

**Alcoa of Australia
Limited**

**Huntly Bauxite Mine
Transition**

Myara North and Holyoake

**EPBC Act Referral
Supporting
Document**



June 2022

Table of contents

1	Introduction	1
1.1	Alcoa background.....	1
1.2	Environmental performance overview	1
2	The Proposed Action.....	3
2.1	Background to Huntly Mine and overview of Proposed Action	3
2.2	Proposed Action	4
2.3	Local and regional context.....	9
2.4	Previous assessments and approvals.....	9
2.5	Other approvals and regulation.....	11
3	Stakeholder Engagement	13
3.1	Overview	13
3.2	Stakeholders engaged on the Proposed Action.....	14
3.3	Jarrahdale and the proposed Myara North mine region.....	18
3.4	Dwellingup and the proposed Holyoake mine region	18
3.5	Stakeholder consultation methods	19
4	Matters of National Environmental Significance (MNES).....	21
4.1	Summary of MNES.....	21
4.2	Flora and vegetation.....	22
4.3	Terrestrial fauna	43
4.4	Topography, soils and hydrology	59
4.5	Social and heritage values.....	67
4.6	Proposed Mitigation.....	76
5	References	78

Table index

Table 3-1	Summary of stakeholders engaged on the Proposed Action	14
Table 3-2	Summary of stakeholders engaged on the Proposed Action	19
Table 4-1	Summary of MNES relevance to the Proposed Action.....	21
Table 4-2	Flora and vegetation baseline studies	22
Table 4-3	Vegetation complexes mapped in the Development Envelope	25
Table 4-4	Vegetation types mapped in the Development Envelope.....	29
Table 4-5	EPBC Act listed threatened flora with a moderate likelihood of occurrence within the Development Envelope.....	39
Table 4-6	Terrestrial fauna baseline studies	43
Table 4-7	Fauna habitats present in the Development Envelope.....	46
Table 4-8	EPBC Act listed fauna occurrence in the Development Envelope.....	54
Table 4-9	Topography, soil and hydrology baseline studies	59
Table 4-10	Heritage baseline studies	67
Table 4-11	Proposed mitigation measures for Matters of National Environmental Significance.....	77

Figure index

Figure 2-1	Proposed Action locality	5
Figure 2-2	Proposed Action development envelope	6
Figure 4-1	Vegetation complexes and records of EPBC Act listed flora and TECs	27
Figure 4-2	Vegetation types - Myara North	33
Figure 4-3	Vegetation types - Holyoake.....	34
Figure 4-4	Vegetation condition – Myara North.....	36
Figure 4-5	Vegetation condition – Holyoake.....	37
Figure 4-6	Terrestrial fauna habitats - Myara North.....	49
Figure 4-7	Terrestrial fauna habitats - Holyoake	50
Figure 4-8	Records of EPBC Act listed fauna	56
Figure 4-9	Surface water hydrology.....	61
Figure 4-10	Aboriginal heritage - Myara North	69
Figure 4-11	Aboriginal heritage – Holyoake	70
Figure 4-12	European heritage - Myara North.....	73
Figure 4-13	European heritage - Holyoake	74

Acronyms

Abbreviation	Definition
AHIS	Aboriginal Heritage Inquiry System
Alcoa	Alcoa of Australia Limited
AMSL	Above mean sea level
AQMP	Air Quality Management Plan
ASI	Aluminium Stewardship Initiative
ASS	Acid sulfate soil
BC Act	<i>Biodiversity Conservation Act 2016</i>
BoM	Bureau of Meteorology
CARIREC	CAR Informal Reserves Evaluation Committee
CCN	Community Consultative Network
CO	Carbon monoxide
CPI	Consumer price index
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter at breast height
DJTSI	Department of Jobs, Tourism, Science and Innovation
DMA	Decision-making authority
DMIRS	Department of Mines, Industry Regulation and Safety
DMP	Dust Management Plan
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EAD	Environmental Assessment Document
EIA	Environmental impact assessment
EIP	Environmental Improvement Plan
EMM	Environmental Management Manual
EP Act	<i>Environmental Protection Act 1986 (WA)</i>
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
EPS	Pinjarra Refinery Efficiency Upgrade, Environmental Protection Statement
ERD	Environmental Review Document
ESA	Environmentally Sensitive Area
FMP	Forest Management Plan
FPC	Forest Products Commission
GHG	Greenhouse Gas

Abbreviation	Definition
IBRA	Interim Biogeographic Regionalisation of Australia
ICMM	International Council on Mining and Metals
IRZ	Intermediate Rainfall Zone
JIRZRP	Joint Intermediate Rainfall Zone Research Program
km	Kilometre
KPC	Key Proposal Characteristic
LTFMP	Long Term Fauna Monitoring Program
mbgl	Metres below ground level
ML1SA	Mineral Lease 1SA
MMP	Mining and Management Program
MMPLG	Mining and Management Planning Liaison Group
MNES	Matters of National Environmental Significance
MOG	Mine Operations Group
MSR	Mining sub-region
Mtpa	Million tonnes per annum
PDWSA	Public Drinking Water Source Areas
PMST	Protected Matters Search Tool
RFA	Regional Forest Agreement
RIWI Act	<i>Rights in Water and Irrigation Act 1914 (WA)</i>
ROM	Run of Mine
RPLG	Residue Planning Liaison Group
SRE	Short Range Endemic
SWALSC	South West Aboriginal Land and Sea Council
SWIS	South West Interconnected System
TDS	Total dissolved solids
TEC	Threatened Ecological Community
TMP	Trial Mining Project
tpa	tonnes per annum
WA	Western Australia
WONS	Weed of National Significance

Executive Summary

Alcoa of Australia Limited (Alcoa) operates the Huntly Bauxite Mine (the mine) within ML1SA, located approximately 100 km south-east of Perth, and supplies bauxite to the Pinjarra and Kwinana Refineries.

Alcoa is proposing to increase the rate of bauxite mining after transitioning the existing Huntly Mine mining operations into the new Huntly Mine regions of Myara North and Holyoake. The Proposed Action (the subject of this referral) represents an increase in the existing rate of bauxite mining to:

- achieve an increase in alumina production at the Pinjarra Refinery by 5 percent from 5.0 million tonnes per annum to 5.25 million tonnes per annum (Mtpa), and
- supply of up to 2.5 Mtpa of bauxite for potential future export following approval from the State of Western Australia.

Alcoa is referring the Proposed Action to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) for consideration under the *Environment Protection Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Alcoa has referred part of the Proposed Action to the Western Australian Environmental Protection Authority (EPA) for assessment under Part IV of the *Environmental Protection Act 1986* (WA) (EP Act) as a component of the Pinjarra Alumina Refinery Revised Proposal for Ministerial Statement 646 (Assessment No. 2253). The EPA has determined that the proposal will be assessed via a Public Environmental Review (PER) with 8-weeks of public consultation.

Alcoa commenced its operations in Western Australia in 1963 under an agreement with the State of Western Australia to build and run the Kwinana Alumina Refinery. The same agreement also granted a right to explore and mine for bauxite in the nearby Darling Plateau. Operations expanded under subsequent State Agreements which supported two additional alumina refineries in Pinjarra and Wagerup, with bauxite mining continuing in the original mining lease area. The historical growth of Alcoa's operations has occurred against the backdrop of evolving environmental legislation and management policies, which have been complemented by successive Ministerial Statements and the provision of environmental licences tailored to each of our operations.

Throughout this period, Alcoa has built strong relationships with the people and environment of the Peel Region. Alcoa recognises the Aboriginal Traditional Owners of the land on which it operates, the Noongar people of the Gnaala Karla Booja region, and acknowledge that this referral relates to land over which they are traditional custodians.

Inherent to Alcoa's core values is the protection of the environment and our commitment to the highest standards of environmental performance (Alcoa 2020a). Two of Alcoa's key environmental priorities are mine rehabilitation and bauxite residue management (Alcoa 2020b). Alcoa's efforts are recognised both locally and internationally by government and academics alike. To date, less than 4% of the Jarrah forest within the mining lease area has been mined; Alcoa expects to mine less than 8% of this area over the life of its WA operations. Of the areas that have been mined, 77% has been rehabilitated to date. Importantly, Alcoa does not mine in gazetted national parks, nature conservation reserves, old growth forest or other areas of high conservation value, including rock outcrops.

In addition to fulfilling its business objectives, Alcoa recognises the opportunity this process affords to work with state and federal regulators and the broader community to shape Alcoa's

future mining assessments and approvals processes. Building from the foundation of its existing environmental assessment and approvals framework, Alcoa sees the potential to incorporate modern elements of environmental management practice, ensuring that our environmental assessment and approvals framework continues to grow and change with public and regulator expectations. We aim for this process to provide greater transparency for all stakeholders, increased regulatory confidence, and improved business certainty.

This document outlines the work Alcoa will undertake during this assessment process, including detailed surveys relating to Matters of National Environmental Significance protected under the Commonwealth EPBC Act, and the process Alcoa has committed to engage with communities and other stakeholders on its proposed activities.

1 Introduction

1.1 Alcoa background

Alcoa is owned 60% by Alcoa Corporation (a US listed company) and 40% by Alumina Limited (an Australian listed company).

Alcoa commenced operations in Western Australia in 1963 with the commissioning of its Kwinana Refinery, pursuant to the *Alumina Refinery Agreement Act 1961 (WA)*. The State Agreement between Alcoa and the WA Government granted Alcoa the bauxite mining lease area (ML1SA), which extends over an area of 7,129 square kilometres from Mundaring to Collie, and initially supported development of the Kwinana Refinery.

Alcoa has agreed to two further substantive State Agreements covering the development of the Pinjarra Alumina Refinery and the Wagerup Alumina Refinery:

- *Alumina Refinery (Pinjarra) Agreement Act 1969 (WA)*
- *Alumina Refinery (Wagerup) Agreement and Acts Amendment Act 1978 (WA)*

These State Agreements support the breadth of Alcoa's operations in Western Australia. Alcoa's Western Australian operations support approximately 3,750 direct jobs, predominantly in regional areas, and include:

- two bauxite mines (Huntly and Willowdale),
- three alumina refineries (Kwinana, Pinjarra and Wagerup), and
- two dedicated port facilities (Kwinana and Bunbury).

Alcoa also operates an aluminium smelter in Victoria (Portland).

Alcoa's Australian operations represent one of the world's largest integrated bauxite mining, alumina refining and aluminium smelting systems and add value to Australia's local, state and national economies at each stage of production. In 2019, more than 86 per cent of Alcoa Australia's revenue stayed in Australia through wages, local purchasing, taxes, royalties and dividends to Australian shareholders. Our operations invested \$2.1 billion with more than 1425 Australian suppliers, paid more than \$1.1 billion in State, Federal and Local government taxes and royalties, paid \$681 million in Australian wages, salaries and associated benefits; and made \$4.7 million in community contributions.

1.2 Environmental performance overview

Since mining commenced in 1963, Alcoa has mined less than 4 per cent of the Jarrah forest within ML1SA. Alcoa expects over the lifetime of operations in Western Australia to mine less than 8 per cent of the overall area of ML1SA. Alcoa does not mine in gazetted national parks or nature conservation reserves, or in old growth forest or other areas of high conservation value such as rock outcrops, and has worked collaboratively with government in the development of a comprehensive reserve system in the Northern Jarrah Forest (Gardner and Stoneman 2003).

Inherent to Alcoa's core values is the protection of the environment and our commitment to the highest standards of environmental performance (Alcoa 2020a). One of Alcoa's key environmental priorities is mine rehabilitation (Alcoa 2020b). Alcoa puts sustainability at the heart of its strategic agenda and recognises that sustainable operations support key

business drivers and deliver better outcomes for the environment and the communities where it operates.

In 2019, Alcoa became a member of the International Council on Mining and Metals (ICMM), whose Mining Principles serve as a best practice framework on sustainable development for the mining and metals industry. In 2020, Alcoa also received certification by the Aluminium Stewardship Initiative (ASI) for its Western Australian operations. This certification recognises, in part, our environmental policies and management systems, including Alcoa's compliance with international standards (ISO 14001).

Alcoa has a multi-decade record of mine site rehabilitation and is the first mining company in the world to achieve 100 per cent plant species richness returned in rehabilitated mine site areas. Alcoa has led research into innovative techniques for best-practice restoration including ways to overcome seed dormancy and development of propagation protocols for 'recalcitrant' species (Koch, 2007; Grant and Koch, 2007).

Alcoa's objective for rehabilitation is to re-establish a self-sustaining Jarrah forest ecosystem that fulfils forest land uses that include conservation, timber production, water catchment and recreation (Alcoa, 2020c). Alcoa has developed standards, or Completion Criteria, for its bauxite mine rehabilitation in conjunction with regulatory authorities and other stakeholders. Alcoa's mine rehabilitation completion criteria are available at:

<https://www.alcoa.com/australia/en/sustainability/reports-publications.asp>.

Alcoa's efforts in returning biodiversity to areas of mine rehabilitation have received widespread recognition, including the prestigious Golden Gecko Award in 2002, 2007 and a Certificate of Merit in 2018 from the Department of Mines Industry Regulation and Safety, and in 2003 the Model Project Award from the Society for Ecological Restoration International, for leadership in ecological restoration. In 1990, Alcoa was the first mining company in the world to be listed on the United Nations Environment Programme's Global 500 Roll of Honour for excellence in mine rehabilitation.

2 The Proposed Action

2.1 Background to Huntly Mine and overview of Proposed Action

Alcoa of Australia Limited (Alcoa) operates the Huntly Mine (the mine) within ML1SA, located approximately 100 km south-east of Perth, and supplies bauxite to the Pinjarra and Kwinana Refineries.

Alcoa is proposing to increase the rate of bauxite mining after transitioning the existing Huntly Mine mining operations into the new Huntly Mine regions of Myara North and Holyoake. The Proposed Action (the subject of this referral) represents an increase in the existing rate of bauxite mining to:

- achieve an increase in alumina production at the Pinjarra Refinery by 5 percent from 5.0 million tonnes per annum to 5.25 million tonnes per annum (Mtpa), and
- supply of up to 2.5 Mtpa of bauxite for potential future export following approval from the State of Western Australia.

As further context setting, it is relevant to note that originally, the assessment of the Proposed Action under the EPBC Act was to be conducted under a bilateral agreement between the EPA and DAWE. Under this arrangement, the EPA would have led an accredited assessment process on behalf of both the State and DAWE as part of the Revised Proposal submitted under the EP Act

Through ongoing discussions with State and Commonwealth, it has been identified that the components of the Proposed Action under the EPBC Act and the Revised Proposal under the EP Act have different assessment and approval requirements. As a result, it has been determined that the components will now go through separate State and Commonwealth environmental assessment and approval processes.

Huntly Mine operations are authorised under a mature environmental management regime established under State Agreements and described further in section 2.4.3 below. The Mining and Management Program (MMP)¹ authorises mining associated with the Pinjarra and Kwinana refineries at a recent average of approximately 24.5 Mtpa (dry tonnes) as well as vegetation clearing.

Alcoa's existing Huntly Mine commenced operation in 1976, predating the EPBC Act and has continued to operate since the EPBC Act came into force in July 2000. Due to the increase in the rate of bauxite mining, Alcoa has determined that the Proposed Action (as described in Section 2.2) requires referral under the EPBC Act.

Alcoa will continue to operate the Huntly Mine in accordance with the approved MMP until the transition to the Myara North and Holyoake mine regions, starting from 2023 (subject to receipt of relevant approvals). Activities that are part of or required for continuation of the existing mining operations within the Huntly Mine, are not included in the scope of the Proposed Action.

The existing Huntly Mine is undergoing progressive rehabilitation and Alcoa will continue rehabilitation operations as the transition to the new mine regions takes place. This is consistent with previous moves in mining regions at the Huntly Mine since 1976 within the

¹ Each year, Alcoa submits a five-year MMP to the MMPLG for review, which is approved by the Minister for State Development in whole or with conditions.

overall mining location defined by ML1SA. Rehabilitation associated with the existing Huntly Mine is not included in the scope of the Proposed Action.

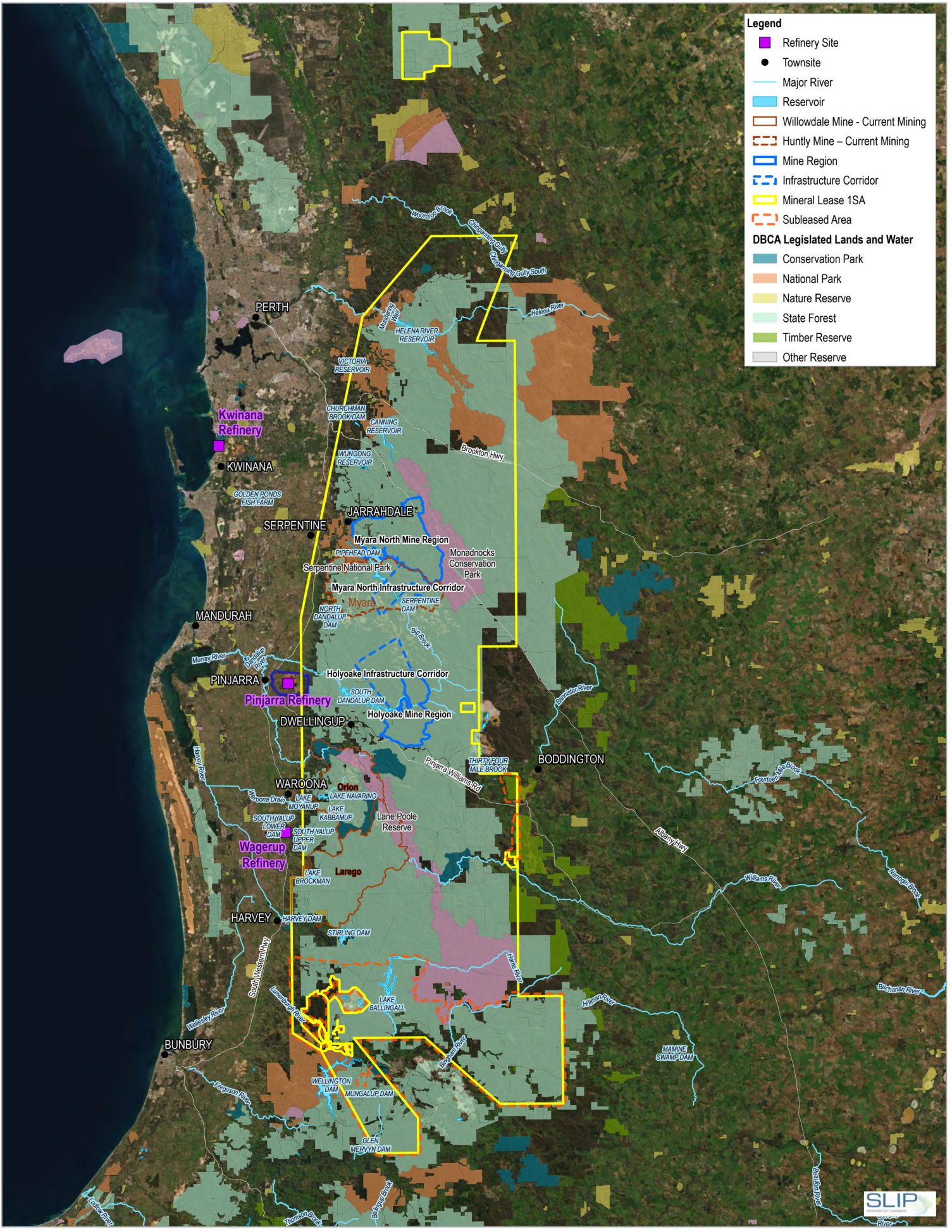
2.2 Proposed Action

Alcoa has not undertaken any mining to date in the Myara North and Holyoake mine regions as part of the Huntly Mine. A northern portion of the Myara North region was mined as part of the former Jarrahdale Mine in the late 1990s and rehabilitated in 1999-2001. The former Jarrahdale Mine operated from 1963 to 1998 and is now closed and rehabilitated.

The Proposed Action is Alcoa's mining in the Myara North and Holyoake mine regions of the Huntly Mine, the construction of new mine infrastructure for those mine regions, and the use of existing mine infrastructure to support those mine regions. The proposed Development Envelope and the current indicative layout of the key components of the Proposed Action are depicted in Figure 2-2.

The Proposed Action has a maximum clearing footprint of 9,273 ha within a Development Envelope of 41,403 ha. Clearing ahead of mining or construction of infrastructure (either undertaken by Alcoa, or the Forest Products Commission (FPC)) will likely result in direct impacts to native vegetation.

A further description of the key components of the Proposed Action is set out below.



- Legend**
- Refinery Site
 - Townsite
 - Major River
 - Reservoir
 - Willowdale Mine - Current Mining
 - Huntly Mine - Current Mining
 - Mine Region
 - Infrastructure Corridor
 - Mineral Lease 1SA
 - Subleased Area
- DBCA Legislated Lands and Water**
- Conservation Park
 - National Park
 - Nature Reserve
 - State Forest
 - Timber Reserve
 - Other Reserve

Paper Size ISO A3
 0 5 10 15 20
 Kilometres



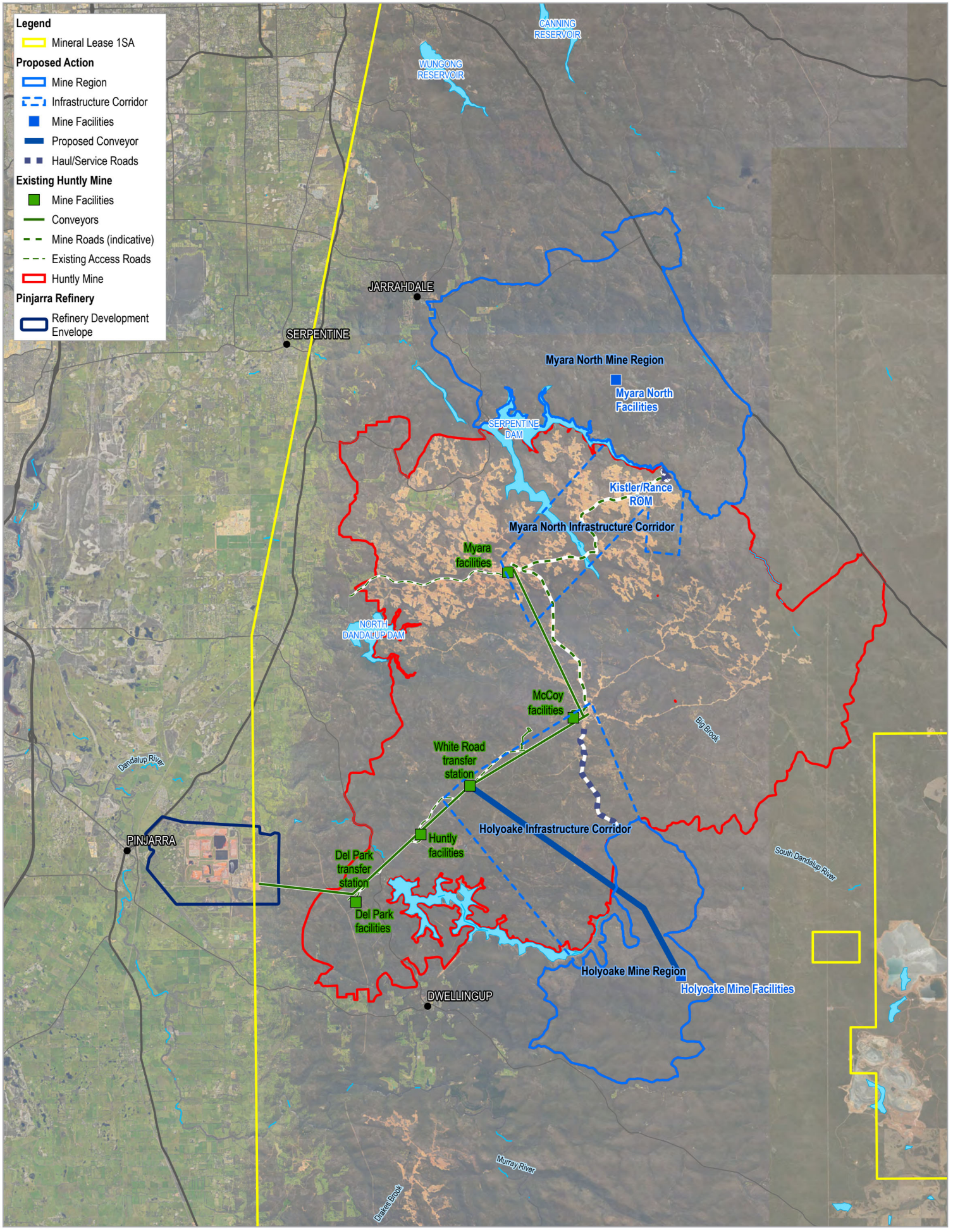
Alcoa of Australia Limited
 Huntly Bauxite Mine Transition - Myara
 North and Holyoake - EPBC Act Referral

Project No. 12520591
 Revision No. 0
 Date 28/03/2022

Proposed Action Locality

FIGURE 2-1

g:\net\ghd\AU\Perth\Projects\12520591\GIS\Maps\Working\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022.aprx-1
 First date: 28 Mar 2022 - 14:03
 Data source: Alcoa/GHD: Pinjarra Refinery Development Envelope - 2020/06/16, DoW: Watercourse - 2020/02/21, DPLH: Zones and Reserves - 2020/05/25, Landgate: Railway - 2019/03/04, Roads - 2019/01/14, World Imagery: Earthstar Geographics/arcsworld_2020/02/04. Created by: drownd



g:\net\gha\AU\Permit\Projects\12520591\GIS\Maps\Working\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022.aprx2-2
Print date: 25 Mar 2022 - 11:12
Data source: Alcoa: Refinery Sites, Huntly Mine boundary, Pinjarra Refinery, Development Envelope - 20200403, Holyoake Conveyor Corridor, Conveyors/Road Envelope - 20200605, Landgate: Roads - 20190108, Railway - 20190304, Wik/Now: Landgate / SLP. Created by: andgard

2.2.1 Mining process

Bauxite occurs as tabular ore bodies averaging 3.5 metres in depth and varying approximately 0.5 to 150 hectares in area. The ore is overlaid with gravel and soils varying in depth from 0 to 1.5 metres. The upper part of the ore frequently presents as cemented caprock, ranging in thickness from 0 to 2.5 metres. Beneath the caprock is a friable zone which merges into clay with uneconomic quantities of alumina.

