documents, other than licences and permits, are not ‘controlled’ but rather kept as a record. For example, an important record is an external report which is generally filed within the appropriate environmental folder (electronic copies), with any hardcopies being kept in a designated office until going to archive. The report is not kept on CDS.

All records shall be:

- Legible, identifiable and traceable to the activity, product or service.
- Readily retrievable.
- Protected against damage, deterioration or loss.
- Retained for the required length of time.

13. Reviewed closure plans

Alcoa will progressively update the MCP over time and use it to capture and store all relevant closure planning information associated with closure planning prior to cessation of operations; implementation of the closure plans; and the post closure monitoring and reporting period. The MCP will therefore be the primary source of operations, closure and post closure information and data.

The MCP and related information will be managed by Alcoa and will be stored in a central and readily accessible location.

14. References

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Appendices

Appendix A – Abbreviations and Definitions

Acronyms

Acronym	Expanded version
AASB	Australian Accounting Standards Board
Alcoa	Alcoa of Australia Limited
ALUM	Australian Land Use and Management
ANFO	Ammonium Nitrate - Fuel Oil
BSEC	Bauxite Strategic Executive Committee
C&M	Care and Maintenance
CARIREC	Comprehensive, Adequate, and Representative Informal Reserves Evaluation Committee
CDS	Controlled Document System
CEP	Closure Execution Plan
CP	Closure Plan
DBCA	Department of Biodiversity, Conservation and Attractions
DE	Development Envelope
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation
EC	Electrical Conductivity
EP Act	*Environmental Protection Act 1986*
FPC	Forest Products Commission
HAZMAT	Hazardous Materials
JTSI	Department of Jobs, Tourism, Science and Innovation
LoM	Life of the Mine
MCP	Mine Closure Plan
ML/year	Megalitre per year
ML1SA	Mineral Lease Area
MMP	Mining and Management Program

Acronym	Expanded version
MMPLG	Mine Management Planning Liaison Group
MOG	Mining Operations Group
PDSWA	Public Drinking Water Source Area
PMLU	Post mining land use
RAP	Reconciliation Action Plan
RIWI Act	*Rights in Water and Irrigation Act 1914 (WA)*
RoM	Run of Mine
ROWS	Run-off Water Storage
TDS	Total Dissolved Solids
WA	Western Australia
WABSI	Western Australian Biodiversity Science Institute

Definitions

Term	Definition
Care and maintenance	Phase following temporary cessation of mining operations where infrastructure remains intact and the site continues to be managed. All mining operations suspended, site being maintained and monitored.
Closure	A whole-of-mine-life process, which typically culminates in tenement relinquishment. It includes decommissioning and rehabilitation.
Completion	The goal of mine closure. A completed mine has reached a state where mining lease ownership can be relinquished and responsibility accepted by the next land user.
Consultation	A process that permits and promotes the two-way flow of ideas and information. Effective consultation is based on principles of openness, transparency, integrity and mutual respect.
Contaminated	Contaminated, in relation to land, water or a site, means having a substance present in or on that land, water or site at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value. This definition may apply to the artificial concentration (localised accumulation) of natural substances or minerals which have the potential to present a risk of harm to human health, the environment or any environmental value through this accumulation, such as mineral processing sites or tailings storage facilities.
Decommissioning	A process that begins near, or at, the cessation of mineral production and ends with removal of all unwanted infrastructure and services.
Disturbed	Area where vegetation has been cleared and/or topsoil (surface cover) removed.
Domain	A group of landform(s) or infrastructure that has similar rehabilitation and closure requirements and objectives.
Earthworks	Reshaping, capping, water/wind erosion control, rock armouring.
Ecologically sustainable	Meeting the goal and principles of the National Strategy for Ecologically Sustainable Development, endorsed by all Australian jurisdictions in 1992, to ensure that development improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.
Environment	Living things, their physical, biological and social surroundings and interactions between all of these.
Environmental value	A beneficial use and/or an ecosystem health condition.
Key stakeholders	The term refers to post-mining land owners/managers and relevant regulators.

Term	Definition
Legal Obligations Register	A register of legally binding conditions and commitments relevant to rehabilitation and closure at a given mine site.
Life of operation	Expected duration of refining operation
Post-mining land use	Describe a land use that occurs after the cessation of mining operations.
Rehabilitation	The return of disturbed land to a safe, stable, non-polluting/ non-contaminating landform in an ecologically sustainable manner that is productive and/or self-sustaining consistent with the agreed post-mining land use.
Relinquishment	A state when agreed completion criteria have been met, government “sign-off” achieved, all obligations under the Mining Act 1978 removed, and the proponent has been released from all forms of security, and responsibility has been accepted by the next land user or manager.
Revegetation	Establishment of self-sustaining vegetation cover after earthworks have been completed, consistent with the post-mining land use.
Safe	A condition where the risk of adverse effects to people, livestock, other fauna and the environment in general has been reduced to a level acceptable to all stakeholders.
Stable	A condition where the rates of change of specified parameters meet agreed criteria.
Stakeholder	A person, group or organisation who have an interest in a particular decision, either as individuals or representative of a group, with the potential to influence or be affected by the process of, or outcome of, mine closure.
Tenement	Land tenure granted under the Mining Act 1978 e.g. Mining Lease, Exploration Licence, Prospecting Licence, Miscellaneous Licence and General Purpose Lease.
Unacceptable liability	Closure should not lead to regulators, or the community, or landowners or land managers having to take on responsibility for ongoing management, maintenance or monitoring above that which applied before mining, or that which applied to managing land uses comparable to the agreed land uses.