Following completion of timber harvesting by the FPC and vegetation clearing activities (see Section 2.2.2), the topsoil and overburden are removed and either stockpiled separately for re-use at a later time or re-used immediately on an area undergoing rehabilitation. Stockpiles are preferentially located on ore bodies, to reduce the amount of required vegetation clearing. Caprock is broken by drilling and blasting, and in some areas by bulldozers. The ore is removed by mass excavators and trucks which haul the ore to central processing facilities, for primary and secondary crushing, via a network of haul roads. Ore will then be transported on a conveyor or by haul trucks to the existing conveyor feeding the refinery.

Following mining, mine pits are rehabilitated to Jarrah forest by removing compaction of pit floors, recontouring the surface, returning of gravels and soil, seeding, planting of nursery-raised seedlings and fertilising. Coarse woody debris in the form of logs and stumps is also returned as fauna habitat.

2.2.2 Clearing of vegetation

As described above, implementation of the Proposed Action will require clearing and is likely to result in direct impacts to 9,273 ha of native vegetation. Because of the location of the Proposed Action within State Forest, that clearing may wholly or in part be undertaken by the FPC in accordance with its timber harvesting operations. A summary of FPC's operations and the relationship to Alcoa's mining operations is set out below.

The FPC manages and coordinates harvesting operations of timber resources within State Forests and private plantations in Western Australia. Within State Forest areas approved for mining, FPC is responsible for any commercial logging operations on areas that need to be cleared prior to mining. FPC may also harvest timber resources within the mining areas that are not associated with mining operations if it is part of an approved logging plan. Officers of the FPC are involved in coordinating harvesting, silviculture and timber salvage on and around the mines. An FPC officer is responsible for the timber harvesting operations in mining areas.

Alcoa's role in clearing ahead of its mining operations is limited to residual vegetation after commercial harvesting has been completed. FPC's operations in State Forest within ML1SA are managed in accordance with the Forest Management Plan 2014-23 (FMP), which came into effect on 1 January 2014.

The provisions for harvesting in mining areas from 2024 onwards will comply with the new FMP (2024-) which is expected to reflect the recent announcement by the State Government to end native forest logging in 2024 and limit timber taken from native forest to forest management activities and clearing for approved mining operations.

2.2.3 New mine infrastructure

The development of the Myara North and Holyoake mine regions will require new infrastructure typically associated with mining activities, including processing hubs, overland conveyors (for the Holyoake mine region only), haul roads, heavy vehicle access roads,

public access roads, electrical power, and other infrastructure. Construction of mine infrastructure in Myara North is scheduled to occur between 2023 and 2025, with operations occurring from 2025 to about 2030.

Planning for the location of mine infrastructure is at preliminary design stage. Figure 2-2 presents indicative locations of the new mine infrastructure proposed at Myara North and Holyoake, a new run-of-mine (ROM) ore storage area at Kisler/Rance immediately south of Myara North, and indicative alignments for a new conveyor and heavy vehicle service road for the Holyoake region. All new infrastructure will be located within the development envelope, but may differ from the location depicted in Figure 2-2.

The proposed mine facilities at the Myara North and Holyoake mine regions will provide a range of administrative and operational support functions including but not limited to workshops, hydrocarbon storage, explosives storage, laydown areas, offices, water storage and treatment, and wastewater treatment. Electrical power infrastructure may include diesel generators, diesel fuel storage, above and below ground electrical powerlines, substations, transformers and control equipment. Construction and operation of other minor infrastructure activities, such as fencing, access tracks, installation of environmental monitoring equipment may also be required.

New surface water drainage infrastructure will be required to maintain surface water flows along natural waterways and to manage surface water runoff and sediment from new mining and infrastructure areas. Drainage infrastructure will include culverts, sumps, bunds and open drains.

2.2.4 Use of existing mine infrastructure

Alcoa will continue to use some existing mine infrastructure at the mine to support mining in the Myara North and Holyoake mine regions. The existing mine infrastructure is located outside of the Myara North and Holyoake mine regions. The use of the existing mine infrastructure for the Myara North and Holyoake mine regions will be in the same manner as the current use. This infrastructure includes:

- Mine facilities² at the Myara, McCoy, White, Huntly Central and Del Park
- Primary haul roads between Kisler/Rance, the Myara mine facilities and McCoy mine facilities
- Conveyors between the Myara mine facilities and Pinjarra Alumina Refinery
- Conveyor transfer stations at White Road and Del Park
- Water offtake and pump station at South Dandalup Dam, water pipelines and water storage dams at existing mine facilities
- Overhead electrical powerlines to existing mine facilities.

2.2.5 Exclusions

The scope of the Proposed Action referred under the EPBC Act excludes:

- Low impact activities, including drilling and associated activities (such as upgrades to existing roads/tracks) for the purposes of resource evaluation, geotechnical assessment, and hydrogeological investigation prior to approval of the Proposed Action

² Mine facilities may include, but not be limited to, run-of-mine (ROM) stockpile and crusher, refuelling and washdown facilities, fuel and oil storage, laydown areas, offices and carparks, wastewater treatment.

- Environmental, heritage and other studies/investigations involving fieldwork
- Activities that are part of or required for continuation of the existing mining operations at the Huntly Mine (outside of the Myara North and Holyoake mine regions), which for the avoidance of doubt includes but is not limited to the following:
 - Upgrades and maintenance to existing mine facilities and infrastructure
 - Operation of water supply activities within the abstraction limits of current licences issued under the RIWI Act

For the avoidance of doubt, use of existing infrastructure for the existing Huntly Mine operations, as described above, is not in the scope of the Proposed Action.

2.3 Local and regional context

The mine is located in the Peel Region of Western Australia. The Peel Region of Western Australia lies within the South West of Australia, which is acknowledged for its biodiversity values. The mine is located within Jarrah Forrest on the Darling Plateau and lies predominantly within the Shires of Murray, Serpentine-Jarrahdale and Boddington.

The Huntly Mine lies predominantly within State Forest, managed for multiple uses under the Regional Forest Agreement (RFA) and Forest Management Plan (FMP) including conservation, recreation, beekeeping, timber production and water supply, in addition to mining.

The Myara North mine region is adjacent to Jarrahdale townsite and is bordered by Monadnocks Conservation Park to the north-east and Serpentine National Park to the west. The Myara North mine region lies predominantly within the catchments of the Serpentine Dam and Wungong Dam. A small portion lies in the catchment of Gooralong Brook, an un-regulated tributary of the Serpentine River downstream of Serpentine Dam.

The Holyoake mine region lies approximately 5 km to the east of Dwellingup and 5 km north-east of Lane Poole Reserve. The Holyoake mine region lies predominantly within the catchment of the South Dandalup Dam, with the southern portion lying in the un-regulated catchment of the Murray River.

2.4 Previous assessments and approvals

2.4.1 State Agreements

The Proposed Action is subject to a State Agreement; the *Alumina Refinery Agreement Act 1961*. The State Agreement details the rights, obligations, terms and conditions in relation to the operation of the mine.

Alcoa's State Agreements, read together, and in conjunction with a range of Ministerial Statements issued under the EP Act, create a regulatory framework that Alcoa has operated under since it first began operations in Western Australia.

Alumina Refinery Agreement Act 1961

As noted in Section 1.1, Alcoa was granted approval to mine bauxite within mineral lease ML1SA, under the *Alumina Refinery Agreement Act 1961*. ML1SA covers 7,129 square kilometres across Darling Plateau and extends from east of Perth to east of Bunbury (Figure 2-1). ML1SA includes several mining areas comprising the Huntly Mine (1976 to present), the former Jarrahdale Mine to the north (1963 to 1998), and the Willowdale Mine to the south (1984 to present) which supplies the Wagerup Alumina Refinery. The western boundary of

ML1SA comprises the Swan Coastal Plain and the eastern boundary adjoins the Worsley mining lease ML258SA.

Under Clause 13(3) of the *Alumina Refinery Agreement Act 1961*, Alcoa pays compensation to the State Government (Conservator of Forests) for forest impacted by or in connection with the Company's mining activities. The amount of compensation is paid based on the planned clearing for the calendar year, with a reconciliation of the actual clearing from the previous year. Over the past 10 years, Alcoa has paid between \$3.82M - \$8.54M compensation per year, with total compensation paid equal to \$55.93M.

Since 1961 a series of reviews of conservation reserves have been undertaken to improve biodiversity protection across the region. As a result of the reviews, Alcoa has agreed not to mine in conservation areas, an agreement incorporated into the *Alumina Refinery Agreement 1961* through a 1986 amendment. Additional reserves have been established under the RFA between the State and Commonwealth and the FMP review process.

2.4.2 Environmental Protection Act 1986 (WA)

As the mine was established before the introduction of environmental legislation in WA (and had existing approval under the *Alumina Refinery Agreement Act 1961*), mine operations were not originally subject to Ministerial conditions pursuant to Part IV of the EP Act. In 2003 the State Agreement exemption in the EP Act was removed.

In December 2003, Alcoa referred the Pinjarra Refinery Efficiency Upgrade (PREU) proposal to the Environmental Protection Authority (EPA) under Part IV of the EP Act. The PREU comprised an increase in alumina production at the Pinjarra Alumina Refinery from 3.5 Mtpa to 4.2 Mtpa, and an increase in the rate of bauxite mining at the mine to supply the increase in alumina production capacity. The PREU referral document (Environmental Protection Statement [EPS], Environ 2003) set out the extent of bauxite mining at the mine.

Following assessment, the PREU was approved by MS 646 in March 2004. Schedule 1 of MS 646 included the following Key Proposal Characteristics:

- Alumina production 4.2 million tonnes per annum (Mtpa)
- Bauxite mining rate 22.6 Mtpa and project life > 45 years

A number of changes have been approved to the PREU proposal under s45C of the EP Act after MS 646 was issued:

- MS 646 Attachment 1, July 2008
- MS 646 Attachment 2, September 2015.

Attachment 2 increased the maximum production at Pinjarra Alumina Refinery to 5 Mtpa with associated bauxite mining.

A key aspect of the PREU proposal referred in 2003 was that bauxite mining would continue to be 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 the MMPLG (Mining and Management Planning Liaison Group). This was provided as a commitment in the PREU EPS document. The MMPLG is recognised by the Minister for Environment in Ministerial Statements (95, 390, 564, 728, 897 and 1069) regarding expansion of Alcoa operations.

Alcoa's mining operations within ML1SA are also conducted in accordance with the Environmental Protection (Alcoa – Huntly and Willowdale Mine Sites) Exemption Order 2004 (Exemption Order) made by the Minister for the Environment. The Exemption Order is consistent with the *Alumina Refinery (Wagerup) State Agreement and Acts Amendment 1978* that established the MMPLG and MMP processes. It also reflects the procedures of Ministerial Statement 728 that sets out the MMPLG's responsibility to review annual rolling 5-year mine plans for Alcoa's operations.

The MMPLG was first established in 1978 and consists of representatives of the Department of Jobs, Tourism, Science and Innovation (JTSI), Department of Water and Environmental Regulation (DWER), Water Corporation, Department of Biodiversity, Conservation and Attractions (DBCA), and the Department of Mines, Industry Regulation and Safety (DMIRS).

Each year, Alcoa submits a five-year MMP to the MMPLG for review, which is approved by the Minister for State Development (on advice from the Minister for the Environment) in whole or with conditions. The MMP sets out Alcoa's mining and rehabilitation schedule and includes priority land uses and management plans agreed through the MMPLG.

2.5 Other approvals and regulation

2.5.1 Land tenure

The mine lies predominantly in State Forest, within Alcoa's mineral lease ML1SA granted under the *Alumina Refinery Agreement Act 1961* (see Figure 2-1).

2.5.2 Licences

The mine operates subject to an Environmental Licence (L6210/1991/10) granted under Part V of the EP Act. The Licence is 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 83356 (70 ML/yr) and 153635 (30 ML/yr) from 2014-2024.

The mine operates in accordance with a Dangerous Goods Storage Licence (DGS008201) granted under the *Dangerous Goods Safety Act 2004*.

2.5.3 Existing environmental management regime

The Proposed Action represents a graduated increase and transition of existing mining operations since the establishment of the mine in 1976. These operations are subject to a mature environmental management regime that has evolved over the past four decades, including developments with the introduction of environmental protection legislation, the RFA and FMP in the 1980s and 1990s.

The environmental management of the mine is principally undertaken in accordance with the approved five-year rolling MMP as defined in the *Alumina Refinery (Wagerup) State Agreement and Acts Amendment 1978*, the Clearing Exemption conditions and Ministerial Statement 728. The MMPLG has two subcommittees: the Mining Operations Group (MOG); and the CAR Informal Reserves Evaluation Committee (CARIREC).

The role of MOG is to oversee and report to the MMPLG on environmental (including forest clearing) and community matters arising from the day-to-day operational activities conducted at Alcoa's mine sites, as part of the Clearing Advice process.

The CARIREC was set up as a result of a process agreed to by the MMPLG and the Western Australian Environmental Protection Authority (EPA) to evaluate Alcoa's planned incursions into CAR Informal Reserves within Alcoa's mining lease, as required under the Regional Forest Agreement. The CARIREC reports its findings and recommendations to the MMPLG which, in turn, makes its recommendations direct to the EPA on the acceptability of Alcoa's proposals.

Management of mining operations are also guided by the principles and procedures set out in two separate Working Arrangements agreed between Alcoa and the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA), and the Water Corporation and the Western Australia Department of Water and Environment Regulation respectively. The Working Arrangements were established jointly between Alcoa and the relevant agencies and are reviewed every five years. The intent of the Working Arrangements is to maintain a coordinated approach to the management of mining operations (including rehabilitation), protection of biodiversity and water resources within ML1SA.

Alcoa also contributes about \$1 million annually (indexed to CPI) to the State under the Forest Enhancement and Works Agreement for prescribed burns, forest road upgrades and other forest management activities. Alcoa also provides an additional \$416,000 per year (indexed to CPI) to the State for conservation and recreation management initiatives including supporting fire and weed management, native species research, feral animal control, community education, and forest recreation infrastructure. This funding is used for projects such as Western Shield, Bibbulmun Track upgrades and weed control programmes.

Alcoa undertakes progressive rehabilitation of its mining areas and has completed a total of 20,381 ha of rehabilitation since operations commenced in 1966 (77% of total mined area to date, including areas reserved for long-term infrastructure). Rehabilitation standards are set out in Alcoa's Bauxite Mine Rehabilitation Completion Criteria as agreed between Alcoa and the State (Alcoa 2016), which are published³. Completion Criteria were first developed in the 1990s, with periodic revision to incorporate changing community expectations and improvements in knowledge. The Completion Criteria set out a process of assessment leading to an agreement between Alcoa and the State government that all rehabilitation requirements have been met.

³ <https://www.alcoa.com/australia/en/pdf/mining-operations-rehabilitation-program-completion-criteria.pdf>

3 Stakeholder Engagement

3.1 Overview

Alcoa has developed and maintained strong and mutually beneficial relationships with stakeholders, including communities near the Mine, consistent with our Social Policy:

‘Our vision is to create sustainable value in the communities where we have a presence and to secure the support of these communities through the full life cycle of our operations.’

We are committed to conducting our business activities responsibly, acknowledging and respecting the rights, cultures, and heritage of all members of the communities where we operate. We manage our social performance through the effective identification of social risks and impacts related to our activities, seeking to avoid, minimize, mitigate, and remediate negative impacts and aspire to leave a positive legacy.

We actively engage with the communities and stakeholders where we operate, and we see our presence as an opportunity to enable economic activity while supporting educational, cultural and environmental programs through partnerships.’

One of Alcoa’s objectives in referring the Huntly Bauxite Mine Transition to the EPA and the Commonwealth has been to further improve transparency regarding its Western Australian operations and engage stakeholders in the establishment of a more contemporary environmental approvals framework.

Alcoa has an existing extensive and mature stakeholder and community engagement program for its Western Australian operations including for the mine. This has included engagement with a broad range of stakeholders and community members regarding future operations, in particular proposed future mine areas, over many years.

Alcoa’s existing stakeholder and community engagement program has been expanded on for this Proposed Action. The specific objectives have been to:

- Inform stakeholders and communities about the Proposed Action
- Understand (and where possible respond to) issues, concerns and opportunities associated with the Proposed Action
- Establish or build on existing relationships to enable ongoing meaningful consultation throughout the assessment process and for the life of the Proposed Action
- Improve transparency and understanding generally for our Western Australian operations, practices and future plans
- Engage stakeholders in the establishment of a more contemporary environmental approvals framework.

In addition to Alcoa’s community and stakeholder engagement program, the EPA advertised the Revised Proposal and invited public submissions over a seven-day period in June 2020. A total of 1732 submissions were received. The EPA determined to assess the Revised Proposal as a Public Environmental Review and to conduct an eight-week public comment period.

As noted in Section 2.1, originally the assessment of the Proposed Action under the EPBC Act was to be conducted under a bilateral agreement between the EPA and DAWE, with the

EPA leading the process on behalf of both agencies. Under this arrangement, the EPA would have led the assessment process on behalf of both EPA and DAWE.

Through ongoing discussions with the State and Commonwealth, it has been identified that the components of the Proposed Action under the EPBC Act and the Revised Proposal under the EP Act have different assessment and approval requirements. As a result, it has been determined that the components will now go through separate State and Commonwealth environmental assessment and approval processes.

3.2 Stakeholders engaged on the Proposed Action

Since referring the Revised Proposal to the EPA in June 2020, Alcoa has engaged with more than 1,700 stakeholders (136 distinct stakeholder groups and nearly 1,600 members of the Jarrahdale, Dwellingup, and Pinjarra communities including neighbouring private property owners) along with members of other nearby Peel communities and our 3,900 employees in Western Australia.

Table 3-1 summarises the stakeholders who have been consistently engaged on the progress of the Project and the assessment process since June 2020.

With regards to the Proposed Action these stakeholders have been informed via various engagement strategies of the transition of the Huntly Mine to Myara North and Holyoake. More recently, to ensure transparency in our processes and communication, these stakeholders were advised by letter of the withdrawal of the bilateral assessment process and the decision to resubmit the Proposed Action for individual assessment by the Commonwealth.

Table 3-1 Summary of stakeholders engaged on the Proposed Action

Stakeholder group	Stakeholder consulted on the Proposed Action
Federal Government	
Federal departments	Department of Agriculture, Water and the Environment
Local Federal Members of Parliament	Member for Brand
	Member for Canning
	Member for Forrest
Other Federal MPs	Member for Burt, Shadow Minister for WA Resources
Federal Ministers	Federal Minister for the Environment
State Government	
State departments	Department of Jobs, Tourism, Science and Innovation
	Department of Biodiversity, Conservation and Attractions
	Department of Water and Environmental Regulation
	Department of Mines, Industry Regulation and Safety
	Department of Planning, Lands and Heritage
	Department of Health
	Department of Local Government, Sport and Cultural Industries
	Department of Primary Industries and Regional Development
State agencies	Environmental Protection Authority
	Water Corporation

Stakeholder group	Stakeholder consulted on the Proposed Action
	Forest Products Commission Main Roads WA Tourism WA Peel Development Commission Mine and Management Planning Liaison Group Conservation and Parks Commission WA Police National Trust of Australia (WA) Regional Development Australia
Local MPs	Member for Darling Range Member for Murray-Wellington Member for Mandurah Member for Dawesville Member for Bunbury Member for Kwinana Member for Collie Preston Member for Rockingham Members for the South West Region Members for the East Metropolitan Region Member for Cockburn
Other State MPs	Member for the Mining and Pastoral Region
State Government Ministers	Premier; Treasurer; Minister for Public Sector Management; Federal-State Relations Minister for Emergency Services; Innovation and ICT; Medical Research; and Volunteering Minister for Mines and Petroleum; Energy; Corrective Services; Industrial Relations Minister for Water; Forestry; Youth Minister for Health and Mental Health Minister for Regional Development; Agriculture and Food; Hydrogen Industry. Deputy Premier; Minister for State Development, Jobs and Trade; Tourism; Commerce; Science Minister for Culture and the Arts; Sport and Recreation; International Education; Heritage Leader of the House Minister for Environment; Climate Action; Minister for Finance, Racing and Gaming; Aboriginal Affairs; Citizenship and Multicultural Interests
State Opposition	Leader of the WA Liberal Party Shadow Minister for State Development; Energy; Hydrogen; Science; Innovation and ICT Leader of the Opposition: Shadow Minister for Regional Development; Finance; Electoral Affairs; Federal-State

Stakeholder group	Stakeholder consulted on the Proposed Action
	Relations; Public Sector Management; Women's Interests; Jobs & Trade Shadow Minister for Tourism; Commerce; Aboriginal Affairs; Government Accountability Shadow Minister for Environment; Defence Industry; Citizenship and Multicultural Affairs
Local Government	
Local governments	Shire of Murray Dwellingup Futures (Shire of Murray) Shire of Serpentine-Jarrahdale Shire of Boddington City of Mandurah Shire of Waroona Shire of Harvey City of Kwinana City of Rockingham City of Cockburn Shire of Wandering
Other stakeholder groups	
Recreational and tourism groups	Bibbulmun Track Foundation Munda Biddi Trail Foundation Hotham Valley Tourist Railway Peel Trails Group Mandurah Peel Tourism Association WestCycle Trails WA HikeWest Cycle West Outdoors WA Perth Bushwalkers Club Southern Hills Mountain Bikers Serpentine Jarrahdale Trails Working Group Western Australian Endurance Riders Association Australian Trail Horse Riders Association Shire of Serpentine Jarrahdale Equine Advisory Group
Environmental groups	Conservation Council of WA WA Forest Alliance Wilderness Society Peel-Harvey Catchment Council SJ Landcare Urban Bushland Council – Peel Preservation Group Mandurah Environment and Heritage Centre

Stakeholder group	Stakeholder consulted on the Proposed Action
	Wildflower Society of WA Karakin Black Cockatoo Preservation Society Murdoch University – Black Cockatoo Conservation Project Murdoch University – Centre for Phytophthora Science and Management Leeuwin Group Beeliar Group Greening Australia Birdlife Australia The Nature Conservancy Botanic Gardens and Parks Authority Perth NRM Nannas for Native Forests Northern Jarrah Forest Alliance
Business and industry groups	Alcoa’s major WA business partners and contractors (~30) Chamber of Minerals and Energy WA Peel Chamber of Commerce and Industry Kwinana Industries Council Bunbury Geographe Economic Alliance Institute of Forests of Australia, WA Division South 32 Newmont Boddington Gold
Community groups	Dwellingup Community Compact Dwellingup Protection Group Save Dwellingup Discovery Forest Jarrahdale Heritage Society Jarrahdale Forest Protectors Jarrahdale Community Collective North Pinjarra Progress Association Alcoa Pinjarra Community Consultative Network Alcoa Wagerup/Willowdale Community Consultative Network Alcoa Kwinana Environmental Improvement Plan Working Group Community Alliance for Positive Solutions
Nearby communities, land owners and neighbours	Jarrahdale Dwellingup Pinjarra Waroona Harvey Peel Kwinana

Stakeholder group	Stakeholder consulted on the Proposed Action
Traditional owners	South West Aboriginal Land and Sea Council
	Bilya Noongar Organisation
	Winjan Aboriginal Corporation
	Murray Districts Aboriginal Association
	Kaarak Dreaming
	Gnaala Karla Booja Representatives
	Jarrahdale Traditional Owners
Unions	Australian Workers Union
	Australian Manufacturing Workers Union
	Electrical Trades Union
	Construction, Forestry, Mining, Maritime and Energy Union
Employees	3,900 Alcoa employees across WA operations

3.3 Jarrahdale and the proposed Myara North mine region

The Proposed Action includes transition of the mine to the Myara North mine region, located south east of the town of Jarrahdale in the Shire of Serpentine Jarrahdale.

Alcoa previously mined near Jarrahdale from 1963 to 1998 for the former Jarrahdale Mine, which is now closed and rehabilitated. In 2017, given plans to transition mining to Myara North, Alcoa initiated communication with local stakeholders including the Shire of Serpentine Jarrahdale, Jarrahdale Forest Protectors, Jarrahdale Community Collective and Jarrahdale Heritage Society. Since that time Alcoa has met regularly with stakeholders to provide updates and discuss questions and concerns about our future mine plans, including as outlined below.

Traditionally, Alcoa initiates consultation with landowners near future mine regions approximately five years prior to the commencement of mining as part of the preparation of the five-year MMP. Given the timing of this referral and plans for mining to commence in Myara North in ~ 2023 (on receipt of relevant approvals), consultation with landowners in the region will continue as part of the environmental impact assessment process. The process will provide a platform from which to build relationships as the mine plan for the region develops.

3.4 Dwellingup and the proposed Holyoake mine region

The Proposal includes transition of mining to the Holyoake mine region. The western border of this region is located approximately 5 kilometres east of the town Dwellingup in the Shire of Murray, and the eastern portion of the region extends into the Shire of Boddington.

Alcoa has long held relationships with members of the Dwellingup community and been a regular supporter of community initiatives, including for example the redevelopment of the Dwellingup Trails and Visitors Centre. Alcoa is also a participant of Dwellingup Futures – a government, industry and community stakeholder group working to identify and support sustainable development in and around the Dwellingup area.

Alcoa has been engaging with Dwellingup landowners and other stakeholders specifically about potential future mining in the vicinity of the town since 2014. At this time, Alcoa initiated

discussions about an exploration drilling program in lease areas near Dwellingup and invited stakeholders to attend an open house forum to learn more about the program. Since then, there have been regular updates about the results of the drilling program and Alcoa's future mine plans, as outlined below. As part of these communications, Alcoa has consistently indicated that mining would commence in the broader Holyoake mine region sometime around 2030, which is aligned with current plans relative to this referral.

These stakeholders will continue to form part of Alcoa's engagement program. Stakeholders will be invited to learn more about the environmental assessment process and related studies and activities as part of this review.

3.5 Stakeholder consultation methods

Alcoa has deployed a range of consultation methods to ensure stakeholders and community members can access information and have opportunities for meaningful consultation on the Proposed Action. Table 3-2 summarises the stakeholder consultation methods deployed on the Proposed Action.

Table 3-2 Summary of stakeholders engaged on the Proposed Action

Consultation method	Value	Deployed
Meetings	Provided an opportunity for two-way dialogue about our Proposal, the environmental assessment process, and stakeholders' interests, concerns and opportunities.	Numerous meetings have been conducted with a broad range of stakeholders. Where possible, these meetings have been held face-to-face. However, due to COVID social distancing requirements, some have been held online
Community information sessions		Three community information sessions were conducted in Pinjarra, Jarrahdale and Dwellingup during August-September 2020 with about 170 people in total attending.
Telephone conversations		Numerous telephone conversations have been conducted with a broad range of stakeholders. Generally, these have been to arrange a follow up meeting, provide updates on the Proposal, or give feedback on issues or opportunities raised.
Written materials	Provided an opportunity to share information and updates about the Proposal and environmental assessment process including how stakeholder feedback was being used and addressed.	Five key written overviews or updates have been issued to stakeholders since the June 2020 referral. This correspondence has been accompanied by a factsheet that provides up-to-date details about Alcoa's operations, the Proposal, and the environmental assessment process.
Website	Provided an opportunity to make detailed, up-to-date information about the Proposal and environmental assessment process available broadly and on an ongoing	A detailed section has been maintained on the Alcoa of Australia website since mid-2020. It has been promoted to stakeholders and the broader community. www.alcoa.com/australia/en/sustainability/pinjarra-huntly-environmental-assessment

Consultation method	Value	Deployed
	basis along with links to key documents.	
Site tours	Provided an opportunity for stakeholders to see first-hand our existing Western Australian operations. We have provided tours of our WA operations for more than 40 years.	Tours of our existing mining operation and rehabilitation activities at the Huntly Bauxite Mine and refining operations at the Pinjarra Alumina Refinery have been provided to numerous interested stakeholders. In many instances, these tours have been tailored to focus on key areas of interest or concern that stakeholders have in relation to Alcoa's Proposal and the environmental assessment process.
Newspaper advertorial	Provided an opportunity to make information and updates about the Proposal and environmental assessment process available broadly in the local community and to direct people on where to find more information.	Information about the Proposal and environmental assessment process have been published in several local newspapers.

4 Matters of National Environmental Significance (MNES)

4.1 Summary of MNES

Table 4-1 presents a summary of the relevant MNES. As presented, the Proposal has the potential to cause significant impacts to listed threatened species (flora and fauna) but is unlikely to cause significant impacts to other MNES.

Table 4-1 Summary of MNES relevance to the Proposed Action

MNES	Relevance to the Proposal
Listed threatened species and ecological communities	<p>Relevant.</p> <p>There are no listed threatened ecological communities known or likely to occur within the development envelope, which lies within Jarrah forest on the Darling Plateau. See Section 4.2.2.</p> <p>Nine listed threatened flora species have a moderate likelihood of occurring within the Development Envelope and eight threatened flora species have a low likelihood of occurring. See Section 4.2.2.</p> <p>Six threatened terrestrial fauna are known or likely to occur within the Development Envelope. See Section 4.3.2.</p> <p>One species of threatened aquatic fauna is known or likely to occur in drinking water reservoirs downstream of the Development Envelope. See Section 4.4.2.</p>
Listed migratory species	<p>Not relevant.</p> <p>Migratory species are unlikely to use the Jarrah forest habitats of the Darling Plateau, which lie away from coastal and wetland habitats on the Swan Coastal Plain.</p> <p>See Section 4.3.2.</p>
Wetlands of international importance	<p>Not relevant.</p> <p>Proposed Action lies approximately 30 to 35 km to the east of the closest Ramsar wetland, the Peel-Yalgorup System.</p> <p>The Development Envelope predominantly lies within catchments of drinking water supply dams that retain all or most of incoming streamflow, with a negligible portion released downstream into the Ramsar wetland.</p> <p>A small portion of the Development Envelope lies within unregulated catchments of the Serpentine and Murray Rivers which flow into the Ramsar wetland. Mining in these portions is highly unlikely to cause a significant impact to the Ramsar wetland.</p> <p>See Section 4.4.2.</p>
Commonwealth marine areas	<p>Not relevant.</p> <p>Proposed Action is not located offshore.</p>
World Heritage properties	<p>Not relevant.</p> <p>No World Heritage properties in vicinity of Proposed Action.</p>
National Heritage places	<p>Not relevant.</p> <p>No National Heritage places in vicinity of Proposed Action.</p>
Nuclear actions	<p>Not relevant.</p> <p>Proposed Action is not a nuclear action.</p>
Great Barrier Reef Marine Park	<p>Not relevant.</p> <p>Proposed Action is on the west coast of Australia.</p>

MNES	Relevance to the Proposal
Protection of water resources from coal seam gas development and large coal mining development	Not relevant. Proposed Action does not involve coal seam gas or coal mine development.

4.2 Flora and vegetation

4.2.1 Baseline studies

Table 4-2 lists the key flora and vegetation studies that have been undertaken in relation to the Proposed Action. The study reports are currently being finalised and the results are summarised in this referral.

Table 4-2 Flora and vegetation baseline studies

Author (Year)	Study Name
Mattiske Consulting (2022)	Targeted Flora Survey for Huntly Mine – Myara North and Holyoake
Mattiske Consulting (2021a)	Detailed Flora and Vegetation Survey for Huntly Mine – Myara North
Mattiske Consulting (2021b)	Detailed Flora and Vegetation Survey for Huntly Mine - Holyoake
Glevan Consulting (2021)	Myara North and Holyoake regions, Huntly Mine Phytophthora Dieback occurrence assessment

4.2.2 Receiving environment

Regional vegetation and floristic diversity

The mine is located within the Southwest Botanical Province as mapped by Beard (1990), 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 a total of approximately 1.90 million ha and is broadly characterised by Jarrah (*Eucalyptus marginata*) forest on ironstone gravels and Marri-Wandoo (*Corymbia calophylla* - *Eucalyptus wandoo*) woodlands on loamy soils, with sclerophyll understoreys.

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. Substantial clearing has occurred for agriculture in the north and east, as well as urban rural residential in the Perth Hills.

The NJF subregion has moderate floristic species richness (400 – 600 species per km²), with higher species richness (500-600 species per km²) in the high to moderate rainfall zone in the west (RFA Comprehensive Regional Assessment 1998). The NJF subregion has previously been estimated to contain more than 784 native flora species (Bell and Heddle 1989), the majority of which are in the understorey, with the subregion containing approximately 20 native tree species (Koch 2007). Upland areas that are subject to bauxite mining may contain 300-400 native flora species, whereas 80 m² sample plots used by Alcoa in their baseline forest monitoring typically record 50-80 native species (Koch 2007). Floristic richness is greatest in areas which contain a combination of short-lived obligatory seeders stimulated by fire, long-lived re-sprouting species that commonly dominate the understorey, and the few species which disperse from adjacent unburnt areas (Bell and Heddle 1989).

Historic timber harvesting and Phytophthora dieback

The NJF subregion has been subject to widespread timber harvesting since the 1870s. The 0.58 million ha of Jarrah forest remaining within ML1SA is predominantly (74 per cent of total) at a juvenile to immature stage of forest structure, comprising regrowth up to 70 years old since the last harvest. Approximately 22 per cent of the remaining Jarrah forest within ML1SA is at a mature forest structure (more than 70 years old) and approximately 4 per cent comprises old growth forest that has never been harvested.

The Development Envelope is predominantly (86 per cent) at an establishment, juvenile or immature stage of forest structure (less than 70 years since last harvest) and approximately 14 per cent at a mature forest stage (70 years or more years since last harvest). The Development Envelope contains small pockets (0.16 per cent) of old growth forest mapped by DBCA.

The NJF subregion has widespread *Phytophthora* dieback infestation, resulting from the extensive activity of the timber industry and environmental conditions favourable to the disease. *Phytophthora* dieback infestation has been identified in 34 per cent of assessed DBCA managed lands within ML1SA. The disease affects more than 20 per cent of native plant species in the South-West region, the most susceptible families being Proteaceae, Ericaceae and Xanthorrhoeaceae. Within these families, the genera *Banksia*, *Isopogon*, *Adenanthos*, *Persoonia*, *Petrophile*, *Xylomelum*, *Andersonia*, *Astroloma*, *Leucopogon* and *Xanthorrhoea* all demonstrate high susceptibility. The affected species are key components of the Jarrah forest floristic diversity.

The Development Envelope has been assessed by DBCA (1980-2019) and by Glevan Consulting (2017-2020) on behalf of Alcoa. The combined assessments covered a total of approximately 93 per cent of the Development Envelope, including 89 per cent of the Myara North Development Envelope and 98 per cent of the Holyoake Development Envelope.

The combined assessments indicate that approximately 43 per cent of the assessed area was infested and approximately 56 per cent uninfested, with a small area (1 per cent) uninterpretable or excluded. The majority of infested areas within the Myara North Development Envelope and Holyoake Development Envelope are in valleys and swamps, with upland areas predominantly uninfested. This is expected as *Phytophthora* Dieback is spread in surface and subsurface water and may disperse a few metres to hundreds of metres a year downslope in incised creeks and gullies, compared to less than one metre a year upslope (Commonwealth Department of Energy and Environment 2018).

Vegetation complexes of the Development Envelope

Vegetation complexes were mapped over the NJF subregion at 1:50,000 by Mattiske and Havel (1998), as part of a biodiversity assessment to inform the RFA. The vegetation complexes over the Development Envelope are presented in Figure 4-1 and Table 4-3.

As presented, the Development Envelope is predominantly covered by Dwellingup complexes (48 per cent) on the uplands and Yarragil and Murray complexes (43 per cent) on the slopes and valley floors. It is the uplands and mid slopes which contain enriched bauxite and are subject to mining. The remaining 9 per cent of the Development Envelope predominantly comprises the Cooke complex on granite outcrops and the Swamp complex, which are not subject to bauxite mining and are the key habitats for EPBC listed threatened flora.

Table 4-3 Vegetation complexes mapped in the Development Envelope

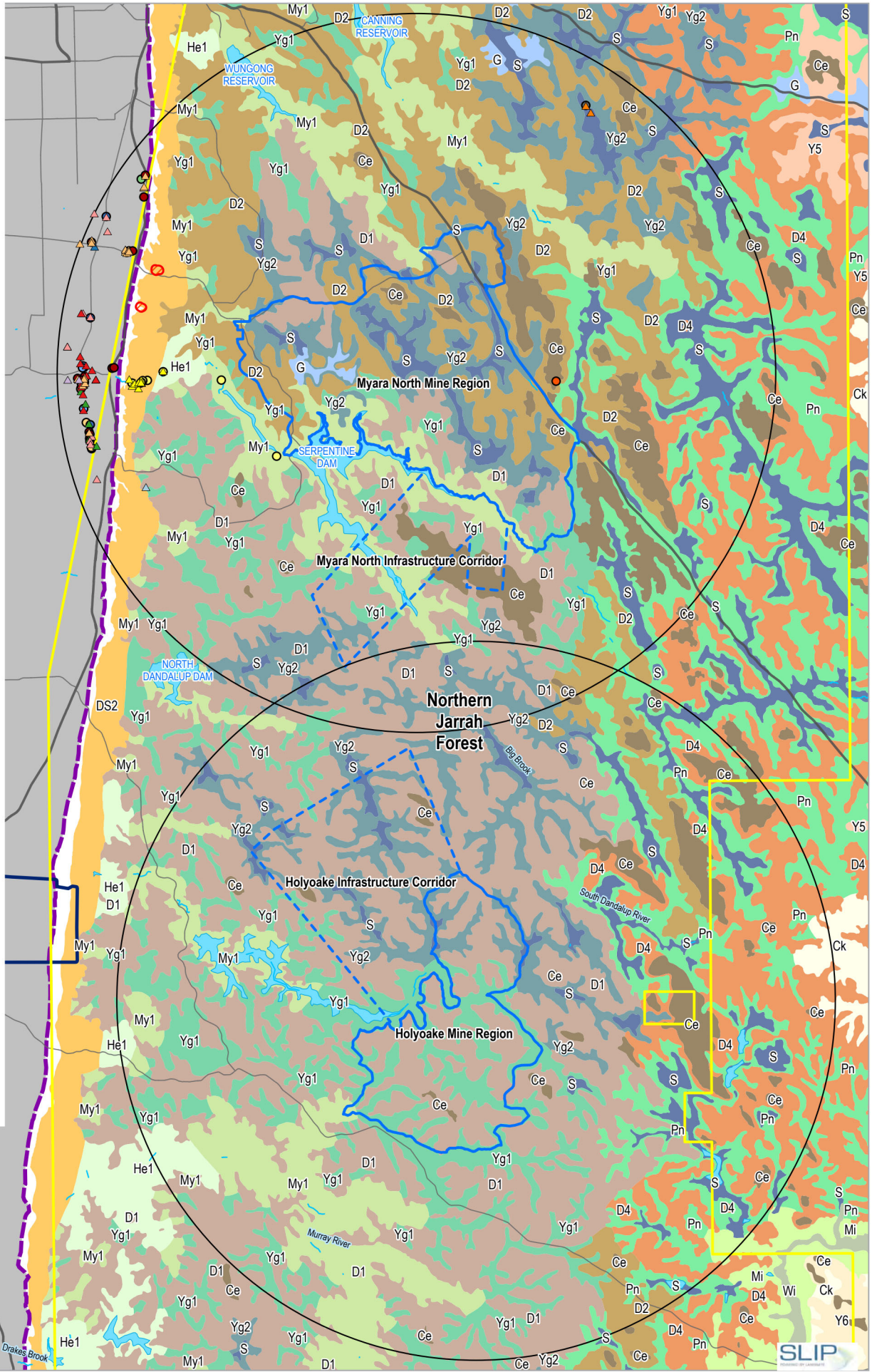
Vegetation complex	Description	Area in Development Envelope (ha)
Cooke Complex	Mosaic of open forest of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> - <i>Corymbia calophylla</i> (subhumid zone) and open forest of <i>Eucalyptus marginata</i> subsp. <i>thalassica</i> - <i>Corymbia calophylla</i> (semiarid and arid zones) and on deeper soils adjacent to outcrops, closed heath of Myrtaceae-Proteaceae species and lithic complex on granite rocks and associated soils in all climate zones, with some <i>Eucalyptus laevis</i> (semiarid), and <i>Allocasuarina huegeliana</i> and <i>Eucalyptus wandoo</i> (mainly semiarid to perarid zones).	1491
Dwellingup Complex (D1)	Open forest of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> - <i>Corymbia calophylla</i> on lateritic uplands in mainly humid and subhumid zones.	15,270
Dwellingup Complex (D2)	Open forest of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> - <i>Corymbia calophylla</i> on lateritic uplands in subhumid and semiarid zones.	4952
Goonaping Complex	Mosaic of open forest of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> (humid zones) and <i>Eucalyptus marginata</i> subsp. <i>thalassica</i> (semiarid to perarid zones) on the sandy-gravels, low woodland of <i>Banksia attenuata</i> on the drier sandier sites (humid to perarid zones) with some <i>Banksia menziesii</i> (northern arid and perarid zones) and low open woodland of <i>Melaleuca preissiana</i> - <i>Banksia littoralis</i> on the moister sandy soils (humid to perarid zones).	304
Murray 1 Complex	Open forest of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> - <i>Corymbia calophylla</i> - <i>Eucalyptus patens</i> on valley slopes to woodland of <i>Eucalyptus rudis</i> - <i>Melaleuca raphiophylla</i> on the valley floors in humid and subhumid zones. Partially inundated by Serpentine Dam and South Dandalup Dam reservoirs	3268
Pindalup Complex	Open forest of <i>Eucalyptus marginata</i> subsp. <i>thalassica</i> - <i>Corymbia calophylla</i> on slopes and open woodland of <i>Eucalyptus wandoo</i> with some <i>Eucalyptus patens</i> on the lower slopes in semiarid and arid zones.	35
Swamp Complex	Mosaic of low open woodland of <i>Melaleuca preissiana</i> - <i>Banksia littoralis</i> , closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp. and sedgelands of <i>Baumea</i> and <i>Leptocarpus</i> spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.	2000
Yarragil 1 Complex	Open forest of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> - <i>Corymbia calophylla</i> on slopes with mixtures of <i>Eucalyptus patens</i> and <i>Eucalyptus megacarpa</i> on the valley floors in humid and subhumid zones.	5318

Vegetation complex	Description	Area in Development Envelope (ha)
Yarragil 2 Complex	Open forest of <i>Eucalyptus marginata</i> subsp. <i>thalassica-Corymbia calophylla</i> on slopes, woodland of <i>Eucalyptus patens-Eucalyptus rudis</i> with <i>Hakea prostrata</i> and <i>Melaleuca viminea</i> on valley floors in subhumid and semiarid zones.	8765
Total		41,403

- Legend**
- Mineral Lease 1SA
 - Proposed Action**
 - Mine Region
 - Infrastructure Corridor
 - Mine Facilities
 - Flora/TEC database search radius (20km from centroid)
 - IBRA region boundary
 - Threatened Ecological Communities**
 - Banksia WL SCP
 - Vegetation Complexes**
 - Depressions and Swamps
 - S - Swamp
 - G - Goonaping
 - Uplands
 - Ce - Cooke
 - D1 - Dwellingup
 - D2 - Dwellingup
 - D4 - Dwellingup
 - DS2 - Darling Scarp
 - Y5 - Yalanbee
 - Y6 - Yalanbee
 - Valley Floors and Swamps
 - Wi - Williams
 - Valleys
 - Ck - Coolakin
 - He1 - Helena 1
 - Mi - Michibin
 - My1 - Murray 1
 - Pn - Pindalup
 - Yg1 - Yarragil 1
 - Yg2 - Yarragil 2

- EPBC Flora - WA Herbarium database**
- Anthocercis gracilis
 - Diuris purdiei
 - Lasiopetalum pterocarpum
 - Synaphea sp. Fairbridge Farm (D. Papenfus 696)
 - Synaphea sp. Pinjarra Plain (A.S. George 17182)
 - Synaphea sp. Serpentine (G.R. Brand 103)
 - Tetralia australiensis
 - Verticordia fimbrialepis subsp. fimbrialepis
 - Verticordia plumosa var. ananeotes

- EPBC Flora - DBCA threatened flora database**
- Drakaea elastica
 - Grevillea flexuosa
 - Lasiopetalum pterocarpum
 - Synaphea sp. Fairbridge Farm (D. Papenfus 696)
 - Synaphea sp. Pinjarra Plain (A.S. George 17182)
 - Synaphea sp. Serpentine (G.R. Brand 103)
 - Tetralia australiensis
 - Verticordia fimbrialepis subsp. fimbrialepis



Swan Coastal Plain

Waroona Drain
Drakes Brook

Paper Size ISO A3

Kilometres

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

Alcoa of Australia Limited
Huntly Bauxite Mine Transition - Myara
North and Holyoake - EPBC Act Referral

Project No. 12520591
Revision No. 0
Date 25/03/2022

Vegetation complexes and EPBC listed flora species and TECs

FIGURE 4-1

g:\net\gha\AU\Permit\Projects\12520591\GIS\Maps\Working\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022.aprx
Print date: 25 Mar 2022 - 13:27

Data source: Alcoa: Refinery Sites, Huntly Mine boundary, Pinjarra Refinery, Development Envelope - 20200403, Holyoake Conveyor Corridor, Conveyorthru Road Envelope - 20200605, Langage Road - 20190106, Railway - 20190304, W/View, Langage - SLIP. Created by: andgar

Vegetation types

Mattiske (2021a, 2021b) conducted detailed flora and vegetation surveys over the Development Envelope, mapping 29 vegetation types (VTs). The VTs were mapped based on a grid survey, using key indicator species and site conditions adapted from the method of Havel (1975a, 1975b), to differentiate vegetation across the continuum of Jarrah-Marri overstorey.

Field surveys were conducted over the mine regions and along a 200 m wide corridor targeted to indicative infrastructure alignments within the infrastructure corridors. Field survey within the infrastructure corridors was targeted to indicative infrastructure alignments due to the very limited clearing required, at about 2 per cent for the Myara North infrastructure corridor and about 1 per cent of the Holyoake infrastructure corridor.

The VTs are presented in Table 4-4, Figure 4-2 and Figure 4-3. The VTs comprise combinations of the 21 site vegetation types (SVTs) developed by Havel (1975a, 1975b), with the first letter reflecting the dominant SVT and the second letter the subdominant SVT.

The VT mapping results were broadly consistent with the vegetation complex mapping. Approximately 66 per cent of the Development Envelope comprises VTs with P, S and T as the dominant SVTs. These three SVTs are relatively widespread and primarily associated with the upland Dwellingup complex in the high to medium rainfall zone (>900 mm/year), and T also associated with the Murray complex (Heddle et al 1980). The Myara North uplands are dominated by the P and S SVTs, whereas the Holyoake Development Envelope uplands are primarily the T SVT. The three upland SVTs vary substantially with respect to soil texture from coarse sandy gravels (P) to loamy gravels (S) and sandy loams (T) (Bell and Heddle 1989).

Approximately 13 per cent of the Development Envelope comprises VTs with C, D, E and W dominant, which are less widespread SVTs found in lower slopes and creeklines of the Yarragil and Murray complexes (Heddle et al 1980).

Approximately 2 per cent of the Development Envelope comprises VTs with G and R dominant, which are restricted in extent to granite outcrops and associated with the Cooke complex. Approximately 5 per cent comprises VT with A dominant, which is an SVT restricted to swamps and associated with the Swamp and Yarragil 2 complexes. The VTs with G, R and A dominant provide habitat for conservation significant flora.

Approximately 12 per cent of the Development Envelope comprises cleared land, pine plantations and mine rehabilitation. Approximately 0.1 per cent comprises open water of the Serpentine Reservoir.

Table 4-4 Vegetation types mapped in the Development Envelope

Code	Description	Total (ha)	Proportion of Development Envelope (%)
Swamps and Broad Valleys			
A	Tall shrubland of <i>Melaleuca lateritia</i> , <i>Hakea varia</i> , <i>Melaleuca viminea</i> and <i>Melaleuca incana</i> subsp. <i>incana</i> on clay-loams in seasonally wet valley floors.	221	0.53
AC	Open Woodland of <i>Eucalyptus rudis</i> – <i>Melaleuca preissiana</i> - <i>Eucalyptus patens</i> - <i>Banksia littoralis</i> with dense <i>Taxandria linearifolia</i> and <i>Astartea scoparia</i> in understorey on broad swamps and water-courses.	1348	3.26
AD	Low open woodland of <i>Eucalyptus rudis</i> and <i>Eucalyptus marginata</i> over <i>Banksia littoralis</i> , <i>Hakea prostrata</i> and <i>Pericalymma ellipticum</i> over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.	291	0.70
AW	Low open woodland of <i>Eucalyptus patens</i> and <i>Melaleuca preissiana</i> over <i>Banksia littoralis</i> , <i>Hakea prostrata</i> and <i>Pericalymma ellipticum</i> over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.	120	0.29
AW/AX	Localised patchy mosaic of AW and AX.	21	0.05
AW/CW	Localised patchy mosaic of AW and CW.	20	0.05
WA	Open Forest of <i>Eucalyptus megacarpa</i> - <i>Eucalyptus patens</i> – <i>Corymbia calophylla</i> on lower slopes with mixed low understorey species, including <i>Banksia littoralis</i> and occasional <i>Melaleuca preissiana</i> over <i>Acacia extensa</i> and <i>Hypocalymma angustifolium</i> on seasonally moister sandy-loam gravelly soils.	22	0.05
AX	Open woodland of <i>Eucalyptus rudis</i> over <i>Acacia saligna</i> , <i>Melaleuca incana</i> subsp. <i>incana</i> and <i>Hypocalymma angustifolium</i> on clay- loams on valley floors.	50	0.12
D	Open Forest of <i>Eucalyptus marginata</i> <i>Corymbia calophylla</i> - <i>Hakea prostrata</i> on lower slopes with mixed low understorey species, including <i>Babingtonia camphorosmae</i> and <i>Acacia extensa</i> on clay loams to gravelly clay-loams.	2085	5.03
DA	Open Forest of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> - <i>Hakea prostrata</i> on lower slopes with patches of <i>Melaleuca preissiana</i> , <i>Banksia littoralis</i> and <i>Hakea varia</i> over mixed low understorey species, including <i>Babingtonia camphorosmae</i> and <i>Acacia extensa</i> on clay loams to gravelly clay-loams. Local variant also includes <i>Xylomelum occidentale</i> (Woody Pear).	215	0.52
DG	Open forest of <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> over <i>Hakea lissocarpa</i> , <i>Macrozamia riedlei</i> , <i>Pericalymma ellipticum</i> , <i>Grevillea bipinnatifida</i> , <i>Allocasuarina humilis</i> , <i>Acacia alata</i> , <i>Babingtonia camphorosmae</i> , <i>Hypocalymma angustifolium</i> and <i>Phyllanthus calycinus</i> on clay-loams on lower slopes with localised patches of outcropping.	22	0.05

Code	Description	Total (ha)	Proportion of Development Envelope (%)
E	Open woodland of <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> over <i>Mesomelaena tetragona</i> , <i>Kingia australis</i> , <i>Leptospermum erubescens</i> and <i>Babingtonia camphorosmae</i> on sandy to sandy-loam soils on slopes.	374	0.90
J	Open Woodland to open forest of <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> and <i>Eucalyptus patens</i> over <i>Mesomelaena tetragona</i> , <i>Leptocarpus scariosus</i> , <i>Babingtonia camphorosmae</i> and <i>Stirlingia latifolia</i> on broad sandy-loam flats valley slopes.	37	0.09
Valley Floors and Lower Slopes			
C	Woodland to Open Forest of <i>Eucalyptus patens</i> – <i>Corymbia calophylla</i> - <i>Banksia littoralis</i> and <i>Banksia seminuda</i> with dense <i>Taxandria linearifolia</i> and <i>Astartea scoparia</i> in understorey on creek-lines and water-courses.	204	0.49
CW	Woodland to Open Forest of <i>Eucalyptus patens</i> – <i>Eucalyptus megacarpa</i> - <i>Corymbia calophylla</i> - <i>Banksia littoralis</i> with dense <i>Taxandria linearifolia</i> and <i>Astartea scoparia</i> in understorey on creek-lines and water-courses.	1050	2.53
W	Open Forest of <i>Eucalyptus megacarpa</i> - <i>Eucalyptus patens</i> – <i>Corymbia calophylla</i> on lower slopes with mixed low understorey species, including <i>Acacia extensa</i> and <i>Hypocalymma angustifolium</i> on seasonally moister sandy-loam gravelly soils.	1406	3.40
Q	Open Forest of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> - <i>Eucalyptus patens</i> with mixed understorey species, including <i>Trymalium floribundum</i> , <i>Acacia extensa</i> and <i>Phyllanthus calycinus</i> on loam soils on lower slopes.	29	0.07
Slopes and Ridges – Sandy Loam Gravels			
M	Open woodland of <i>Eucalyptus wandoo</i> over <i>Trymalium ledifolium</i> , <i>Macrozamia riedlei</i> and <i>Hakea lissocarpha</i> on clay loams with some gravel on mid to upper slopes and ridges.	3	0.01
P	Open Forest of <i>Allocasuarina fraseriana</i> - <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> - <i>Banksia grandis</i> with scattered understorey, including <i>Adenanthos barbiger</i> , <i>Styphelia nitens</i> , <i>Grevillea wilsonii</i> , <i>Leucopogon capitellatus</i> on sandy gravels.	1271	3.07
PT	Open Forest of <i>Allocasuarina fraseriana</i> - <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> - <i>Banksia grandis</i> with scattered understorey, including <i>Adenanthos barbiger</i> , <i>Leucopogon verticillatus</i> , <i>Pteridium esculentum</i> and <i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i> on sandy-loam gravels.	718	1.74
PS	Open Forest of <i>Allocasuarina fraseriana</i> - <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> - <i>Banksia grandis</i> with scattered understorey, including <i>Adenanthos barbiger</i> , <i>Leucopogon capitellatus</i> on gravels and sandy gravels.	4540	10.96

Code	Description	Total (ha)	Proportion of Development Envelope (%)
SP	Open Forest of <i>Allocasuarina fraseriana</i> - <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> - <i>Banksia grandis</i> with scattered understorey, including <i>Adenanthos barbiger</i> , <i>Grevillea wilsonii</i> and <i>Leucopogon capitellatus</i> on sandy-gravels to gravelly soils.	2633	6.36
SP-D	Degraded SP vegetation type	10	0.02
S	Open Forest of <i>Eucalyptus marginata</i> - <i>Banksia grandis</i> - <i>Allocasuarina fraseriana</i> with scattered understorey, including <i>Adenanthos barbiger</i> , <i>Leucopogon capitellatus</i> and <i>Styphelia tenuiflora</i> on gravels and sandy- gravels.	6774	16.36
ST	Open Forest of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> with scattered understorey, including <i>Leucopogon capitellatus</i> , <i>Leucopogon verticillatus</i> , <i>Pteridium esculentum</i> , <i>Lasiopetalum floribundum</i> and <i>Styphelia tenuiflora</i> on sandy-gravelly soils.	2729	6.59
Slopes and Ridges – Loam Gravels			
TS	Open Forest of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> – <i>Banksia grandis</i> with scattered understorey, including <i>Leucopogon verticillatus</i> , <i>Pteridium esculentum</i> , <i>Clematis pubescens</i> and <i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i> on sandy-loam gravelly to gravelly soils.	3591	8.67
T	Open Forest of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> with scattered understorey, including <i>Leucopogon verticillatus</i> , <i>Pteridium esculentum</i> , <i>Clematis pubescens</i> and <i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i> on sandy-loam gravelly soils.	2828	6.83
Slopes with Higher Seasonal Soil Moisture			
SW	Open Forest of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> – <i>Banksiagrandsis</i> with scattered understorey, including <i>Adenanthos barbiger</i> , <i>Hypocalymma angustifolium</i> and <i>Styphelia tenuiflora</i> on seasonally moister sandy-gravelly soils.	1363	3.29
SW-D	Degraded SW vegetation type	9	0.02
PW	Open Forest of <i>Allocasuarina fraseriana</i> - <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> with scattered understorey, including <i>Grevillea wilsonii</i> , <i>Adenanthos barbiger</i> , <i>Babingtonia camphorosmae</i> and <i>Hypocalymma angustifolium</i> on sandy gravels.	874	2.11
Outcrop Areas			
R	Open Woodland of <i>Eucalyptus marginata</i> - <i>Corymbia calophylla</i> on fringes of granite outcrops or shallow soils over mixed understorey species reflecting shallow soils over granite.	504	1.22

Code	Description	Total (ha)	Proportion of Development Envelope (%)
RG	Localised patchy mosaic of R and G site-vegetation types.	1	0.00
G	Mosaic of Open Woodland of <i>Eucalyptus marginata</i> – <i>Corymbia calophylla</i> on the fringes of outcrops ranging to open heath communities of Proteaceae-Myrtaceae species and lithic complexes on the outcrop areas.	283	0.68
G1	Mosaic of Open Woodland of <i>Eucalyptus marginata</i> – <i>Corymbia calophylla</i> on the fringes of outcrops ranging to open heath communities of Proteaceae-Myrtaceae species and lithic complexes on the outcrop areas.	137	0.33
G2	Woodland of <i>Allocasuarina huegeliana</i> and associated herbs and lowshrubs on shallow granite outcrops.	1	0.00
Other Areas			
CL	Cleared	1378	3.33
CL Other	Cleared Other	199	0.48
PL	Plantation	162	0.39
Rehab	Rehabilitation Areas	3353	8.10
DAM	Dam	61	0.15
N/A	Unsurveyed	463	1.12
Total Area		41,403	100.00

Vegetation condition

Mattiske (2021a, 2021b) mapped vegetation condition over the Development Envelope, based on the criteria by Keighery (1994) and considering the effects of timber harvesting, *Phytophthora* Dieback, past mining and rehabilitation, agricultural and residential clearing, tracks and roads, and introduced flora species

The vegetation condition is presented in Figure 4-4 and Figure 4-5. Vegetation condition was mapped over the full extent of each mine region and targeted along indicative infrastructure alignments within the Infrastructure Corridors. Past vegetation condition mapping was not available for the remaining area within the Infrastructure Corridors.

The mapping indicates that the Myara North mine region is predominantly (79.5 per cent) in Good to Very Good condition, with approximately 16.2 per cent in Very Good to Excellent condition and small area (4.3 per cent) in Completely Degraded to Degraded condition. The predominantly Good to Very Good condition reflects the Juvenile to Immature forest structure (< 70 years since last harvest), the presence of occasional forest tracks, and presence of *Phytophthora* Dieback vulnerable vegetation and infestation.

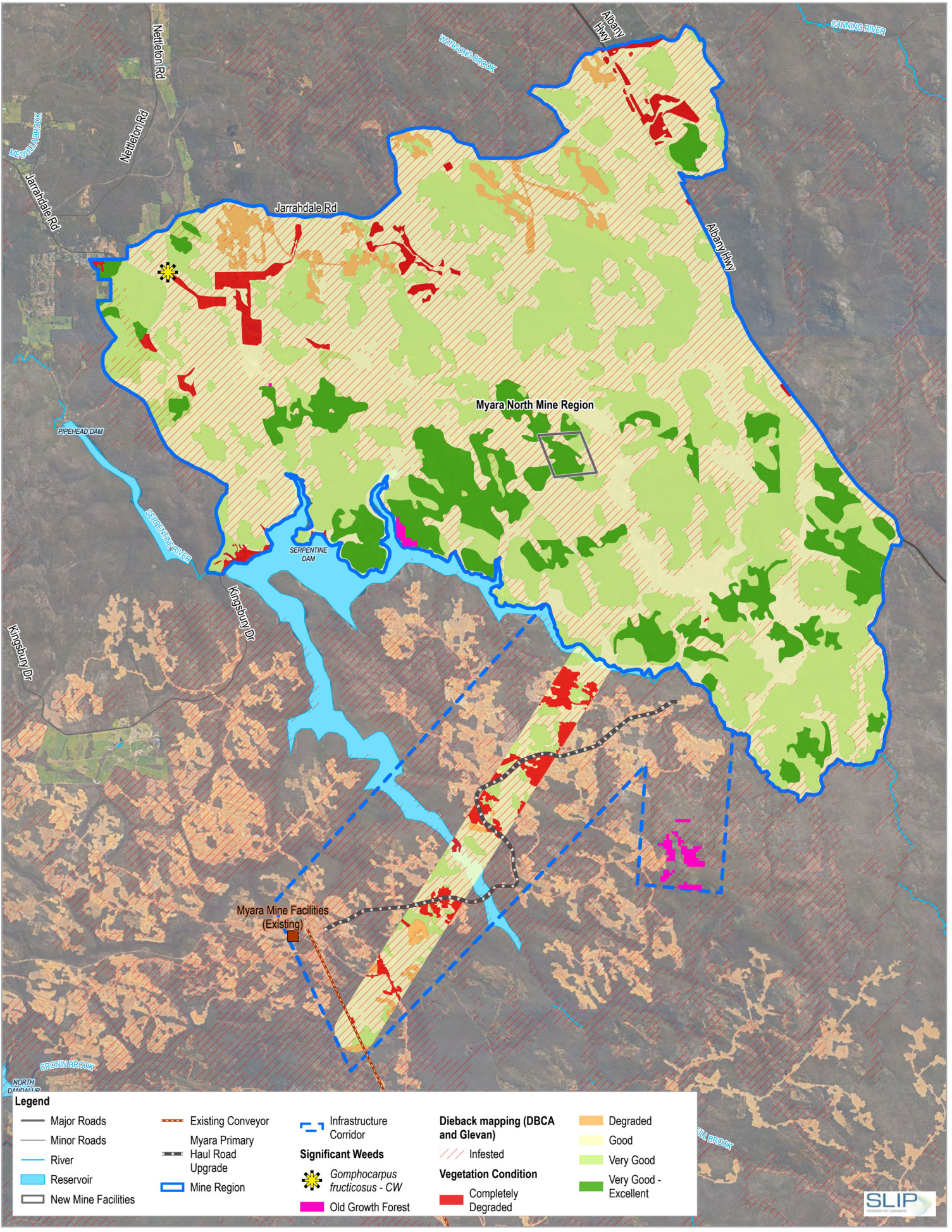
The mapping indicates that the Holyoake mine region is a mix of Very Good to Excellent condition (46.7 per cent) and Good to Very Good condition (52.6 per cent), with a very small area (0.6 per cent) in Completely Degraded condition.

EPBC Act listed threatened ecological communities

No threatened ecological communities (TECs) are known or likely to occur within the Development Envelope. A search of the Commonwealth Protected Matters Search Tool (PMST) and DBCA TEC database indicated that the following TECs are known or likely to occur within 20 km of the centroid of the Myara North and/or Holyoake mine regions.

- Banksia Woodlands of the Swan Coastal Plain ecological community
- *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain
- *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain
- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain Ecological Community.

None of the above listed TECs are expected to occur in the Development Envelope, as the TECs are restricted to the Swan Coastal Plain and do not extend into the Jarrah forest of the Darling Plateau. The location of DBCA database records for TECs is presented in Figure 4-1, which indicates that records of Banksia Woodlands on the Swan Coastal Plain lie west of the Myara North region, on the Darling Scarp adjacent to the Swan Coastal Plain.



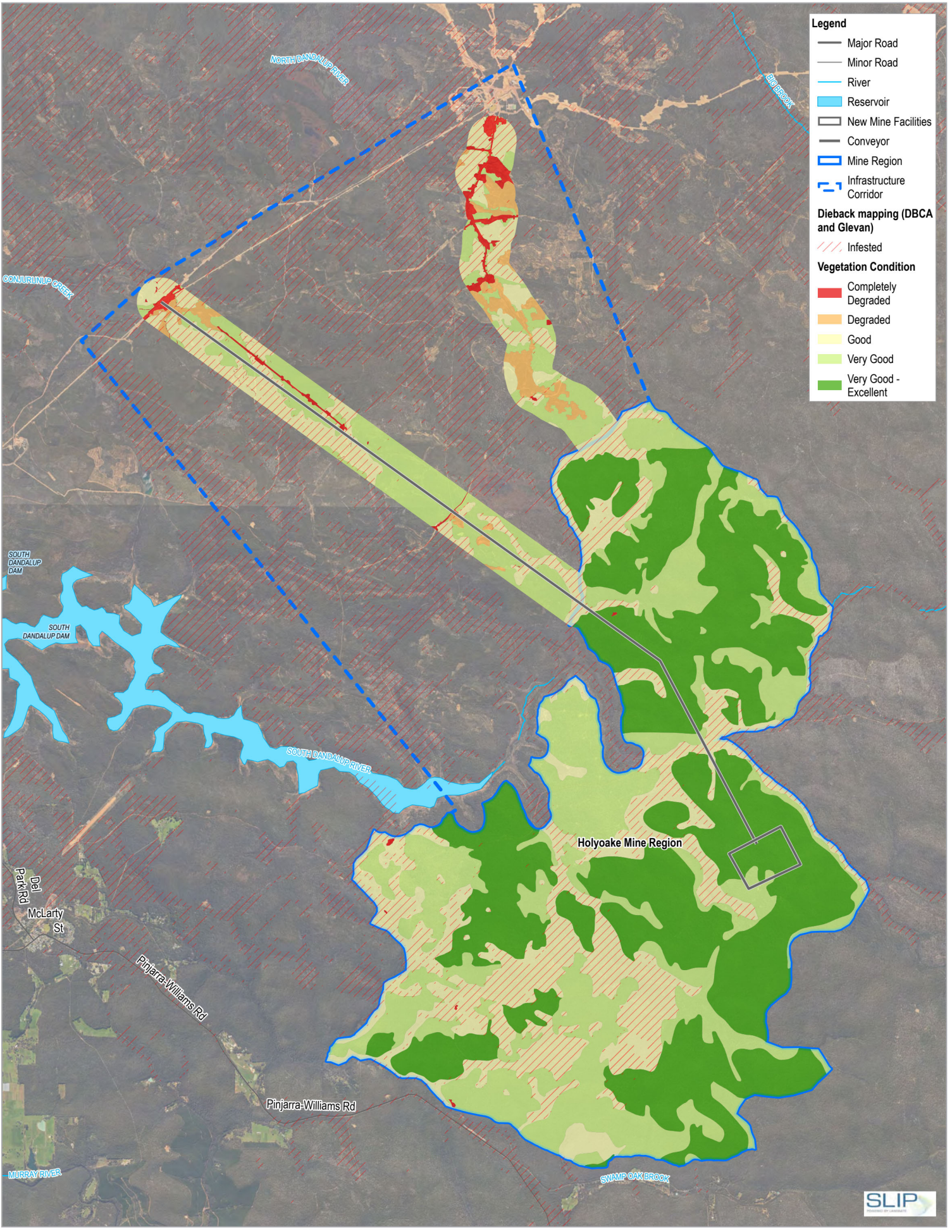
Legend

— Major Roads	— Existing Conveyor	— Infrastructure Corridor	Dieback mapping (DBCAs and Glevan)	— Degraded
— Minor Roads	— Myara Primary	— Significant Weeds	— Infested	— Good
— River	— Haul Road Upgrade	— <i>Gomphocarpus fruticosus</i> - CW	Vegetation Condition	— Very Good
— Reservoir	— Mine Region	— Old Growth Forest	— Completely Degraded	— Very Good - Excellent
— New Mine Facilities				

<p>Paper Size ISO A3</p> <p>Kilometres</p> <p>Map Projection: Transverse Mercator Horizontal Datum: GDA 1994 Grid: GDA 1994 MGA Zone 50</p>			<p>Alcoa of Australia Limited Huntly Bauxite Mine Transition Myara North and Holyoake - EPBC Act Referral</p>	<p>Project No. 12520591 Revision No. 0 Date 29/03/2022</p>
---	--	--	---	--

Vegetation Condition - Myara North **FIGURE 4-4**

g:\hntly\ghd\AU\Permit\Projects\12520591\GIS\Maps\Working\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022.aprx4-4 (new)
Data source: WAlko; Landgate / SLIP; Created by: frow3



Legend

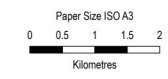
- Major Road
- Minor Road
- River
- Reservoir
- New Mine Facilities
- Conveyor
- ▭ Mine Region
- ▭ Infrastructure Corridor

Dieback mapping (DBCAs and Glevan)

- ▨ Infested

Vegetation Condition

- Red: Completely Degraded
- Orange: Degraded
- Yellow: Good
- Light Green: Very Good
- Dark Green: Very Good - Excellent



Map Projection: Mercator Auxiliary Sphere
 Horizontal Datum: WGS 1984
 Grid: WGS 1984 Web Mercator Auxiliary Sphere

Alcoa of Australia Limited
 Huntly Bauxite Mine Transition - Myara
 North and Holyoake - EPBC Act Referral

Project No. 12520591
 Revision No. 0
 Date 29/03/2022

Vegetation Condition - Holyoake

FIGURE 4-5

g:\net\ghd\AU\Perth\Projects\B1\12520591\GIS\Maps\Working\12520591_HuntlyEPBCReferral_March2022\12520591_HuntlyEPBCReferral_March2022.aprx4-5 (new)
 Print date: 29 Mar 2022 - 15:39

Data source: WAlow, Landgate / SLIP. Created by: frow3

EPBC Act listed flora species

Table 4-5 presents EPBC Act listed flora species that have a high to moderate potential to occur in the Development Envelope, based on a desktop assessment of the EPBC Act Protected Matters Search Tool (PMST), DBCA NatureMap database, DBCA and WA Herbarium threatened flora records and the habitat requirements for each species conducted by Mattiske (2021a, 2021b). The Mattiske (2021a, 2021b) review has determined that there is a moderate potential for eight EPBC Act listed flora species to occur in the Myara North mine region and infrastructure corridor Development Envelope and a moderate potential for three EPBC Act listed flora species to occur in the Holyoake mine region and infrastructure corridor. A further nine species reported by the PMST are considered to be of low potential to occur, most of which are associated with the Swan Coastal Plain.

Targeted surveys by Mattiske Consulting in spring of 2020 and 2021 (Mattiske 2021a, 2021b, 2022) did not record any EPBC Act listed flora species within the Development Envelope.

Figure 4-1 presents the locations of DBCA and WA Herbarium threatened flora records within a 20 km radius of the centroid of the Myara North and Holyoake regions, which covers an extent greater than 5 km from the Development Envelope. As presented, the majority of threatened flora records within the search radius lie on the Swan Coastal Plain, west of the Jarrah forest and Darling Plateau. The presence of threatened flora records on the Swan Coastal Plain reflects the highly cleared and fragmented nature of that region, which is distinct from the more intact and extensive Jarrah forest of the Darling Plateau.

Two threatened flora species (*Grevillea flexuosa*, *Lasiopetalum pterocarpum*) have previously recorded within 2 km of the Myara North mine region. *Lasiopetalum pterocarpum* is recorded at two locations within the Serpentine National Park to the west of the Myara North mine region, on the Serpentine River downstream of Serpentine Dam. *Grevillea flexuosa* is located in one location in the Monadnocks Conservation Park to the east of the mine region.

Table 4-5 EPBC Act listed threatened flora with a moderate likelihood of occurrence within the Development Envelope

Status	Species	Occurrence within Development Envelope and key threatening processes	Associated Site Vegetation Types	Area of potential habitat within Development Envelope (ha)	Recorded Distribution outside Mine DE
Vulnerable	<i>Anthocercis gracilis</i>	Not recorded in Development Envelope. Moderate likelihood of occurrence in Myara North. Potential threats: frequent fire and weed invasion.	G and R dominant (granite soils).	926	47 locations in the Northern Jarrah Forest, Swan Coastal Plain and Avon Wheatbelt regions. Populations ranging from one plant to largest known population of is 1,500 mature plants (WA Herbarium 1998–). Total estimated population is 3,631 plants (DEWHA 2008a). Closest record ~8 km south-west of the Myara North DE.
Vulnerable	<i>Diuris drummondii</i>	Not recorded in Development Envelope. Moderate likelihood of occurrence in Myara North. Potential threats: fire and changes in the water table.	A, C, D, E and W dominant (valleys and swamps).	4,180	107 locations in the Northern and Southern Jarrah Forests, Swan Coastal Plain, Avon Wheatbelt and Warren regions (DBCA 2007–). Known from 12 populations, with recorded frequencies ranging from 2 plants, to upwards of 6,000 plants (DEWHA) 2008b; WA Herbarium 1998–). Closest records ~20 km west of Holyoake infrastructure corridor and ~35 km west of Myara North Conveyor/Haul Road DE.
Vulnerable	<i>Diuris micrantha</i>	Not recorded in Development Envelope. Moderate likelihood of occurrence in Myara North and Holyoake. Potential threats: fire and weed invasion.	A, C, D, E and W dominant (valleys and swamps).	7,516	36 locations in the Northern and Southern Jarrah Forests and Swan Coastal Plain regions (DBCA 2007–). Known from seven populations including frequencies such as 7 plants and 50+ plants (DEWHA 2008c; WA Herbarium 1998–). Closest record ~35 km south-west of the Myara North DE.

Status	Species	Occurrence within Development Envelope and key threatening processes	Associated Site Vegetation Types	Area of potential habitat within Development Envelope (ha)	Recorded Distribution outside Mine DE
Vulnerable	<i>Eleocharis keigheryi</i>	Not recorded in Development Envelope. Moderate likelihood of occurrence in Myara North. Potential threats: invasive weeds, firebreak road and rail maintenance, and livestock damage and grazing.	A, C, D, E and W dominant (valleys and swamps).	4,180	115 locations in the Northern and Southern Jarrah Forests, Swan Coastal Plain and Avon Wheatbelt regions. (DBCA 2007–). Known from 15 populations ranging from 50+ to ~3000 plants (DEWHA 2008e; WA Herbarium 1998–). Total estimated population is 13,800 mature plants (DEWHA 2008c). Closest records ~22 km south-west of Holyoake DE and 30 km north-west of the Myara North DE.
Vulnerable	<i>Grevillea flexuosa</i>	Not recorded in Development Envelope. Moderate likelihood of occurrence in Myara North. Potential threats: dieback, broad-scale vegetation clearing, increasing fragmentation, grazing pressure, weeds, changed hydrology including salinisation, and changed fire regimes.	G and R dominant (granite soils).	926	93 locations in the Northern Jarrah Forest, Swan Coastal Plain and Avon Wheatbelt regions (DBCA 2007–). Population frequencies ranging from 1 plant up to 486 plants (WA Herbarium 1998–). In the Stoneville and Toodyay area, known from 12 populations, with more than 2000 plants (DEWHA 2008f). Closest record ~960 m east of the Myara North DE.
Endangered	<i>Lasiopetalum pterocarpum</i>	Not recorded in Development Envelope. Moderate likelihood of occurrence in Myara North and Holyoake. Potential threats: weeds, grazing by insects and kangaroos, recreational activity and disease and too frequent or infrequent fire.	G and R dominant (granite soils).	926	34 locations in the Northern Jarrah Forest and Avon Wheatbelt regions (DBCA 2007–). In Serpentine National Park known from 4 wild populations and a translocated population, totalling 580 plants at last survey (DEE 2017a). Closest record ~430 m west of the Myara North DE.

Status	Species	Occurrence within Development Envelope and key threatening processes	Associated Site Vegetation Types	Area of potential habitat within Development Envelope (ha)	Recorded Distribution outside Mine DE
Endangered	<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	Not recorded in Development Envelope. Moderate likelihood of occurrence in Myara North and Holyoake. Potential threats: road/powerline maintenance, poor recruitment, inappropriate fire regimes, grazing/trampling, feral pigs, dieback, salinity, farming, gravel extraction.	P, S, T (Lateritic soils) and A, C, D, E and W (valleys and swamps) dominant.	34,861	78 locations in Northern and Southern Jarrah Forests, Avon Wheatbelt regions (DBCA 2007–). Known from 16 populations (DEC) 2010. Population frequency ranging from one plant to 700 plants and upwards of 19,120 plants (WA Herbarium 1998–). Closest record ~8.3 km north-east of the Myara North DE.
Endangered	<i>Verticordia plumosa</i> var. <i>ananeotes</i>	Not recorded in Development Envelope. Moderate likelihood of occurrence in Myara North. Potential threats: weeds, inappropriate fire regimes, grazing and trampling, road/track/firebreak maintenance activities, chemical drift from herbicide/fertilizer applications and dieback.	A, C, D, E and W dominant (valleys and swamps).	4,180	44 locations in the Northern and Southern Jarrah Forests and Swan Coastal Plain regions (DBCA 2007–). Populations ranging from 6-20 plants to 100+ plants. Also known from three wild populations in the Blackwood District near Busseilton, with a total of 571 plants at last survey. Also recorded in the Serpentine and Murray districts (DEC 2008b). Closest record <500 m south of the Myara North DE.

4.2.3 Existing management

Huntly Mine flora and vegetation surveys

The mine is subject to pre-mining flora and vegetation surveys for all mining areas. Pre-mining flora and vegetation surveys involve vegetation mapping and targeted searches for conservation significant flora. The surveys inform mine planning to minimise the risk of impacts to conservation significant flora and poorly represented vegetation types. The pre-mining flora surveys inform Alcoa's biannual submission of Forest Clearing Advice to the Mine Operations Group (MOG), a sub-committee of MMPLG.

Huntly Mine dieback control

Alcoa undertakes dieback management in accordance with its working arrangements with DBCA. Alcoa adopts a dieback management regime at the mine based on a number of factors including:

- Proportion of dieback-affected and dieback-free forest in the mine region as determined by pre-mine mapping of disease areas.
- Well defined access controls both into and within mining areas.
- A haul road network constructed and maintained to control spread via infected materials or drainage into dieback-free forest.
- High level of hygiene with well-maintained and effective clean down facilities at dieback boundaries.
- Well developed drainage controls including appropriate use of drainage protection slots (stormwater infiltration beds in blasted/ripped rock) before clearing, stripping or mining operations.
- Training and awareness of dieback management requirements.

Huntly Mine rehabilitation and research

Alcoa maintains a progressive rehabilitation program, averaging around 420 ha per year over the past 10 years at Huntly Mine. Concurrent with rehabilitation, Alcoa has developed rehabilitation methods, technologies and completion criteria for the Jarrah forest over a period of more than 40 years (Gardner and Bell 2007). 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 following rehabilitation objective:

'Establish a self-sustaining Jarrah forest ecosystem, planned to enhance or maintain water, timber, recreation, conservation and other nominated forest values. Rehabilitated areas must become amenable to similar management practices employed in the surrounding Jarrah forest.'

Alcoa maintains a rehabilitation monitoring program, with evaluation against approved Completion Criteria 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. Since 1996 Alcoa has pursued an internal target of 100% plant species richness return to rehabilitated areas, a target that is higher than that required through the approved Rehabilitation Completion Criteria.

Alcoa also 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 CSIRO and Kings Park and Botanic Gardens. Research into the return of 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) and propagation of resprouting species (Willyams 2015). Results of all research are made publicly available, with publication of more than 250 refereed journal papers and book chapters, 80 technical studies and about 60 higher-degree research theses since 1975.

4.2.4 Potential impacts

The Proposed Action is unlikely to cause direct or indirect impacts to EPBC Act listed TECs, as no TECs are known or likely to occur within or adjacent to the Development Envelope.

The Proposed Action is unlikely to cause direct impacts to any recorded populations of EPBC Act listed flora species, as no populations are recorded within the Development Envelope.

The Proposed Action may cause direct impacts to unrecorded EPBC listed threatened flora as a result of clearing of vegetation for mining or new mine infrastructure within the Development Envelope. As noted in Section 4.2.2, there are eight species with moderate potential to occur within the Development Envelope, though none have been found during targeted surveys.

The Proposed Action may cause the following indirect impacts to threatened flora:

- Introduction and/or spread of weeds.
- Introduction and/or spread of dieback.
- Spills and/or leaks from storage and handling of hazardous materials and waste.

4.3 Terrestrial fauna

4.3.1 Baseline studies

Table 4-6 lists the key terrestrial fauna studies that have been undertaken in relation to the Proposed Action. The study reports are currently being finalised and the results are summarised in this referral.

Table 4-6 Terrestrial fauna baseline studies

Author (Year)	Study Name
GHD (2021a)	Myara North – Terrestrial Fauna Survey and Black Cockatoo Assessment
GHD (2021b)	Holyoake – Terrestrial Fauna Survey and Black Cockatoo Assessment
Wetland Research & Management (WRM 2021)	Aquatic Fauna Desktop Assessment Myara North and Holyoake Regions

4.3.2 Receiving environment

The Development Envelope lies within a large continuous extent of the Northern Jarrah Forest that has a high native fauna diversity, providing habitat for approximately 240 terrestrial vertebrate fauna species, including 29 mammals, 45 reptiles, 11 frogs, four fish

and about 150 birds. Introduced fauna in the Jarrah forest include the Fox (*Vulpes vulpes*), feral Cat (*Felis catus*) and feral European Honey-Bee (*Apis mellifera*). The Fox and Cat contribute threatening processes to threatened fauna of the Northern Jarrah Forest including the Woylie (*Bettongia penicillata ogilbyi*), Quokka (*Setonix brachyurus*) and Chuditch (*Dasyurus geoffroii*), while feral Honey-Bee contributes a threatening process to Black Cockatoos through invading and occupying breeding hollows.

Fauna communities

GHD (2021a, 2021b) conducted detailed and targeted terrestrial fauna surveys over the Development Envelope and identified three main fauna communities to be present:

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

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. Associated water courses provide seasonal breeding for locally common frog species.

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 mammals such as the Chuditch and Woylie.

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 are present in this community.

Terrestrial fauna habitats

The terrestrial fauna surveys (GHD 2021a, 2021b) identified eight broad fauna habitat types within the Development Envelope, based on vegetation, hydrology, soil and topography. The fauna habitat types are presented in Table 4-7, Figure 4-6 and Figure 4-7. The surveys covered the Development Envelope and a 100 m wide corridor around indicative conveyor routes within the infrastructure corridors. Fauna habitat types have been interpreted for the infrastructure corridors based on previous vegetation mapping by Mattiske.

A small proportion of the Development Envelope comprises cleared rural land. Cleared land has limited habitat values due to lack, paucity, or low quality of intact native vegetation.

In addition to the mapped terrestrial fauna habitats, the Development Envelope contains aquatic habitat associated with seasonally flowing streams, seasonally waterlogged swamps and downstream artificial perennial water bodies (drinking water reservoirs).

The habitat mapping results were broadly consistent with the vegetation type and complex mapping (see Section 4.2.2). Approximately 73 per cent of the Development Envelope comprises Jarrah-Marri forest, which is associated with the P, S, T, E and D dominant SVTs in uplands and slopes, and is widespread across the NJF. A further 8 per cent of the Development Envelope comprise mine site rehabilitation, which is predominantly a restoration of the Jarrah-Marri forest habitat type.

Approximately 7 per cent of the Development Envelope comprises Blackbutt and Bullich Forest, associated with the C and W dominant SVTs in lower slopes and creek lines, and less widespread across the NJF subregion.

Approximately 5 per cent of the Development Envelope comprises Flooded Gum Woodland and Melaleuca Dampland, associated with the A dominant SVT in swamps and drainage floors, which is relatively restricted in distribution in the NJF subregion.

Approximately 2 per cent of the Development Envelope comprises Granite Outcrops, associated with the G and R dominant SVTs, comprised VTs with G and R dominant, which is relatively restricted in distribution in the NJF subregion.

Approximately 5 per cent of the Development Envelope comprises cleared land and pine plantations.

Aquatic fauna habitats

The aquatic fauna desktop assessment (WRM 2021) reviewed known and potential aquatic fauna habitat within the Development Envelope. This includes:

- perennial water bodies in river pools and downstream reservoirs and perennial rivers
- seasonal and ephemeral streams and swamps
- hyporheic zones in stream beds and swamps.

Perennial aquatic habitat within the Development Envelope is limited to isolated river pools and farm dams as well as perennial waters downstream. Topographic mapping and aerial imagery indicate the presence of two river pools on South Dandalup River that may be perennial water bodies, namely Kennedy's Pool immediately upstream of the Holyoake Development Envelope and Mundalup Pool several kilometres further upstream. Pindalup Pool was previously mapped on South Dandalup River a few kilometres upstream of Kennedy's Pool however aerial imagery indicates that pool is now dry, potentially due to the historic decline in rainfall and groundwater levels. Topographic mapping and aerial imagery do not indicate the presence of river pools within the Myara North Development Envelope or upstream. Field survey recorded small river pools within the Myara North mine region, including at Jack Rocks on 39 Mile Brook and at Banksia Gully and Goldmine Gully, however all recorded pools dried up in summer and are considered seasonal.

Farm dams are located along Gooralong Brook in the north-west portion of the Myara North mine region, associated with rural properties on Balmoral Road. The farm dams may provide perennial aquatic fauna habitat but are also expected to disrupt aquatic fauna migrations along Gooralong Brook, which is unregulated downstream of the Myara North mine region.

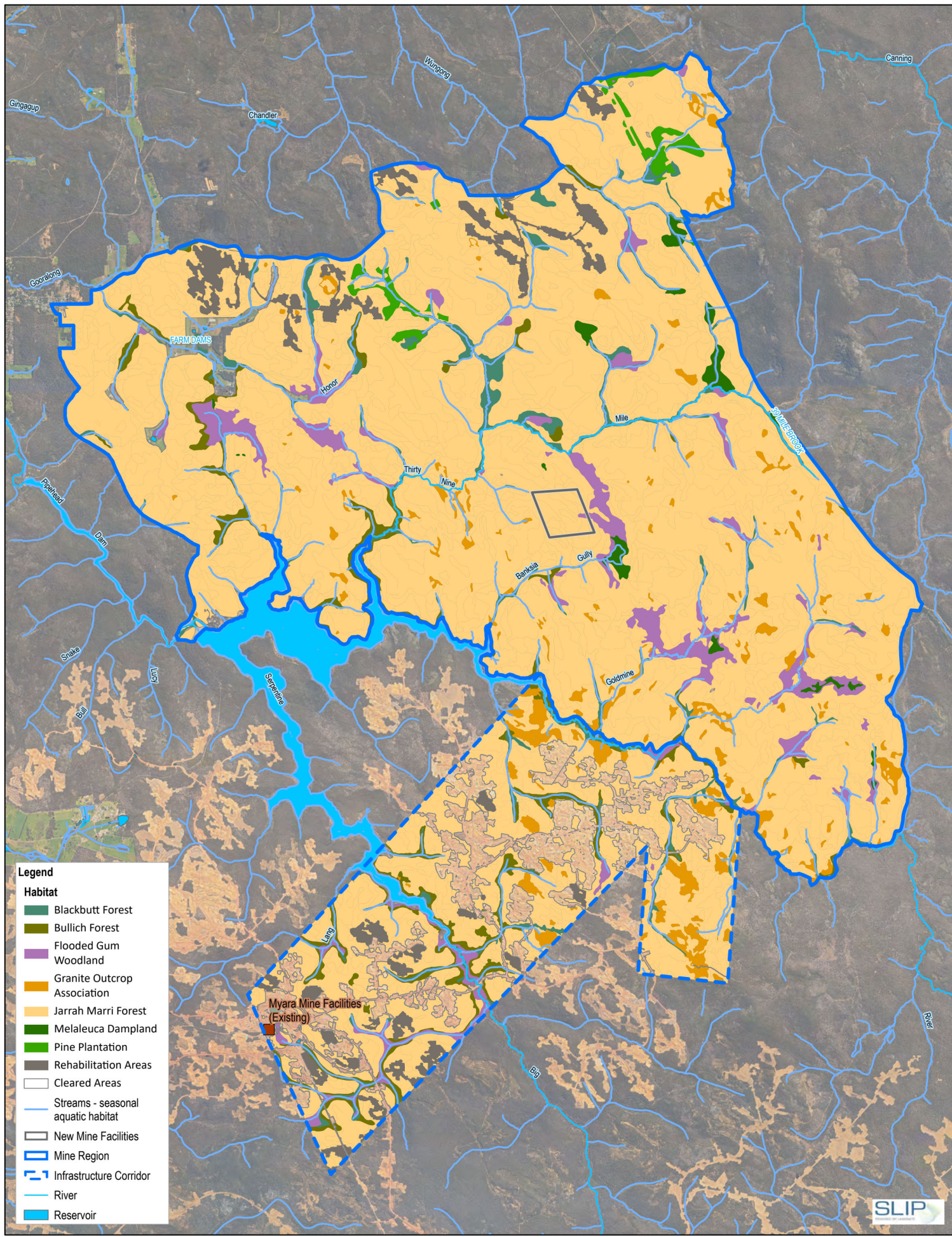
The Development Envelope lies upstream of perennial surface waters, including Serpentine Dam, South Dandalup Dam, Wungong Dam and the Murray River, which are known or highly likely to support populations of aquatic fauna. The presence of dams is expected to have disrupted aquatic fauna migrations from downstream rivers. Murray River remains undammed and has potential to support migrations of aquatic fauna, however the river has elevated salinity from its cleared agricultural upper catchment.

Table 4-7 Fauna habitats present in the Development Envelope

Description	Area (ha)	Proportion of Development Envelope (%)
<p>Blackbutt Forest Blackbutt open forest with occasional Bullich, and Marri over sparse <i>Banksia littoralis</i> over <i>Trymalium</i>, <i>Macrozamia</i>, <i>Xanthorrhoea preissii</i>, over <i>Lepidospermum tetraquetrum</i>, <i>Asterlea scoparia</i> and areas of dense Swamp peppermint (<i>Taxandria linearifolia</i>). This habitat is limited to localised patches often associated with creeks and drainage lines. Disturbance factors include frequent fire, feral pigs, dieback, trail bike and 4WD</p> <p>Habitat for EPBC Act listed species: Quokka and Chuditch. Breeding and roosting habitat for all three Black Cockatoo species.</p>	1416	3.42
<p>Bullich forest Valleys and drainage areas dominated by Bullich (<i>Eucalyptus megacarpa</i>) and with some Blackbutt (<i>E. patens</i>), occasional Marri (<i>Corymbia calophylla</i>), over Sheoak (<i>Allocasuarina fraseriana</i>), <i>Banksia littoralis</i> over Grass trees (<i>Xanthorrhoea preissii</i>), Bracken fern, patches of dense <i>Gahnia trifida</i> shrubland over <i>Lasiopetalum floribundum</i>, 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 Myara North DE. Disturbance factors include frequent fire, feral pigs, dieback.</p> <p>Habitat for EPBC Act listed species: Black Cockatoos, Chuditch, Quokka.</p>	1429	3.45
<p>Flooded Gum woodland Flooded Gum (<i>E. rudis</i>) open woodland with occasional Blackbutt, over open to open to sparse <i>Banksia littoralis</i> over Prickly Moses (<i>Acacia pulchella</i>), myrtaceous species such as Swamp peppermint (<i>Taxandria linearifolia</i>), <i>Asterlea scoparia</i> <i>Trymalium odoratissimum</i>, 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. Disturbance factors include frequent fire, feral pigs.</p> <p>Habitat for EPBC Act listed species: Chuditch and potential foraging habitat for Black Cockatoos. In areas of dense Myrtaceous thicket (low fire frequency) this provides refuge and movement corridors for Quokka.</p>	1690	4.08

Description	Area (ha)	Proportion of Development Envelope (%)
<p>Granite outcrop Granite outcrops with associated lithic vegetation complexes and adjacent associated fringing open Jarrah and Marri areas with scattered Sheoak, Melaleuca, <i>Banksia ilicifolia</i> 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 throughout the Survey Area. Disturbance factors include frequent fire, feral pigs, dieback, damage caused by rock removal, trail bike and 4WD on granite.</p> <p>Habitat for EPBC Act listed species: Foraging and denning habitat for Chuditch. Fringing open forest provides foraging and potential breeding habitat for Black Cockatoo species.</p>	926	2.24
<p>Jarrah – Marri forest <i>E. marginata</i> and <i>C. calophylla</i> open forest over Grass trees (<i>Xanthorrhoea preissi</i>), <i>Lasiopetalum floribundum</i>, <i>Macrozamia</i> mid shrubland. Patches have dominance of understory <i>Allocasuarina fraseriana</i> and <i>Banksia grandis</i>. Often with complex mosaic of low shrubs such as Fabaceae, <i>Hibbertia</i>, <i>Leucopogon</i>, <i>Adenanthos</i>, and <i>Pteridium</i>. 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 disturbances include frequent fire (significant), feral pigs, dieback, trail bike, 4WD and dumped rubbish including weed plants.</p> <p>Habitat for EPBC Act listed species: Chuditch. Foraging and potential roosting habitat for all three locally occurring Black Cockatoo (<i>Calyptorhynchus</i>) species. Breeding habitat for all three Black Cockatoo species.</p>	30,107	72.72
<p>Melaleuca dampland Paperbark (<i>Melaleuca pressiana</i>) over sparse isolated <i>Banksia littoralis</i> over open <i>Hakea</i>, occasional Woody Pear (<i>Xylomelum</i>), Grass trees and over mixed shrublayer of Cyperaceae, Restionaceae, <i>Babingtonia</i>, <i>Jacksonia</i> and <i>Acacia</i>, 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. Disturbance factors include frequent fire and feral pigs.</p> <p>Habitat for EPBC Act listed species:</p>	220	0.53

Description	Area (ha)	Proportion of Development Envelope (%)
Foraging habitat for all three locally occurring Black Cockatoo (<i>Calyptorhynchus</i>) species although Jarrah and Marri are generally stunted and sub-optimal for potential breeding habitat. Where creek lines or dense vegetation is present Quokka reside.		
<p>Mine rehabilitation</p> <p>Historical mine rehabilitation (> 20 years old) of the Huntly Mine and former Jarrahdale Mine. This is historical 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.</p>	3353	8.10
<p>Pine plantation</p> <p>These are monocultures of Pine timber tree species (<i>Pinus</i>). They represent very high quality foraging habit for Carnaby's and Baudin's Cockatoos. They tend to be devoid of understory and ground layer vegetation and lack habitat values for most other native vertebrates.</p>	162	0.39
Cleared areas	1638	3.96
Unsurveyed	463	1.12
Total Area	41,403	100.00



Fauna diversity

GHD (2021a, 2021b) reported that a total of 233 terrestrial vertebrate fauna species have potential to occur within the Development Envelope, based on desktop review of published data and previous surveys in the vicinity. The vertebrate fauna included 33 mammals, 133 birds, 43 reptiles and 14 amphibians previously recorded within a 20 km search radius of the proposed centroids of the Development Envelope. The detailed and targeted fauna surveys (GHD 2021a, 2021b) recorded 175 vertebrate fauna species, including 28 mammals, 104 birds, 34 reptiles and 7 amphibians.

The Development Envelope aquatic habitats are considered to potentially have high beta diversity, which is a characteristic of interconnected ephemeral, seasonal and permanent waterways (WRM 2021). Seasonal and ephemeral waterbodies support important ecosystem processes and services, and often high biodiversity (Boulton 2014 as cited in WRM 2021). As well, shallow sub-surface flows can be critical for the transport of energy, water, nutrients and sediments to permanent surface waters downstream, and may also support a diversity of hyporheic biota (Leigh et al. 2013 as cited in WRM 2021).

EPBC Act listed fauna species

GHD (2021a, 2021b) assessed the likelihood of occurrence of EPBC Act listed threatened and migratory fauna within the Development Envelope. In total six species of threatened fauna are known or likely to occur in the Mine DE, as presented in Table 4-8 and Figure 4-8:

- 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.

Threatened species that were assessed as unlikely to occur in the Development Envelope include the Numbat (*Myrmecobius fasciatus*), Noisy Scrub Bird (*Atrichornis clamosus*) and Malleefowl (*Leipoa ocellata*). The Development Envelope may include suitable habitat for these species and Numbat and Malleefowl have previously been recorded in the Development Envelope (see Figure 4-8) and the Noisy Scrub Bird previously recorded south of Dwellingup. The Noisy Scrub bird was translocated into sites in the Northern Jarrah Forest from 1997-2003, however monitoring indicates that establishment of permanent populations was unsuccessful. The three species were not recorded during surveys in the Development Envelope nor recorded in the vicinity of the Development Envelope in recent decades and accordingly are considered locally extinct. In the event of sustained feral predator control over the Northern Jarrah Forest there may be potential to reintroduce these species into the Development Envelope at some point in the future.

No migratory bird species were recorded in the Development Envelope during fauna surveys (GHD 2021a, 2021b) nor are they likely to occur due to the lack of wetland habitats favoured by the species. The Flooded Gum Woodland and Melaleuca Dampland habitats are seasonally waterlogged and may have areas that are seasonally inundated, however they do not contain large areas of wading habitat with mudflat, grasses, sedges, rushes or reeds. Similarly, the Development Envelope is unlikely to support populations of threatened birds

that use such wetland habitats, such as the Australasian Bittern (*Botaurus poiciloptilus*) and Australian Painted Snipe (*Rostratula australis*).

The threatened aquatic invertebrate Carters Freshwater Mussel (*Westralunio carterii*) is known or likely to occur in the artificial perennial waterbodies (reservoirs) adjacent and downstream of the Development Envelope. The species may also occur in Kennedy's Pool and Mundalup Pool upstream of the Holyoake mine region and in farm dams on Gooralong Brook within the Myara North mine region. The species may disperse from the reservoirs into the Development Envelope in the form of glochidia cysts attached to fish that swim upstream during periods of seasonal stream flow. Any juveniles that detach from their fish hosts and settle into sediments of seasonal streams or swamps are expected to die off during the subsequent sustained dry period (> 6 months) each year. The species was not recorded within the during targeted surveys of streams within the Development Envelope (GHD 2021a, 2021b), either as live specimens or dead (e.g. shells, middens).

Black Cockatoo habitat

All three threatened Black Cockatoo species were recorded in the Development Envelope, as presented in Figure 4-8 and Table 4-8, with Forest Red Tailed Black Cockatoos (FRTBC) recorded at numerous locations at both Myara North and Holyoake.

Assessment of foraging habitat based on foraging evidence and presence of foraging species indicates that the Development Envelope is predominantly high quality foraging habitat due to the prevalence of Jarrah forest, which contains key foraging species including Marri, Jarrah and proteaceous species. Myara North comprises approximately 80 per cent high quality foraging habitat for FRTBC and approximately 75 per cent high quality foraging habitat for Baudin's and Carnaby's Cockatoos. Other fauna habitats provide low to medium quality foraging habitat, with pine plantations providing foraging habitat for Baudin's and Carnaby's Cockatoos. Holyoake is also predominantly high quality foraging habitat due to the prevalence of Jarrah forest, comprising 72 per cent high quality habitat for FRTBC and 69 per cent high quality habitat for Baudin's and Carnaby's Cockatoo. Holyoake has a higher proportion of medium quality foraging habitat due to the more extensive mine rehabilitation, which comprises immature foraging species of Jarrah and Marri with a comparatively lower density of foraging.

The Myara North mine region is known to support breeding by FRTBC as well as Baudin's Cockatoo in the southern area (T. Kirkby, pers. comm). Carnaby's Cockatoo breeding is suspected to occur near Solus Road in the Myara North infrastructure corridor, but is not confirmed, with the nearest confirmed breeding site approximately 6 km to the north at 31 Mile Brook and 5km to the west near the Darling Scarp (T. Kirkby, pers. comm.). The Holyoake mine region is known to support breeding by FRTBC, with the nearest Baudin's Cockatoo breeding record approximately 30 km to the north at Myara North, and the nearest Carnaby's Cockatoo breeding record approximately 18 km to the east near Bannister (T. Kirkby, pers. comm).

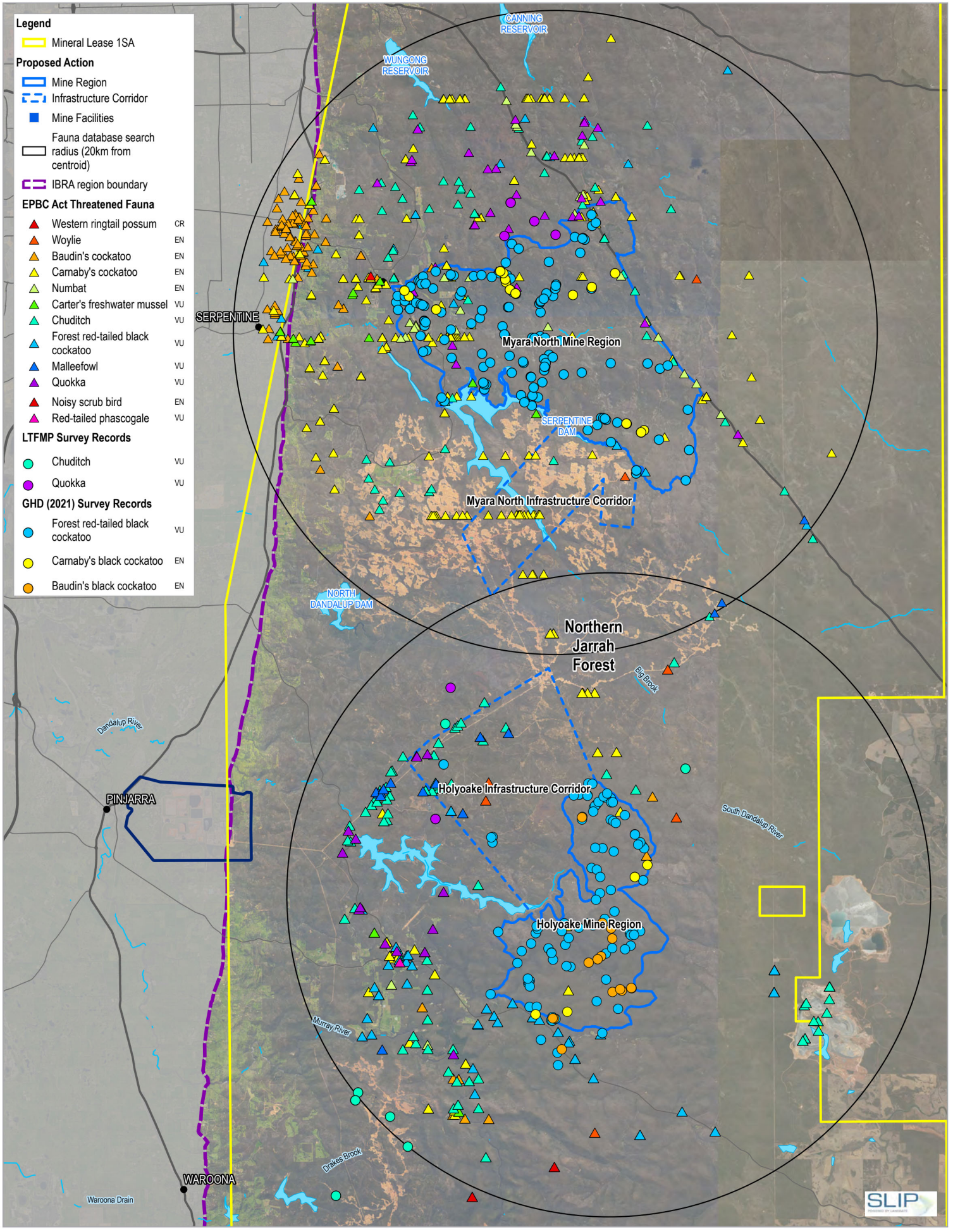
One roost site was recorded in the Myara North mine region and none within the Holyoake mine region, however it is highly likely that roosting occurs at multiple locations within the Development Envelope, due to the large number of birds recorded at Myara North (854 consisting of 443 Carnaby's, 40 Baudin's and 371 FRTBC) (GHD 2021a) and at Holyoake (119 consisting of 15 Carnaby's, 4 Baudin's and 100 FRTBC) (GHD 2021b) and the large areas of high quality foraging habitat and presence of water sources. Carnaby's and Baudin's

Cockatoos mainly use night roost sites in non-breeding areas, whereas both breeding and non-breeding FRTBC may use roost sites (DSEWPaC 2012).

Table 4-8 EPBC Act listed fauna occurrence in the Development Envelope

Species	Conservation Status EPBC Act	Likelihood of occurrence	Suitable habitat types (high and medium value) in the Mine DE
Baudin's Cockatoo (<i>Calyptorhynchus baudinii</i>)	Endangered	Known Recorded in the Myara North and Holyoake DEs (GHD 2021a; GHD 2021b).	<ul style="list-style-type: none"> • Bullich forest • Granite outcrop (fringing open forest) • Blackbutt forest • Flooded gum woodland • Jarrah-Marri forest • Melaleuca dampland • Mine rehabilitation
Carnaby's Cockatoo (<i>Calyptorhynchus latirostris</i>)	Endangered	Known Recorded in the Myara North and Holyoake DE (GHD 2021a; GHD 2021b).	<ul style="list-style-type: none"> • Bullich forest • Granite outcrop (fringing open forest) • Blackbutt forest • Flooded gum woodland • Jarrah-Marri forest • Melaleuca dampland • Mine rehabilitation
Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>)	Vulnerable	Known Recorded in the Myara North and Holyoake DE (GHD 2021a; GHD 2021b).	<ul style="list-style-type: none"> • Bullich forest • Granite outcrop (fringing open forest) • Blackbutt forest • Flooded gum woodland (potential foraging) • Jarrah-Marri forest (foraging, breeding and potential roosting) • Melaleuca dampland (foraging) • Mine rehabilitation
Woylie (<i>Bettongia penicillata ogilbyi</i>)	Endangered	Likely to occur at least on an occasional basis in the Holyoake DE (GHD 2021b).	<ul style="list-style-type: none"> • Bullich forest • Blackbutt forest • Flooded gum woodland • Jarrah-Marri forest • Melaleuca dampland • Granite outcrop • Mine rehabilitation

Species	Conservation Status EPBC Act	Likelihood of occurrence	Suitable habitat types (high and medium value) in the Mine DE
Chuditch (<i>Dasyurus geoffroii</i>)	Vulnerable	Known Recorded in Myara North and Holyoake DE (GHD 2021a; GHD 2021b).	<ul style="list-style-type: none"> • Bullich forest • Granite outcrop (foraging and denning) • Blackbutt forest • Flooded gum woodland • Jarrah-Marri forest • Melaleuca dampland • Mine rehabilitation
Quokka (<i>Setonix brachyurus</i>)	Vulnerable	Known Recorded in Myara North and Holyoake DE (GHD 2021a; GHD 2021b).	<ul style="list-style-type: none"> • Jarrah-Marri forest • Bullich forest • Blackbutt forest • Granite outcrop • Flooded gum woodland • Melaleuca dampland • Mine rehabilitation
Carter's Freshwater Mussel (<i>Westralunio carteri</i>)	Vulnerable	<p>Likely / Known – downstream perennial water bodies. Recorded downstream of Holyoake DE (GHD 2021b).</p> <p>Potential – Kennedy's Pool, Mundalup Pool, farm dams</p> <p>Unlikely – seasonal streams, seasonal river pools and swamps</p>	<ul style="list-style-type: none"> • Artificial perennial water bodies (drinking water reservoirs) downstream of the Mine DE • Kennedy's Pool and Mundalup Pool upstream of Holyoake mine region • Farm dams in Myara North mine region



- Legend**
- Mineral Lease 1SA
- Proposed Action**
- Mine Region
 - Infrastructure Corridor
 - Mine Facilities
 - Fauna database search radius (20km from centroid)
 - IBRA region boundary
- EPBC Act Threatened Fauna**
- | | |
|--|----|
| ▲ Western ringtail possum | CR |
| ▲ Woylie | EN |
| ▲ Baudin's cockatoo | EN |
| ▲ Carnaby's cockatoo | EN |
| ▲ Numbat | EN |
| ▲ Carter's freshwater mussel | VU |
| ▲ Chuditch | VU |
| ▲ Forest red-tailed black cockatoo | VU |
| ▲ Malleefowl | VU |
| ▲ Quokka | VU |
| ▲ Noisy scrub bird | EN |
| ▲ Red-tailed phascogale | VU |
- LTFMP Survey Records**
- | | |
|--|----|
| ● Chuditch | VU |
| ● Quokka | VU |
- GHD (2021) Survey Records**
- | | |
|--|----|
| ● Forest red-tailed black cockatoo | VU |
| ● Carnaby's black cockatoo | EN |
| ● Baudin's black cockatoo | EN |

Paper Size ISO A3
 0 1 2 3 4
 Kilometres



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

Alcoa of Australia Limited
 Huntly Bauxite Mine Transition - Myara
 North and Holyoake - EPBC Act Referral

Project No. 12520591
 Revision No. 0
 Date 28/03/2022

EPBC listed fauna species

FIGURE 4-8

4.3.3 Existing management

Huntly Mine fauna studies and long term monitoring

Alcoa has undertaken studies into terrestrial fauna (vertebrates and invertebrates) of the Jarrah forest for over 40 years, with particular emphasis on fauna recolonisation into rehabilitated mine areas (Craig et al 2012, Craig et al 2015, Cross et al 2019, Nichols and Grant 2007, Majer et al 2007). The studies have indicated a high recolonisation by birds and most reptiles, and varying recolonisation by mammals depending on their habitat preferences and distribution within the Jarrah forest (Craig et al 2012, Nichols and Grant 2007, Majer et al 2007). The studies have provided knowledge on species ecology including habitat needs such as coarse woody debris (e.g. stumps and logs) and rockpiles, as well as improving survey methods for invertebrate fauna.

Alcoa established a Long Term Fauna Monitoring Program (LTFMP) to assess progress towards Alcoa's rehabilitation objectives of establishing self-sustaining Jarrah forest ecosystems including the full diversity of fauna that typically occurred pre-mining. Monitoring commenced at the mine in 1992 and was repeated in 1995, 1998, 2001, 2006 and 2011 (Alcoa 2012), and more recently at the Willowdale Mine to the south of Huntly Mine. Monitoring involved representative control (upland forest and stream zone) sites and rehabilitated mine sites.

The LTFMP findings indicated that stream zones were the most species rich, diverse and abundant sites for birds compared to upland forest and rehabilitated sites. Mammal species recorded a similar community composition between rehabilitated and un-mined sites, with stream zones identified as important habitat. Chuditch was recorded at very low densities at the mine during targeted surveys, and Quokkas were recorded at Huntly and Jarrahdale mines including a rehabilitated site. Reptiles were recorded at lower diversity and abundance in rehabilitated sites compared to un-mined sites, suggesting a lack of thermal conditions and habitat. Coarse woody debris was identified as important habitat for some reptile and invertebrate species that were infrequently observed or absent from rehabilitation sites (Alcoa 2012).

Huntly Mine fauna management

Alcoa manages impacts to fauna through pre-mining fauna surveys as well as Threatened Species Management Plans (Alcoa 2010). Elements of the Threatened Species Management Plans include:

- Pre-mine surveys to identify critical breeding habitat for all three listed black cockatoo species, and amendment of mine plans to protect these features.
- Protection of larger areas containing high densities of critical breeding habitat for black cockatoos, including collaboration with DBCA to establish Fauna Habitat Zones.
- Contribution of funding to the Chuditch recovery plan, which succeeded in moving the species from Endangered to Vulnerable in 2001.
- Contribution of funding to the Western Shield feral animal control program since its inception in 1998.
- Contribution of funding to Black Cockatoo research to understand breeding success, forage value of restored areas, and forest habitat value in relation to water availability.
- Provision of constructed fauna habitat at a target rate of one per hectare in rehabilitated sites, comprising woody material, rocks and soil to assist recolonization by selected species with specialist habitat requirements.

- Design and construction of fauna underpasses for haul road stream crossings to aid movement of fauna including threatened species such as quokka (Alcoa 2015).
- Support for prescribed burning (excluding swamps) to minimise species and habitat loss from large scale, hot wildfires.

4.3.4 Potential impacts

The Proposed Action may cause direct impacts to Black Cockatoos (FRTBC, Carnaby's Cockatoo, Baudin's Cockatoo), Chuditch, Woylie and Quokka through clearing of vegetation for mining or new mine infrastructure for the Development Envelope, or injury/mortality from fauna entrapment or vehicle/equipment collisions.

The Proposed Action is unlikely to directly impact habitat for Carters Freshwater Mussel, as the species is unlikely to persist in the seasonally flowing streams or seasonal river pools within the Development Envelope. The Proposed Action will not result in direct impacts to potential habitat for Carters Freshwater Mussel in farm dams on Gooralong Brook, in Kennedy's Pool or Mundalup Pool upstream of Holyoake, or in drinking water reservoirs downstream of the Development Envelope.

The Proposed Action is unlikely to cause impacts to EPBC listed migratory fauna as the Development Envelope does not contain suitable habitat for these species and lies away from their preferred coastal and wetland habitats on the Swan Coastal Plain.

The Proposed Action may cause the following indirect impacts to threatened fauna:

- Introduction and/or spread of weeds.
- Introduction and/or spread of dieback.
- Facilitation of feral animal dispersal through cleared areas.
- Noise emissions from construction and operational equipment.
- Spills and/or leaks from storage and handling of hazardous materials and waste.

4.4 Topography, soils and hydrology

4.4.1 Baseline and impact assessment studies

Table 4-9 lists the baseline and impact assessment studies conducted for the Proposed Action with respect to hydrology and water quality. The study reports are currently being finalised and the findings are summarised in this referral.

Table 4-9 Topography, soil and hydrology baseline studies

Author (Year)	Study Name
GHD (2021c)	Hydrology and Water Quality Assessment Component studies: <ul style="list-style-type: none">• Baseline Surface and Ground Water Monitoring Report – Myara North and Holyoake• Hydrological Setting and Understanding – Myara North and Holyoake• Groundwater Modelling Report for Huntly Mine – Myara North• Groundwater Modelling Report for Huntly Mine – Holyoake• Drinking Water Risk Assessment – Serpentine, Serpentine Pipehead, South Dandalup, and Wungong Brook Catchments

4.4.2 Receiving environment

Topography, geology and soils

The mine lies on the Darling Plateau, which has elevations ranging from about 240 m to 370 m above sea level.

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 0.5 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.

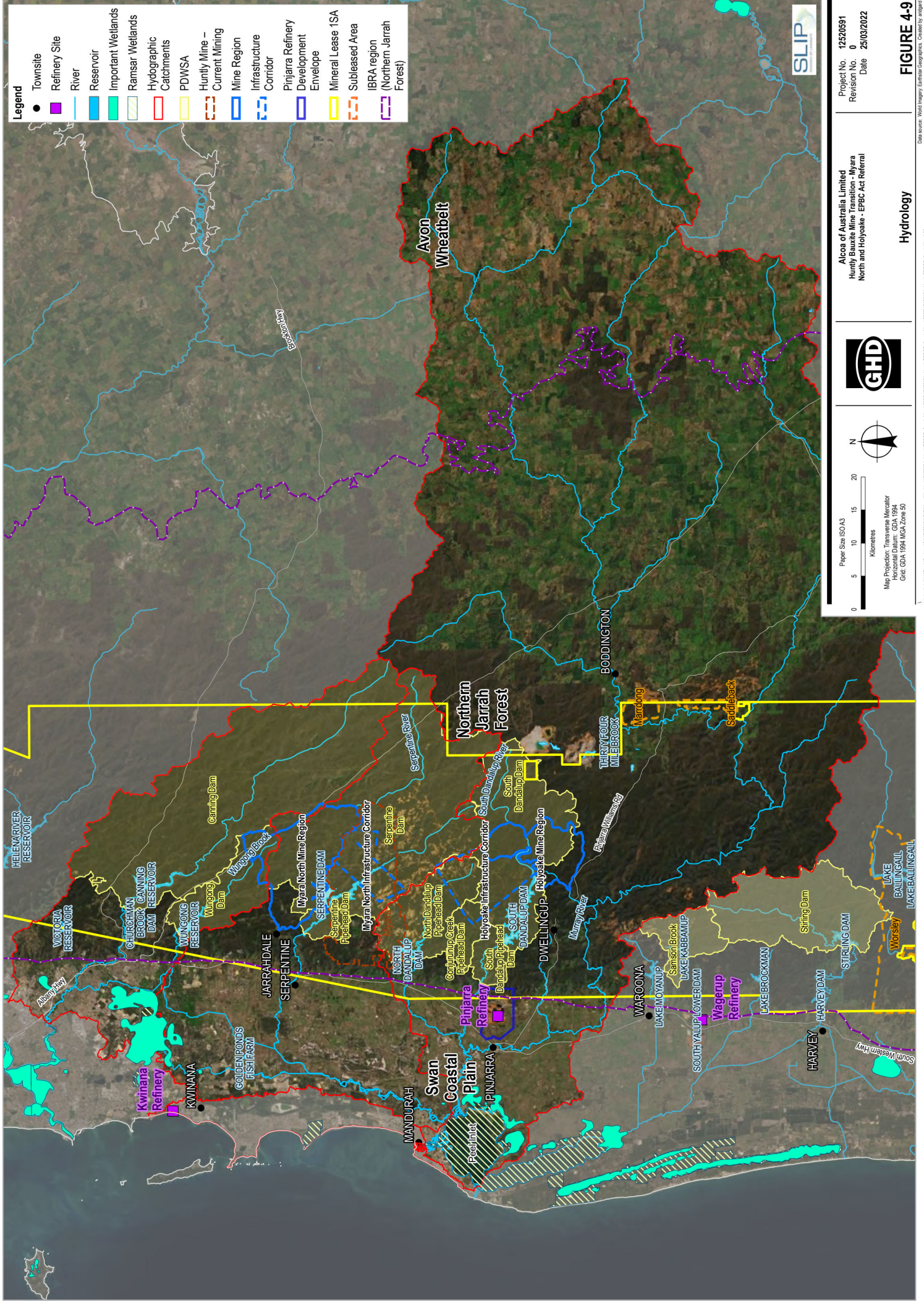
The regolith is partially or fully eroded in valleys that dissect the Darling Plateau, with the upper lateritic layers often absent and replaced by colluvial or alluvial deposits (Hickman et al 1992, Fordyce et al 2007). In some areas the regolith is fully eroded to expose bedrock.

Surface hydrology

Streams within the Development Envelope are predominantly (85 per cent) first or second order streams and streamflow is seasonal. These streams flow only after winter and spring rains have saturated surrounding soils causing runoff and seepage to occur. Some higher order streams in the high rainfall zone have historically supported perennial base flows, however there has been a widespread reduction in annual flows across the Jarrah forest, with an increasing proportion of seasonal flows, related to a drying climate and resultant declining groundwater storage and disconnection of groundwater from valley floors (Grigg and Hughes 2018, Hughes et al 2012, Petrone et al 2010, Silberstein et al 2012). There are no natural perennial watercourses within the Development Envelope. The ephemeral waterways and downstream man-made drinking water reservoirs (e.g. Serpentine Dam) support aquatic fauna species including native fish and macroinvertebrates. Seasonally waterlogged swamps lie over the valley floors, containing vegetation communities distinct from the upland Jarrah forest and providing important habitats for terrestrial flora and fauna (see Section 4.2.1 and Section 4.3.1).

The Development Envelope predominantly (88 per cent) lies within catchment areas of public drinking water supply dams, including the Serpentine Dam, South Dandalup Dam, North Dandalup Dam and Wungong Dam (see Figure 4-9). The Serpentine Dam and North Dandalup Dam release limited flows (less than ten per cent of inflows) to downstream rivers and the South Dandalup Dam and Wungong Dam release no water to downstream rivers.

The remaining 12 per cent of the Development Envelope lies in un-regulated catchments of the Serpentine River and Murray River, which flow west through the Swan Coastal Plain and discharge into the Peel Inlet, part of the Peel-Yalgorup Ramsar wetlands.



- Legend**
- Townsite
 - Refinery Site
 - River
 - Reservoir
 - Important Wetlands
 - Ramsar Wetlands
 - Hydrographic Catchments
 - PDWSA
 - Hurly Mine – Current Mining
 - Mine Region
 - Infrastructure Corridor
 - Pinjarra Refinery Development Envelope
 - Mineral Lease TSA
 - Subleased Area
 - IBRA region (Northern Jarrah Forest)

Project No. 12520591
 Revision No. 0
 Date 25/03/2022



Alcoa of Australia Limited
 Huntly Bauxite Mine Transition - Myara
 North and Holyoake - EPBC Act Referral

Hydrology

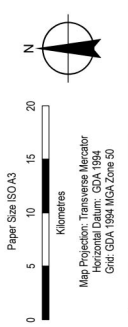


FIGURE 4-9

Data source: Wood Energy; Esri; Natural Resources Australia; Geoscience Australia; Google Earth; Department of Water and Environmental Conservation
 Project: 12520591
 Date: 25/03/2022
 Print date: 25 Mar 2022 - 14:49

Groundwater

The mine lies over the Darling Plateau which comprises of a weathered regolith typically 20 m to 30 m in depth with unconfined aquifers. In the higher rainfall areas of the Plateau, depths to groundwater in stream zones range from 0 m to 10 m below ground level. Groundwater saturated thickness decreases on hill slopes away from stream zones with limited groundwater above bedrock on hilltops and ridgelines. Groundwater exists in rock fractures within the first few metres of unweathered bedrock and in sediments laid down along creek lines or which have accumulated in valleys. There may be localised areas of groundwater held in seasonally perched water tables in caprock overlying relatively less permeable pallid zone clays. Due to the clayey nature of the weathered profile nearly all water bores have very low yields and there is no groundwater abstraction at the mine.

Water quality

Historic water quality monitoring over the Myara North mine region is available from the 1970s to 1990s, though discontinuous and limited to salinity, pH and some turbidity data (GHD 2021d). Historic monitoring indicates that surface water salinity is fresh (less than 500 mg/L total dissolved salts [TDS]) in streams west of the 1100 mm/year rainfall isohyet. Peak salinity levels increase in streams east of the 1100 mm/year isohyet, with median salinity remaining fresh. pH is typically neutral with some streams recording minimum pH in the acidic range. Turbidity monitoring in the Myara North mine region indicates median turbidity below 1.5 nephelometric turbidity units (NTU). DWER monitoring indicates turbidity ranging from 1.6 to 2.6 NTU (GHD 2021c).

GHD (2021c) undertook baseline surface water monitoring at 20 sites within the Myara North mine region between August 2020 and January 2021. Baseline surface water monitoring included all major tributaries of Serpentine Dam, Gooralong Brook and Wungong Brook. The results indicate that surface water is similar across the Myara North mine region, being fresh and relatively un-impacted by anthropogenic use.

Historic water quality monitoring of the Holyoake mine region has been limited to a site on Davis Brook, with discontinuous records from the 1970s to 1990s and data limited to salinity, pH and some turbidity data (GHD 2021d). Historic monitoring indicates that surface water is typically fresh, with a median EC below 350 $\mu\text{S}/\text{cm}$. Limited pH data is available for gauging locations which indicates that the median pH of tributaries is neutral. Baseline turbidity for monitoring locations in the South Dandalup catchment are marginally higher than Myara North, with median values ranging between 0.9 and 7.3 NTU.

GHD (2021d) undertook baseline surface water monitoring at 15 sites within the Holyoake mine region between August 2020 and January 2021. Baseline surface water monitoring included South Dandalup River, Davis Brook and Swamp Oak Brook. The results indicate that surface water is similar across the Holyoake mine region, being fresh and relatively un-impacted by anthropogenic use.

Matters of National Environmental Significance

The drinking water reservoirs downstream of the Development Envelope are known or likely to support populations of the EPBC Act listed threatened aquatic species *Westralunio carteri* (Carter's Freshwater Mussel) (see Section 0). The species is unlikely to occur in the Development Envelope as streamflow is seasonal and streams and swamps dry up for about six months of the year. There are no large permanent river pools identifiable on the Serpentine River within or upstream of the Myara North mine region and river pools

identifiable on the South Dandalup River are mapped as upstream of the Holyoake mine region.

The Development Envelope lies approximately 30 to 35 km to the east of the closest Ramsar wetland, the Peel-Yalgorup System. The Development Envelope predominantly lies within catchments of drinking water supply dams that retain all or most of incoming streamflow, with a very small portion of runoff released downstream into the Ramsar wetland. Any releases from the Serpentine Dam or North Dandalup Dam occur after substantial detention in the large reservoirs and are of freshwater, being suitable for drinking following chlorination.

Approximately 12 per cent of the Development Envelope lies within un-regulated catchments of the Serpentine and Murray Rivers which flow into the Peel-Yalgorup Ramsar wetland.

4.4.3 Existing studies and management

Overview of research

Alcoa, in association with the former Water and Rivers Commission, has researched the hydrology and salinity in the Jarrah forest since the 1970s (Mauger et al 1998; Croton and Reed 2007), as part of the Joint Intermediate Rainfall Zone Research Program (JIRZRP). The JIRZRP has included monitoring of surface water, groundwater and salinity as well as analysis and modelling of the Intermediate Rainfall Zone (IRZ). The JIRZRP was overseen by the Bauxite Hydrology Committee, formerly an MMPLG subcommittee, with respect to impacts on hydrology and stream zone ecology from Alcoa's bauxite mining in the Jarrah forest. The committee's objectives were to:

- Minimise salinity risks associated with mining in the Intermediate Rainfall Zone, where clearing of the natural vegetation could cause secondary salinity if not properly managed.
- Minimise impacts of mine rehabilitation on catchment water yields and riparian ecosystems caused by high water use of dense, regrowth forests.

Jarrah forest hydrology and mining effects on streamflow

Alcoa has undertaken joint research to better understand hydrological processes leading to streamflow in the NJF and the interaction of bauxite mining with these processes. Studies have included long-term paired catchment experiments (Grigg 2017), development and testing of runoff models (Grigg and Hughes 2018), and vegetation water use studies since evapotranspiration forms the largest loss component of the water balance in this environment (Macfarlane et al 2010, Macfarlane et al 2018). These studies demonstrate that where groundwater is connected to the valley floor, clearing for mining results in a relative increase in streamflow followed by a return to the unmined situation as the restored forest develops. The response is superimposed on longer-term streamflow trends related to a drying climate (Petroni et al 2010).

Trial Mining Project

The Trial Mining Project (TMP) was a key investigation into the impact of bauxite mining in the IRZ. The TMP covered the Cameron experimental catchments, located approximately 15 km north-east of Dwellingup (Croton et al 2011). The TMP comprised a long-term monitoring program (1988-2016) for streamflow, salinity and groundwater responses to bauxite mining. Mining occurred from 2003 to 2011 and rehabilitation from 2006 to 2013. Prior to mining the Cameron catchment was managed as State forest including timber harvesting and prescribed burning in the 1990s up to 2002 (Croton et al 2011). The Cameron experimental

catchments comprised three catchments subject to mining, varying from approximately 190 ha to 4580 ha and involving mining over 13% to 33% of their extent. A fourth catchment of approximately 210 ha was not subject to mining and was used as a control (Croton et al 2011).

The TMP monitoring results indicated no response in streamflow or stream salinity over the Cameron experimental catchments that could be attributed to mining. The lack of stream response to mining was attributed to the absence of any interaction between surface flows in the valley floor and the deep groundwater. The declining rainfalls in the WA south-west region resulted in groundwater levels below the stream zones to decline over the study period despite mining-related groundwater mounding on hillslopes. It was concluded that further monitoring was not warranted unless rainfall exceeded 1150 mm/year to generate substantive stream flows, which had not occurred for approximately four decades (Croton et al 2011).

Salinity and flow modelling of Serpentine Reservoir

DWER, in collaboration with Alcoa, investigated the potential flow and salinity changes in the Serpentine Reservoir as a result of bauxite mining (Dixon et al 2019). The investigation was undertaken using the LUCICAT catchment model, which is used by DWER for water allocation planning in Western Australia. The modelling considered two potential mining proposals (either 9% or 12% of the catchment including parts of the Myara North mine area) and a no-mining comparison, in the context of two future climates ('average' 914 mm/year and 'dry' 841 mm/year over the Serpentine Dam catchment) to give a total of six future (2011–2050) scenarios. Under the scenarios described and assumptions used (e.g. Forest recovery trajectories over time), the modelling estimated a change in Dam inflows no greater than approximately 2 GL/year in any one year, or 5% of flow on an annual average basis (Dixon et al 2019). The modelling estimated a mining-related increase in salinity of 5.4 mg/L or 3% of reservoir salinity on an annual average. DWER considered that mining posed effects on reservoir salinity that were within acceptable limits (Dixon et al 2019). DWER noted that LUCICAT appeared to overestimate flows subsequent to strong drought years and recommended that the model be investigated in more detail to improve understanding of groundwater dynamics following strong drought years (Dixon et al 2019).

Salinity and flow modelling for the Proposed Action

GHD (2021c) undertook a Hydrology and Water Quality Assessment for the Proposed Action, including modelling of the potential effects of mining on streamflow salinity and yield. The study report is being finalised and a summary is provided below.

The potential changes to the salinity of streamflow entering the Serpentine Dam and South Dandalup Dam were estimated using modelled changes in streamflow along with observed groundwater salinity. This was achieved by comparing modelled streamflow volumes and their proportional groundwater discharge component between mined and unmined cases. Modelled streamflow were converted to salt loads using observed salinity ranges.

For the Serpentine Dam reservoir, average annual salinity in inflows is estimated to range from 222 to 261 mg/L during mining and from 230 to 254 mg/L post-mining, with estimates largely dependent on the estimation of salinity of contributing groundwaters, which varies throughout the catchment. Modelling indicates that the Proposed Action has potential to result in an average of about 2 per cent decrease in salinity of inflows during mining and an average of about 5 per cent increase in salinity of inflows post-mining compared to the non-

mining case and that inflows to the Serpentine Dam are expected to fall well within the threshold of freshwater quality.

The predicted small effect of mining on inflow salinity is validated by the historic trend in salinity recorded in Serpentine Dam, which has remained in the range of 25-35 mS/m (250-350 μ S/cm) over the past 20 years despite clearing of approximately 10 per cent of the catchment, including the O'Neil and McCoy mine regions that lie within the IRZ. The historic variation in salinity recorded in Serpentine Reservoir follows the trend of reservoir inflows, rising over extended periods of low inflows and decreasing in response to higher inflows.

For the South Dandalup Dam reservoir, average annual salinity in inflows is predicted to range from 100 to 130 mg/L during mining and from 105 to 163 mg/L post-mining, with estimates largely dependent on the estimation of salinity of contributing groundwaters. Modelling indicates that the Proposed Action has the potential to result in an average of about 7 per cent increase in salinity of inflows during mining and an average of about 13 per cent increase in salinity of inflows post-mining compared to the non-mining case and that inflows to the South Dandalup Dam are expected to fall well within the threshold of freshwater quality.

Salinity monitoring data available for Wungong Dam from 2000 to 2003 indicates salinity ranging from 27-33 mS/m (270-330 μ S/cm) despite clearing of approximately 20 per cent of the catchment for the former Jarrahdale Mine. Given the smaller scale of mining proposed within Upper Wungong Brook (approximately 5 per cent of the catchment) and that the majority of the catchment lies in the high rainfall zone, it is expected that the effect on stream salinity will be comparable or less than that assessed for Serpentine Dam.

Groundwater modelling for the Proposed Action

The Hydrology and Water Quality Assessment for the Proposed Action (GHD 2021c) included groundwater modelling to assess the effects of mining on groundwater levels and potential groundwater dependent ecosystems (GDEs). The study report is being finalised and a summary is provided below.

The groundwater modelling indicates that the Proposed Action is expected to cause groundwater mounding beneath and in the vicinity of mine pits due to the clearing of native vegetation and increased recharge of rainfall. Groundwater mounding of up to 20 m is predicted to occur within the Development Envelope as mining progresses. The highest groundwater rise is predicted to occur in the vicinity of mined areas, with more limited groundwater rise in valleys where potential GDEs are located. Groundwater levels are predicted to rise over the first 15 years and then slowly decline towards an un-mined baseline. Greater mounding is predicted for wetter climatic conditions. The Proposed Action is not expected to cause groundwater declines.

Modelling for the Myara North mine region indicates that climatic variation has a major effect on depth to groundwater for A and D vegetation types (see Section 4.2.2), with depth varying by approximately 10 m between dry and wet climatic conditions. The effect is less for the C vegetation type, with depth varying by approximately 5 m between dry and wet climatic conditions. The Proposed Action is predicted to cause an average increase of approximately 1-2 m in groundwater levels at GDEs in the Myara North mine region, peaking around 2035-2040 and then slowly subsiding to approximately 0.5-1 m by 2060. Some areas of potential GDEs may be subject to rises of 2-5 m and more than 5 m in small areas.

Modelling for the Holyoake mine region also indicates that climatic variation has a major effect on depth to groundwater for the potential GDEs. The Proposed Action is predicted to cause an average increase of approximately 2-5 m in groundwater levels at GDEs in Holyoake, peaking around 2035-2040 and then slowly subsiding to approximately 0.5-1 m by 2060. Some small areas of potential GDEs may be subject to rises of more than 5 m.

The predicted modest rise in groundwater levels due to the Proposed Action is expected to partially offset the decline in levels observed since the 1990s, creating more shallow groundwater conditions that benefit potential GDEs, particularly shallower rooted vegetation. This includes threatened flora associated with shallow water, such as Tall Donkey Orchid (*Diuris drummondii*) and Dwarf Bee-orchid (*Diuris micrantha*), if these are present within the Development Envelope.

Modelling indicates that the decline in groundwater rise following mining will be gradual over a few decades, which is expected to allow any potential GDEs (including groundwater dependent threatened flora, if present) that have exploited the modest groundwater rise to adapt to the change. By contrast, groundwater levels within the Development Envelope will be dominated by climatic influences and accordingly climate change is expected to have the greatest impact to flora and vegetation associated with potential GDEs.

Mine water management

Alcoa implements preventative risk management at the mine, which incorporates multiple preventative mitigation measures or 'barriers' to prevent hazards to downstream drinking water reservoirs from occurring or reduce them to acceptable levels. The barriers act to prevent and minimise the discharge of pathogens, sediment and hydrocarbons into downstream reservoirs, which are themselves barriers to contaminant transport prior to raw water being removed at the offtakes and entering the Water Corporation's water treatment and distribution system.

Key components of the barriers include:

- Well developed drainage controls including appropriate use of drainage protection slots (stormwater infiltration beds in blasted/ripped rock) in mine pits and drainage sumps for all mine infrastructure areas.
- Roofed and sealed refuelling bays and workshops at mine facilities.
- Vehicle wash bays that drain to an oily water treatment system at mine facilities.
- Fuel and oil storage in above ground double walled tanks at mine facilities.

4.4.4 Potential impacts

The Proposed Action is unlikely to cause significant indirect impacts to populations of Carters Freshwater Mussel within reservoirs downstream of the Development Envelope, as mining will cause very minor increases in salinity inflows to reservoirs and mining incorporates multiple barriers to protect drinking water quality. Accordingly, water quality in downstream reservoirs is expected to remain fresh and fit for human consumption, which will protect the water quality for Carters Freshwater Mussel.

The Proposed Action is unlikely to cause significant indirect impacts to populations of threatened flora, if occurring within the Development Envelope, due to hydrological effects. The predicted modest rise in groundwater levels due to the Proposed Action is expected to partially offset the decline in levels observed since the 1990s, creating more shallow

groundwater conditions that benefit potential GDEs, particularly shallower rooted vegetation which may include threatened flora.

The Proposed Action has potential to cause indirect impacts to the Peel-Yalgorup System as the Development Envelope lies within the catchment of the Peel Inlet. However, the Proposed Action is highly unlikely to cause significant indirect impacts to the Peel-Yalgorup System. Eighty-eight per cent of the Development Envelope lies within the catchments of drinking water reservoirs, which release a small portion of water (if any) into downstream rivers (see Section 4.4.2) and 12 per cent of the Development Envelope lies within un-regulated catchments of the Serpentine and Murray Rivers. Given the multiple-barriers maintained to protect drinking water quality downstream of mining areas, the demonstrated minor effects of mining on reservoir salinity, and the limited mining in un-regulated catchments, the Proposal is expected to have a negligible impact to either water quantity or quality of inflows to the Peel Inlet and therefore a negligible impact to the Peel-Yalgorup System Ramsar site.

4.5 Social and heritage values

4.5.1 Baseline studies

Table 4-10 lists the baseline heritage studies conducted for the Proposed Action. The study reports are currently being finalised and the findings are summarised in this referral.

Table 4-10 Heritage baseline studies

Author (Year)	Study Name
Archae-aus (2021a)	Pinjarra Alumina Refinery Revised Proposal Aboriginal Archaeological heritage report – Myara North and Holyoake
Archae-aus (2021b)	Pinjarra Alumina Refinery Revised Proposal Historical Archaeological Assessment - Holyoake, Myara North and Pinjarra Alumina Refinery

4.5.2 Receiving environment

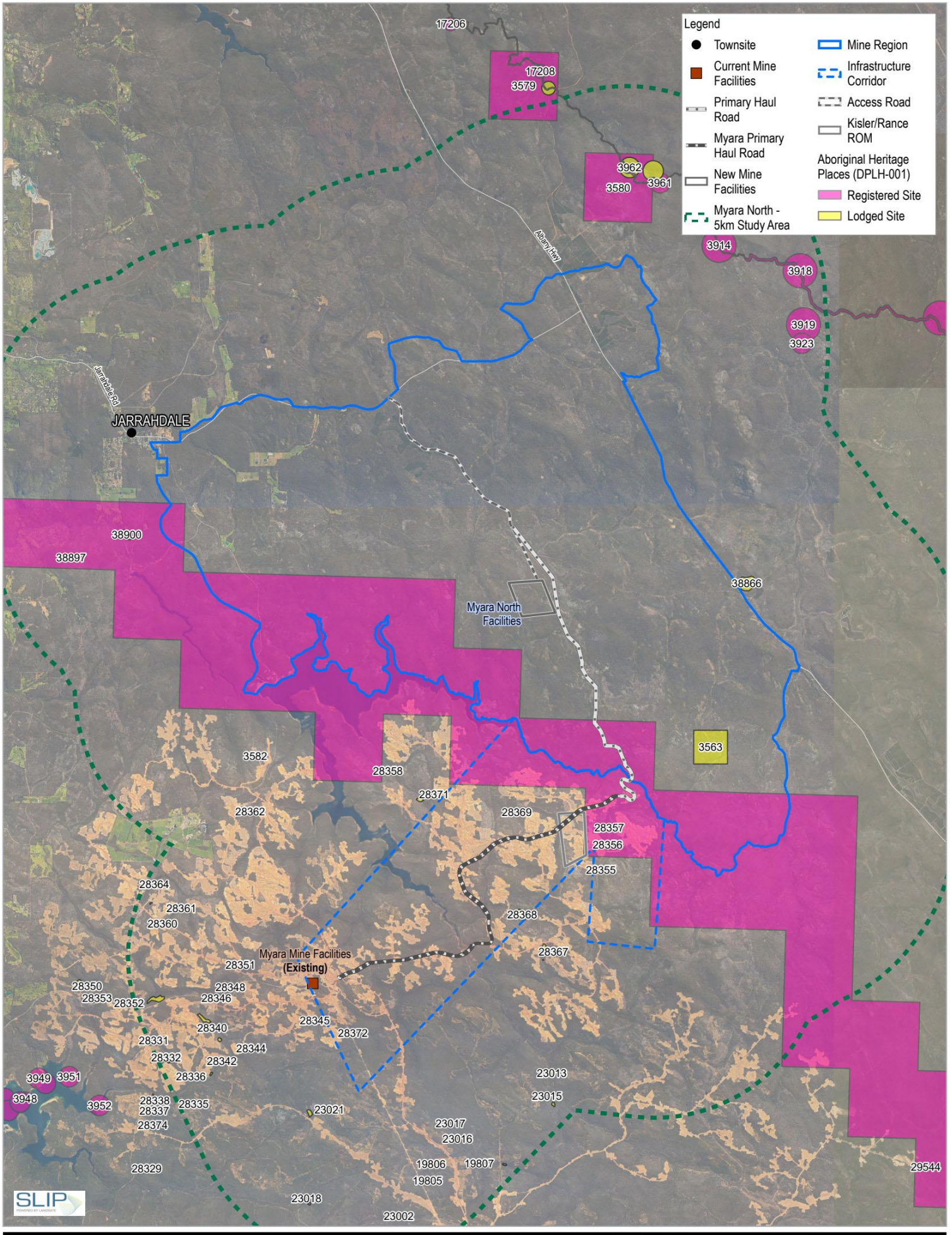
Native Title and Aboriginal heritage

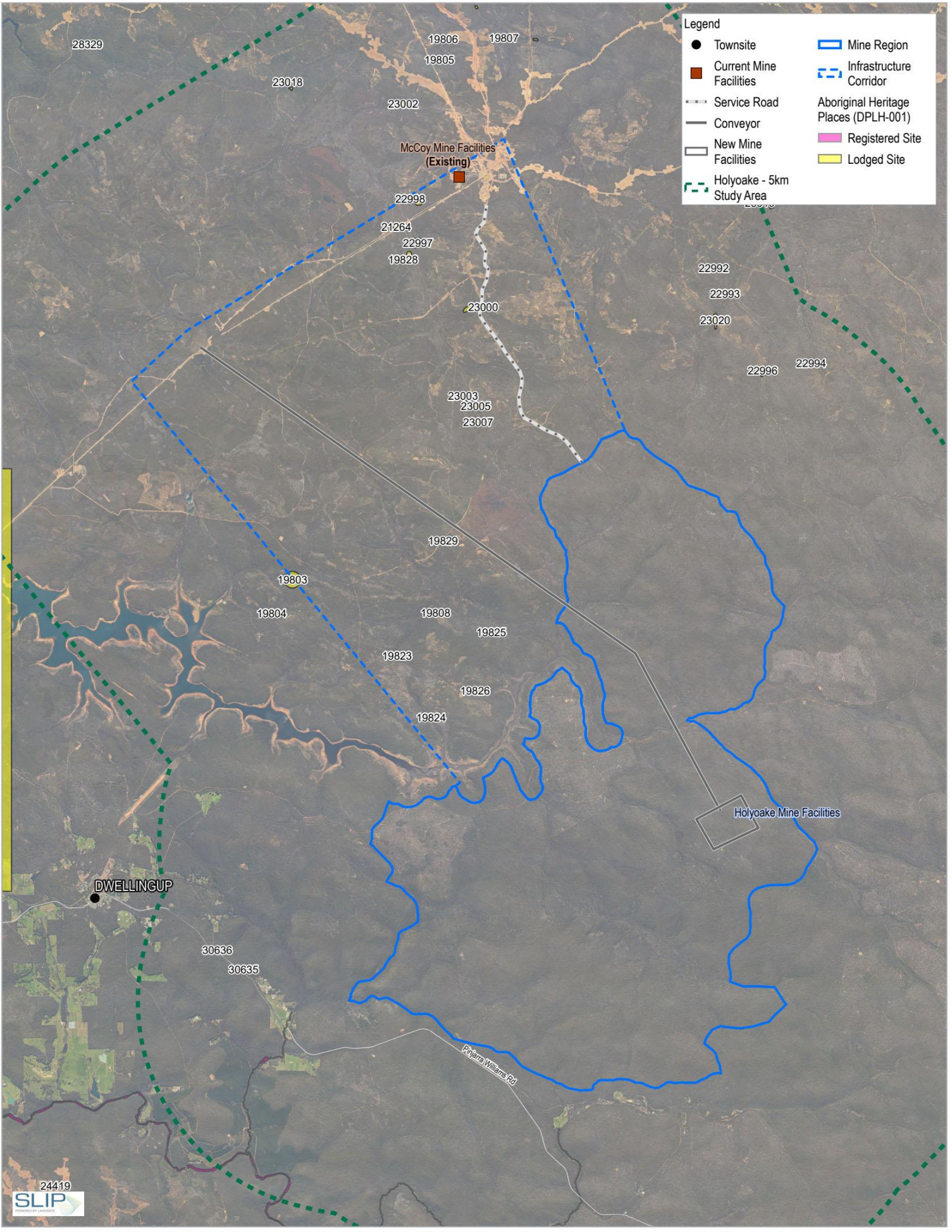
The Development Envelope lies within the South West Native Title Settlement Area, which is governed by an overarching Native Title Agreement between the South West Aboriginal Land and Sea Council (SWALSC) and the Government of WA and is referred to as the South West Native Title Settlement (the Settlement). More specifically, the Proposed Action is located within the Gnaala Karla Booja (GKB) Agreement Area (Department of Premier and Cabinet 2020).

The Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Places database records seven archaeological sites within the Myara North Development Envelope and a further 52 archaeological sites within 5 km of the Myara North Development Envelope (Figure 4-10). The DPLH database records 20 archaeological sites within the Holyoake Development Envelope and 17 archaeological sites within 5 km of the Holyoake Development Envelope (Figure 4-11).

The DPLH database records a registered ethnographic site within the Myara North Development Envelope, comprising the Serpentine River mythological / ceremonial site. The databases records three other registered / lodged ethnographic sites with mythological and

other values within 5 km of the Myara North Development Envelope. No registered / lodged ethnographic sites are recorded in the Holyoake Development Envelope, with one potential ethnographic (mythological) sites recorded within 5 km of the Holyoake Development Envelope.





Legend

- Townsite
- Current Mine Facilities
- Service Road
- Conveyor
- New Mine Facilities
- Holyoake - 5km Study Area
- ▭ Mine Region
- Infrastructure Corridor
- Aboriginal Heritage Places (DPLH-001)
- Registered Site
- Lodged Site



Paper Size ISO A3

0 1 2 3 4
Kilometres

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



Alcoa of Australia Limited
Huntly Bauxite Mine Transition - Myara
North and Holyoake - EPBC Act Referral

**Aboriginal Heritage
within Holyoake DE**

Project No. 12520591
Revision No. 0
Date 06/01/2022

FIGURE 4-11

Archae-aus (2021a) reviewed previous Aboriginal archaeological surveys in the proposed Myara North and Holyoake mine regions. The archaeological surveys covered the entire Myara North mine region plus part of the infrastructure corridor and the majority of the Holyoake mine region.

Alcoa are conducting Aboriginal heritage surveys in accordance with a Noongar Standard Heritage Agreement (NSHA) to address all survey gaps within the Development Envelope, including engagement of Aboriginal Consultants nominated by the South West Aboriginal Land and Sea Council (SWALSC). The Aboriginal heritage surveys are currently underway and will be completed by Q4 2022, prior to ground disturbing activities.

The findings of the Archae-aus (2021a) review are summarised below:

- A total of 704 isolated stone artefacts were identified and recorded during the course of the surveys, scattered across 57 individual sites of which 7 sites are recorded in the DPLH Aboriginal Heritage Places dataset and 50 sites are additional.
- Seven of the 57 sites were identified in 2013 Holyoake survey, including one site within the Holyoake mine region, three sites in close proximity (<100 m) to the mine region and three sites within 5 km of the mine region. Five sites were artefact scatters ranging from 30 m² to 841 m² and two sites were individual artefacts.
- 50 of the 57 sites were identified within or in close proximity to the Myara North mine region and predominantly comprised artefact scatters ranging from 43 m² to 9800 m² and one large artefact scatter over 76,210 m², as well as some occurrences of stone structures, scarred trees and reduction areas.

Archae-aus (2021a) noted that the identified sites were located relatively close to water sources, ranging from first to third order streams. Sites were typically small with localised artefact assemblages, being used on a short term basis by the Bilya Noongar people's ancestors as they travelled across the southwest. The resulting stone assemblages are primarily made from quartz, with lesser numbers of quartzite, dolerite, crystal quartz and granite (Archae-aus 2021a) which reflect the presence of granite and dolerite outcrops within the Mine Development Envelope and elsewhere within the Darling Plateau.

Archae-aus (2021a) noted that the low number of larger archaeological sites would be attributed to longer term use of an area when people gathered together for cultural purposes and to utilise the resources around larger water sources, such as swamps and creeks. The higher number of small, short term use sites are consistent with winter land use, where water sources are abundant, and a wider area is travelled and utilised.

Ethnographic survey was undertaken over the Serpentine River Registered Site (3582) within the Myara North mine region and infrastructure corridor on behalf of Alcoa (Randolph and McDonald 2010). The survey included consultation with Aboriginal representatives, who advised that mining was acceptable within 500 m of the Serpentine River and that mining closer to the river only occur subject to further consultation and agreement with the representatives. The representatives also advised that construction of a temporary haul road crossing over the river was acceptable at a designated location and subject to certain conditions.

Subsequent ethnographic consultation was undertaken by Randolph (2010) regarding mining within 500 m of the Serpentine River. The consultation confirmed that mining could proceed to within 100 m of the river and that any disturbance proposed within 100 m of the river be

subject to further consultation with representatives of the Bilya Noongar Organisation and the Nannup Family.

Alcoa is undertaking further ethnographic survey in accordance with an NSHA for all disturbance within 100 m of the Serpentine River, including all proposed infrastructure crossings. Ethnographic survey will also be undertaken for the Holyoake mine region to ensure that any previously unrecorded ethnographic sites within the mine region are identified and assessed. Ethnographic survey will involve Aboriginal Consultants nominated by SWALSC. The Aboriginal heritage surveys are currently underway and will be completed in Q4 2022, prior to ground disturbing activities.

European heritage

The Development Envelope contains and lies in proximity to European heritage associated with the historic timber industry centred at Jarrahdale and Dwellingup.

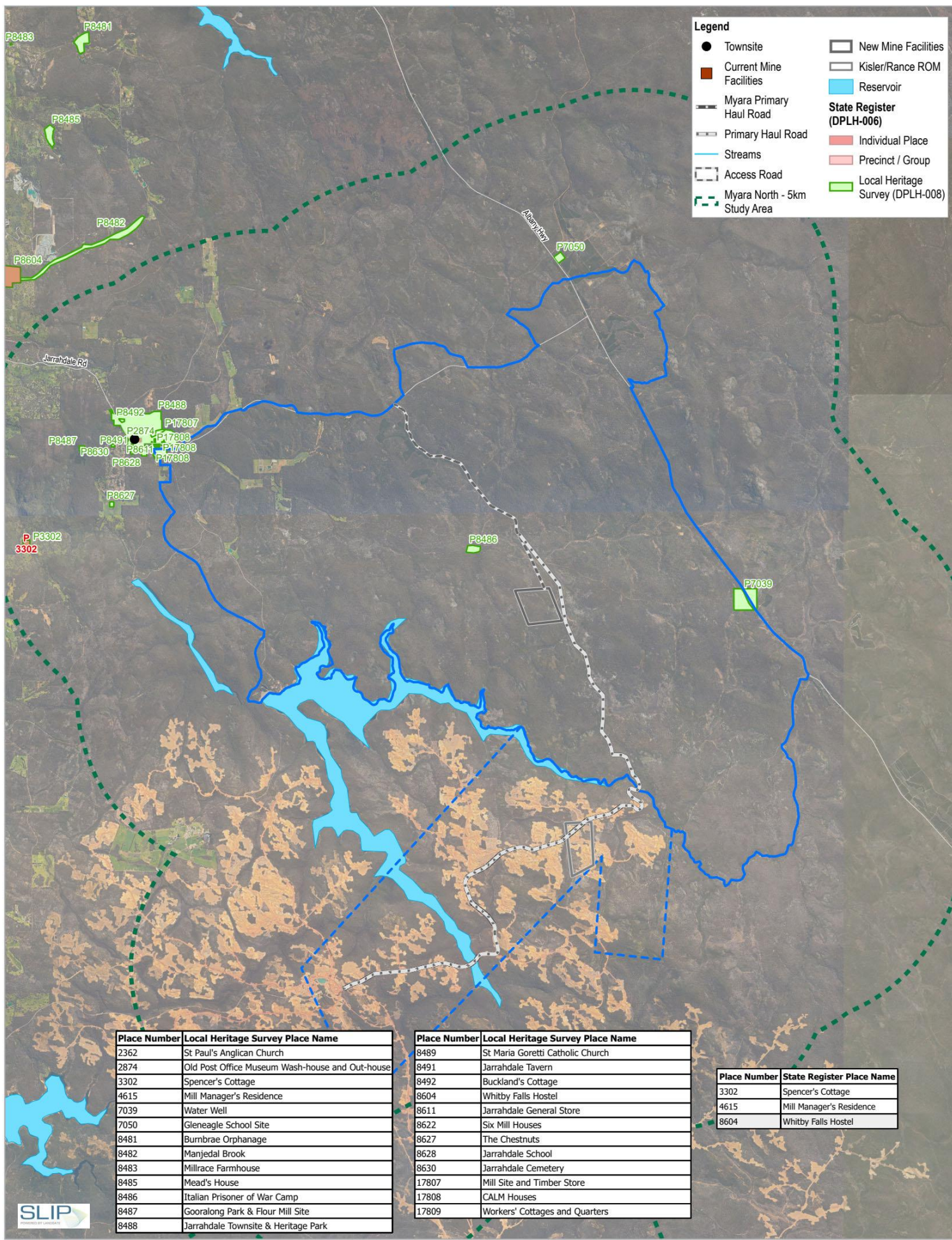
No World Heritage Sites or Commonwealth Heritage Sites occur within 5 km of the Development Envelope.

The DPLH State Heritage Register dataset does not record any places on the State Heritage Register within the Development Envelope, however two State Heritage Register places lie within 5 km of the Development Envelope; the Mill Manager's Residence and Spencers Cottage which lie in Jarrahdale townsite west of Myara North.

The DPLH Local Heritage Survey dataset records three local heritage sites within the Myara North Development Envelope including Jarrahdale Townsite and Heritage Park at the north-west edge of the mine region, the Italian POW camp close to the centroid of the mine region, and a water well on the east portion of the mine region. A further 13 local heritage sites are within 5 km of the Myara North Development Envelope (Figure 4-12). The DPLH dataset records three local heritage sites are located within 5 km of the Holyoake Development Envelope, including the Dwellingup-Boddington railway which lies within 100 m of the mine region (Figure 4-13).

Archae-aus (2021b) reviewed historical archaeological assessments in the Myara North and Holyoake mine regions. The review did not address historical archaeology within the Myara North or Holyoake infrastructure corridors, as these lie within existing or previous Huntly mine regions in which disturbance has already occurred. Historic railway maps and known historic sites within the Myara North and Holyoake mine regions were used to identify nine target locations within Myara North and ten within Holyoake (plus two within 1 km of the southern boundary) to identify any remaining historical archaeological features at the sites. The locations were then visited by vehicle and on foot to determine if any physical evidence remained and then to record and interpret (if possible) that evidence. Sites identified within the target survey locations are listed with a description of archaeological significance of each site.

In addition to the site surveys, a review was conducted for a 5 km radius around the mine regions to identify historical sites, features and artefacts.



Alcoa of Australia Limited
Huntly Bauxite Mine Transition - Myara North and Holyoake - EPBC Act Referral

Project No. 12520591
Revision No. 0
Date 25/03/2022

European Heritage within Myara North DE

FIGURE 4-12

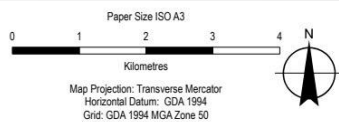
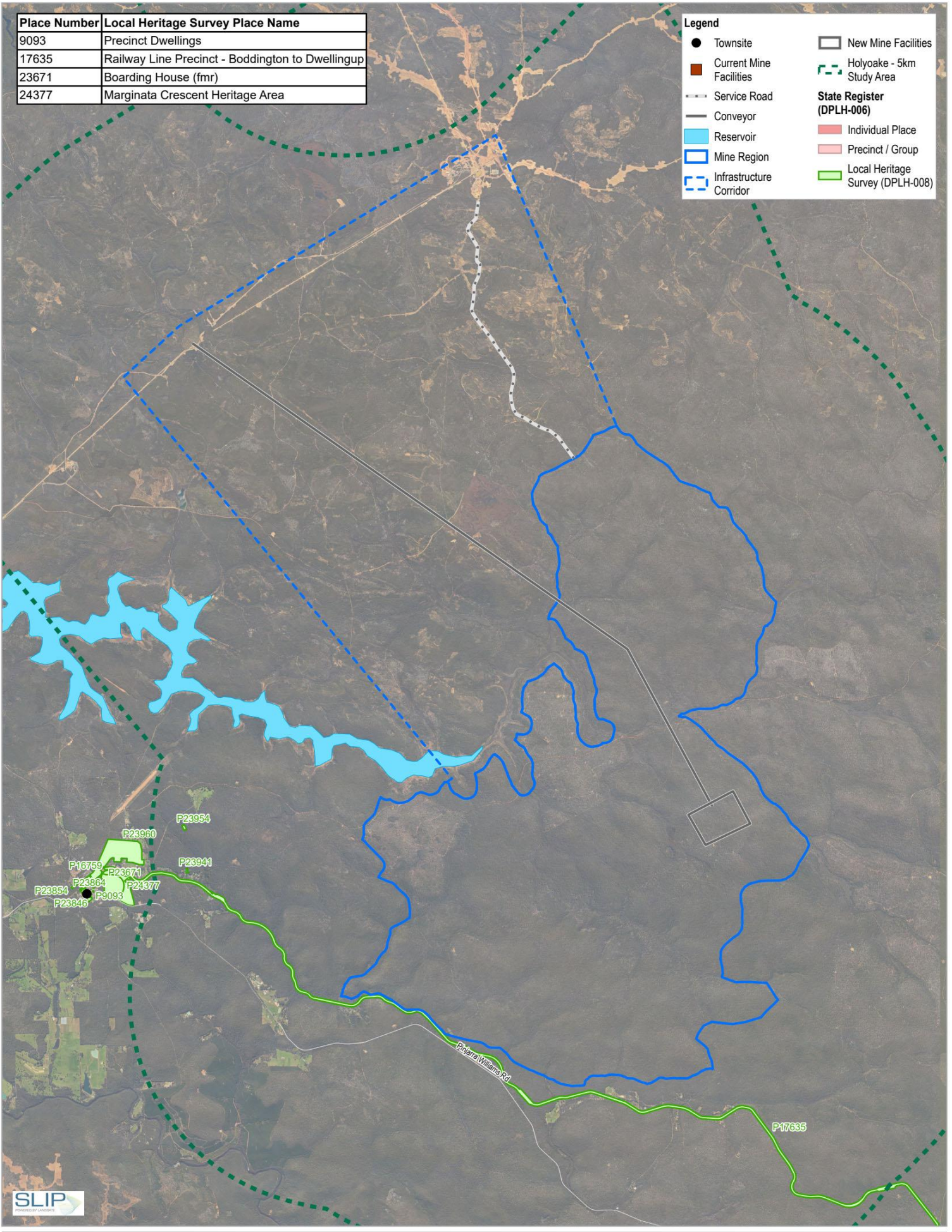
Place Number	Local Heritage Survey Place Name
9093	Precinct Dwellings
17635	Railway Line Precinct - Boddington to Dwellingup
23671	Boarding House (fmr)
24377	Marginata Crescent Heritage Area

Legend

- Townsite
- Current Mine Facilities
- Service Road
- Conveyor
- Reservoir
- Mine Region
- Infrastructure Corridor
- New Mine Facilities
- Holyoake - 5km Study Area

State Register (DPLH-006)

- Individual Place
- Precinct / Group
- Local Heritage Survey (DPLH-008)



Alcoa of Australia Limited
Huntly Bauxite Mine Transition - Myara
North and Holyoake - EPBC Act Referral

Project No. 12520591
Revision No. 0
Date 06/01/2022

European Heritage within
Holyoake DE

FIGURE 4-13

The presence of shield trees was assessed through spatial analysis of the DBCA dataset, which indicates that there 331 shield trees recorded within the Mine DE including:

- Myara North mine region: 119 trees
- Myara North infrastructure corridor: 44 trees
- Holyoake mine region: 92 trees
- Holyoake infrastructure corridor: 76 trees

The DBCA dataset indicates shield trees are scattered throughout the NJF, with a total of 3437 shield trees recorded within Alcoa's ML1SA mining lease.

Social and economic receptors

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

The Development Envelope predominantly lies within State Forest, which is multiple-use and managed for water catchment protection, timber production, recreation and conservation. Timber production is expected to cease as of 2024 following a recent announcement by the Western Australian Government to end native forest logging, with the exception of forest thinning and approved mine operations. Recreational uses of the Jarrah forest include bushwalking and cycling, as well as outdoor activities associated with the various rivers and drinking water dams present throughout the region.

4.5.3 Existing studies and management

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. Alcoa and Aboriginal heritage consultants have developed a draft model to predict areas most likely to contain heritage values, based on soil types, aspect, slope and vicinity to streams. This allows intensive surveys in areas more likely to have heritage values. Surveys of mining areas have been undertaken using this model. Sites that have been identified are recorded and protected from mining impacts.

Noise management

The mine is subject to a two-stage operational noise management process. Stage 1 comprises noise modelling of planned mining and forecast weather to predict potential impacts on noise sensitive premises. The modelling informs adjustment to mine planning to ensure compliance with the Environmental Protection (Noise) Regulations 1997.

Stage 2 comprises noise modelling of actual mine operations and live weather to predict potential impacts on noise sensitive premises. The operations noise model is used to monitor the risk of active operations causing an exceedance of the Noise Regulations, and informs adjustment to at risk operations to reduce the potential noise impacts.

During 2018, Alcoa received four noise complaints from two complainants regarding the mine. In 2019, seven complaints were received from five complainants. All complaints were investigated and compliance with the Environmental Protection (Noise) Regulations 1997 confirmed.

4.5.4 Potential impacts

The Proposal may cause potential impacts to social and heritage values as a result of:

- Disturbance to Aboriginal heritage sites.
- Disturbance to European heritage sites.
- Impacts to amenity through construction and operational noise.
- Impact to visual amenity from mining operations and infrastructure.
- Impact on recreational use of areas, including potential realignment of biking and walking tracks.

4.5.5 Studies undertaken for impact assessment

Alcoa have engaged Aboriginal heritage surveys of the Development Envelope to address gaps in past surveys and to update an understanding of management requirements. The surveys are being undertaken in accordance with an NSHA under the South West Native Title Settlement, and involve Aboriginal representatives nominated by the SWALSC.

The surveys will guide site avoidance and management. Any disturbance to identified Aboriginal heritage sites will be managed in accordance with an agreed Cultural Heritage Management Plan under the *Aboriginal Cultural Heritage Act 2021*.

Alcoa have completed European heritage surveys of the Development Envelope. The surveys will inform impact assessment for the PER under Part IV of the EP Act and will inform mine management arrangements

Alcoa have completed a noise impact assessment of mining, which comprises monitoring of ambient noise levels and predictive modelling of mining noise emissions and noise levels at sensitive receptors.

Alcoa have completed a landscape and visual impact assessment of mining to determine the landscape and visual amenity values of the area, the potential viewsheds and key viewpoints, and the significance of visual impacts from mine operations and infrastructure to those viewpoints and landscape / visual values.

Alcoa have prepared a Recreational Trails and Facilities Management Plan as part of the PER under Part IV of the EP Act. The management plan addresses impacts to recreational and scientific facilities within the Development Envelope and realignment of the section of the Munda Biddi Trail within the Development Envelope. The management plan will be implemented to the requirements of DBCA.

4.6 Proposed Mitigation

Impacts to MNES will be avoided and minimised through the following mitigation and management measures presented in Table 4-11.

Table 4-11 Proposed mitigation measures for Matters of National Environmental Significance

MNES	Avoid	Minimise	Rehabilitate
<i>Anthocercis gracilis</i> (Slender Tailflower) <i>Grevillea flexuosa</i> (Zig Zag Grevillea) <i>Lasiopetalum pterocarpum</i> (Wing-fruited Lasiopetalum)	<ul style="list-style-type: none"> Mining avoids granite outcrops which are the habitat of these species Mine infrastructure avoids granite outcrops, where practicable Mining and mine infrastructure avoids formal conservation reserves and DBCA mapped old growth forest Mining avoids swamp areas, creeklines and clay pans which are the habitats of these species Mining and infrastructure avoids formal conservation reserves and old growth forest 	<ul style="list-style-type: none"> Linear infrastructure (conveyor and haul road) crossings to granite outcrops minimised as far as practicable Pre-clearing surveys of all linear infrastructure alignments, avoidance of identified populations as far as practicable Translocation of individuals to be cleared, as far as practicable Weed and dieback hygiene during construction and operations Linear infrastructure crossings to swamp areas, creeklines and clay pans minimised as far as practicable Pre-clearing surveys of all linear infrastructure alignments, avoidance of identified populations as far as practicable Translocation of individuals to be cleared, as far as practicable Weed and dieback hygiene during construction and operations Strict pollutant management controls in Development Envelope to achieve public drinking water standards in adjacent reservoirs will minimise risk posed to swamps, creeklines and clay pans Dieback controls including exploration, clearing, topsoil harvesting, drainage, access tracks and haul roads, rehabilitation 	<ul style="list-style-type: none"> n/a, no direct impacts expected All cleared areas rehabilitated to Jarrah forest ecosystem
<i>Diuris drummondii</i> (Tall Donkey Orchid) <i>Diuris micrantha</i> (Dwarf Bee-orchid) <i>Eleocharis keigheryi</i> (Keighery's Eleocharis) <i>Verticordia firmbrilepis</i> subsp. <i>Firmbrilepis</i> (Shy Featherflower)	<ul style="list-style-type: none"> Mining and mine infrastructure avoids formal conservation reserves and old growth forest Mining avoids drainage floors and creeklines which support the highest occurrence of trees with nesting hollows Mining and mine infrastructure avoids perennial water areas at adjacent reservoirs Detailed survey of all clearing areas prior to clearing All potential breeding trees with suitable hollows retained Mining and infrastructure avoids formal conservation reserves and old growth forest 	<ul style="list-style-type: none"> Dieback controls including exploration, clearing, topsoil harvesting, drainage, access tracks and haul roads, rehabilitation 	<ul style="list-style-type: none"> All cleared areas rehabilitated to Jarrah forest ecosystem Long term fauna monitoring of rehabilitated areas
<i>Calyptorhynchus banksii naso</i> (Forest Red-tailed Black-Cockatoo) <i>Calyptorhynchus bawdinii</i> (Bawdin's Cockatoo) <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo)	<ul style="list-style-type: none"> Mining and infrastructure avoids formal conservation reserves and old growth forest Mining and infrastructure avoids formal conservation reserves and old growth forest Mining and infrastructure avoids formal conservation reserves and old growth forest Mining avoids drainage floors which are preferred habitat for species No water supply dams/storages in streamzones. 	<ul style="list-style-type: none"> Dieback controls including exploration, clearing, topsoil harvesting, drainage, access tracks and haul roads, rehabilitation Fauna underpasses for conveyors and major haul road crossings over swamp and stream zones, where practicable Mine access road speed limits to minimise vehicle collisions 	<ul style="list-style-type: none"> All cleared areas rehabilitated to Jarrah forest ecosystem Provision of constructed fauna habitat at a target rate of one per hectare. Long term fauna monitoring of rehabilitated areas All cleared areas rehabilitated to Jarrah forest ecosystem (McGregor et al 2014) Provision of constructed fauna habitat at a target rate of one per hectare. Long term fauna monitoring of rehabilitated areas
<i>Bettongia penicillata ogilbyi</i> (Woylie)	<ul style="list-style-type: none"> Mining and infrastructure avoids formal conservation reserves and old growth forest 	<ul style="list-style-type: none"> Linear infrastructure crossings to drainage floors minimised as far as practicable Dieback controls including exploration, clearing, topsoil harvesting, drainage, access tracks and haul roads, rehabilitation Fauna underpasses for conveyors and major haul road crossings over swamp and stream zones, where practicable Mine access road speed limits to minimise vehicle collisions, particularly across or along streamzones Strict pollutant management controls in Development Envelope to achieve public drinking water standards in adjacent reservoirs will minimise risk to potential habitat 	<ul style="list-style-type: none"> All cleared areas rehabilitated to Jarrah forest ecosystem (Craig et al 2017) Provision of constructed fauna habitat at a target rate of one per hectare. Long term fauna monitoring of rehabilitated areas Removal of haul road stream crossings and rehabilitation with streamzone vegetation species after mining to enhance habitat connectivity.
<i>Dasyurus geoffroyi</i> (Chuditch)	<ul style="list-style-type: none"> Mining and infrastructure avoids formal conservation reserves and old growth forest 	<ul style="list-style-type: none"> Linear infrastructure crossings to drainage floors minimised as far as practicable Dieback controls including exploration, clearing, topsoil harvesting, drainage, access tracks and haul roads, rehabilitation Fauna underpasses for conveyors and major haul road crossings over swamp and stream zones, where practicable Mine access road speed limits to minimise vehicle collisions 	<ul style="list-style-type: none"> All cleared areas rehabilitated to Jarrah forest ecosystem Provision of constructed fauna habitat at a target rate of one per hectare. Long term fauna monitoring of rehabilitated areas
<i>Setonix brachyurus</i> (Quokka)	<ul style="list-style-type: none"> Mining and infrastructure avoids formal conservation reserves and old growth forest Mining avoids drainage floors which are preferred habitat for species No water supply dams/storages in streamzones. 	<ul style="list-style-type: none"> Linear infrastructure crossings to drainage floors minimised as far as practicable Dieback controls including exploration, clearing, topsoil harvesting, drainage, access tracks and haul roads, rehabilitation Fauna underpasses for conveyors and major haul road crossings over swamp and stream zones, where practicable Strict pollutant management controls in Development Envelope to achieve public drinking water standards in adjacent reservoirs will minimise risk posed to drainage floors Mine access road speed limits to minimise vehicle collisions, particularly across or along streamzones 	<ul style="list-style-type: none"> All cleared areas rehabilitated to Jarrah forest ecosystem Provision of constructed fauna habitat at a target rate of one per hectare. Long term fauna monitoring of rehabilitated areas Removal of haul road stream crossings and rehabilitation with streamzone vegetation species after mining to enhance habitat connectivity.
<i>Westralunio carteri</i> (Carter's Freshwater Mussel)	<ul style="list-style-type: none"> Mining and infrastructure avoids direct impact to potential habitat in adjacent reservoirs Limited habitat expected in seasonal rivers, tributaries or drainage floors elsewhere in Development Envelope. 	<ul style="list-style-type: none"> Strict pollutant management controls in Development Envelope to achieve public drinking water standards in adjacent reservoirs will minimise risk to potential habitat 	<ul style="list-style-type: none"> n/a – no direct impacts expected

5 References

Air Assessments 2014, Pinjarra Alumina Refinery Air Quality Modelling for 2014 Health Risk Assessment, Prepared for Alcoa of Australia Limited, December.

Alcoa of Australia Limited (Alcoa) 2016, Alcoa's bauxite mine rehabilitation program. Completion Criteria and overview of area certification process. Available from: <https://www.jtsi.wa.gov.au/what-we-do/manage-state-agreements/alcoa's-bauxite-mine-rehabilitation-program>

Alcoa of Australia Limited (Alcoa) 2017, WA Mining Group Environmental Improvement Plan 2014-2018. Available from: <https://www.alcoa.com/australia/en/sustainability/reports-publications.asp>.

Alcoa of Australia Ltd (Alcoa) 2012, Jarrahdale and Huntly Long Term Fauna Monitoring Program 2011/12, Environmental Research Department, April 2012.

Alcoa of Australia Ltd (Alcoa) 2015, Report on Fauna Use of the Fauna Underpass at Ironbark Haul Road, Huntly Mine.

Alcoa of Australia Ltd (Alcoa) 2018, Triennial Environmental Review 2015-2017, Alcoa WA Mining Operations, September 2018 as amended, submitted to Department of Jobs, Tourism, Science and Innovation.

Alcoa of Australia Ltd (Alcoa) 2020a, Who We Are: Values, retrieved April 2020, from: <https://www.alcoa.com/global/en/who-we-are/values/default.asp>

Alcoa of Australia Ltd (Alcoa) 2020b, Sustainability: Environment, Health and Safety, retrieved April 2020, from: <https://www.alcoa.com/sustainability/en/environment-health-safety.asp>

Alcoa of Australia Ltd (Alcoa) 2020c, Sustainability: Environmental Management, retrieved April 2020, from: <https://www.alcoa.com/australia/en/sustainability/environmental-management.asp>

Alcoa World Alumina Australia (Alcoa) 2010, Threatened Fauna Species Management Plans for Alcoa's Bauxite Mining Operations in the Jarrah Forest, Alcoa Research Bulletin No. 40, June 2010.

Archae-aus 2021a, Report of Aboriginal Archaeological Assessments of Targeted Heritage Search Areas, Rock Outcrops and Swamps in the Holyoake Mine Region (2013), Jarrahdale South Project Area (2014), Jarrahdale South and Myara East Project Areas (2016) and Jarrahdale South – Northern Section Project Area (2017), prepared for Alcoa of Australia Ltd.

Archae-aus 2021b, Pinjarra Alumina Refinery Revised Proposal Historical Archaeological Assessment - Holyoake, Myara North and Pinjarra Alumina Refinery, prepared for Alcoa of Australia Ltd.

Tacey, W.H and Glossop, B.L. 1980, Assessment of topsoil handling techniques for rehabilitation of sites mined for bauxite within the jarrah forest of Western Australia. *Journal of Applied Ecology* 17, pp. 195-201.

Beard J.S., 1990. *Plant Life of Western Australia*. Kangaroo Press.

Bell, D.T., Plummer, J.A. and Taylor, S.K. 1993, Seed germination ecology in Southwestern Western Australia. *Botanical Review* 59, pp. 24-73. Craig, M.D., Hardy, G.E. StJ., Fontaine, J.B., Garkakalis, M.J., Grigg, A.H., Grant, C.D., Fleming, P.A. and Hobbs, R.J. 2012, Identifying unidirectional and dynamic habitat filters to faunal recolonisation in restored mine-pits. *Journal of Applied Ecology* 49, pp.919–928.

Craig, M.D., Stokes, V.L., Fontaine, J.B., Hardy, G.E., Grigg, A.H and Hobbs, R.J. 2015, Do state-and-transition models derived from vegetation succession also represent avian succession in restored mine-pits? *Ecological Applications* 25, pp. 1790-1806.

Craig, M.D., White, D.A., Stokes, V.L. and Prince, J. 2017, Can postmining revegetation create habitat for a threatened mammal? *Ecological Management & Restoration* 18(2), pp. 149-155

Cross S.L, Tomlinson, S., Craig, M.D., Dixon, K.W. and Bateman, P.W. 2019, Overlooked and undervalued: the neglected role of fauna and a global bias in ecological restoration assessments. *Pacific Conservation Biology* doi.org/10.1071/PC18079

Croton J. and Reed A. 2007, Hydrology and bauxite mining on the Darling Plateau. *Restoration Ecology* Vol. 15, No. 4 (Supplement), pp. S40–S47.

Croton, J., Nions, A. and Dalton, J. 2011, Review of the Trial Mining Project. Report to the Bauxite Hydrology Committee, March 2011.

Department of Agriculture, Water and the Environment (DAWE) 2015, Protected Matters Search Tool. Accessed 2 July 2020. Available from: <https://www.environment.gov.au/epbc/pmst/index.html>.

Department of Planning, Lands and Heritage (DPLH) 2019, Aboriginal Heritage Inquiry System. <https://maps.daa.wa.gov.au/AHIS/>. Accessed 21 February 2020.

Department of Premier and Cabinet. 2020. “South West Native Title Settlement <https://www.wa.gov.au/organisation/department-of-the-premier-andcabinet/south-west-native-title-settlement>

Department of the Environment (DotE) 2013, Environmental Protection and Biodiversity Conservation Act 1999 Matters of National Environmental Significance Significant impact guidelines. Available from: <https://www.environment.gov.au/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance>.

Dixon R., Grigg A. and Alam M. 2019, Modelling long-term flow and salinity response to bauxite mining in the Upper Serpentine catchment, Salinity and land use impacts series, report no. 66, Department of Water and Environmental Regulation, Western Australia.

Doherty, T.S., Wingfield, B.N., Stokes, V.L., Craig, M.D., Lee, J.H.G., Finn, H.C. and Calver, M.C. 2016, Successional changes in feeding activity by threatened cockatoos in revegetated mine sites. *Wildlife Research* 43, pp. 93-104.

Environ 2003, Pinjarra Alumina Refinery Efficiency Upgrade Environmental Protection Statement, Prepared for Alcoa World Alumina Australia. http://www.epa.wa.gov.au/sites/default/files/Referral_Documentation/A1498_R1122_EPS_Efficiency%20Upgrade-Final%201Dec03.pdf

Environ 2014, Revision of Pinjarra Refinery Health Risk Screening Assessment, Prepared for Alcoa of Australia Ltd, Project No: AS110754, December.

Environmental Protection Authority (EPA) 2003, Pinjarra Refinery Efficiency Upgrade, Alcoa World Alumina Australia, Report and recommendations of the Environmental Protection Authority, Bulletin 1122, December 2003.

http://www.epa.wa.gov.au/sites/default/files/EPA_Report/1727_B1122.pdf.

Environmental Protection Authority (EPA) 2016a, Instructions and template: Defining the key proposal characteristics. Perth: Environmental Protection Authority.

<http://www.epa.wa.gov.au/forms-templates/instructions-how-define-key-characteristics-proposal>.

Environmental Protection Authority (EPA) 2016c. Environmental Factor Guideline: Flora and Vegetation. Perth: Environmental Protection Authority. <http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-flora-and-vegetation>.

Environmental Protection Authority (EPA) 2016d, Environmental Factor Guideline: Terrestrial Environmental Quality. Perth: Environmental Protection Authority. EPA, Western Australia.

Environmental Protection Authority (EPA) 2016e, Environmental Factor Guideline: Terrestrial Fauna. Perth: Environmental Protection Authority. <http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-terrestrial-fauna>.

Environmental Protection Authority (EPA) 2016f, Environmental Factor Guideline: Inland Waters. Perth: Environmental Protection Authority. <https://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-inland-waters>.

Environmental Protection Authority (EPA) 2016g, Environmental Factor Guideline: Social Surroundings. Perth: Environmental Protection Authority. <http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-social-surroundings>.

Environmental Protection Authority (EPA) 2018b, Statement of Environmental Principles, Factors and Objectives. Perth: Environmental Protection Authority.

<https://www.epa.wa.gov.au/statement-environmental-principles-factors-and-objectives>.

Environmental Protection Authority (EPA) 2020a, Environmental Factor Guideline: Air Quality. EPA, Western Australia.

Environmental Protection Authority (EPA) 2020b, Environmental Factor Guideline: Greenhouse Gas Emissions. EPA, Western Australia.

Fordyce I.R., Gilkes R.J., Loneragan W.A., Beale S. and Middleton N. 2007, Vegetation zoning in relation to site and soil properties: A case study in the Darling Range, south-western Australia. *Journal of the Royal Society of Western Australia* Vol 90, pp 1-14

Gardner J. and Bell D. 2007, Bauxite mining restoration by Alcoa World Alumina Australia in Western Australia: Social, political, and environmental contexts. *Restoration Ecology* Vol. 15, No. 4 (Supplement), pp. S3–S10.

Gardner J. and Stoneman G. 2003, Bauxite Mining and Conservation of the Jarrah Forest in SouthWest Australia. In IUCN ICMM Workshop 'Mining, Protected Areas and Biodiversity Conservation: Searching and Pursuing Best Practice and Reporting in the Mining Industry', Gland, Switzerland, 7-9 July 2002.

Geological Survey of Western Australia (1976) Pinjarra, Sheet SI-52, Perth Western Australia.

GHD 2021a, Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine - Myara North, unpublished, currently being prepared for Alcoa of Australia Ltd.

GHD 2021b, Terrestrial Fauna Survey and Black Cockatoo Assessment – Holyoake, unpublished, currently being prepared for Alcoa of Australia Ltd.

GHD 2021c, Hydrology and Water Quality Assessment – Huntly Mine Extension, unpublished, currently being prepared for Alcoa of Australia Ltd.

Glevan Consulting, 2021, Myara North and Holyoake regions, Huntly Mine Phytophthora Dieback occurrence assessment, currently being prepared for Alcoa of Australia Ltd.

Grant C. 2006, Decommissioning Alcoa's first bauxite mine in the jarrah forest of Western Australia—cradle to grave. Pp. 287–298 in A. Fourie and M. Tibbett, editors. Mine closure 2006. Proceedings of the first international seminar on mine closure, 13–15 September 2006. Perth, Australia.

Grant C. and Koch J. 2007, Decommissioning Western Australia's first bauxite mine: co-evolving vegetation restoration techniques and targets. *Ecological Management and Restoration* Vol, 2, pp. 92-105.

Grigg, A.H. 2017, Hydrological response to bauxite mining and rehabilitation in the jarrah forest in south west Australia. *Journal of Hydrology: Regional Studies* 12, pp. 150-164.

Grigg, A.H. 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.

Havel JJ 1975a, Site-vegetation mapping in the northern jarrah forest (Darling Range). 1. Definition of site-vegetation types. Bulletin 86, Forests Department of Western Australia.

Havel JJ 1975b, Site-vegetation mapping in the northern jarrah forest (Darling Range). 2. Location and mapping of site-vegetation types. Bulletin 87, Forests Department of Western Australia.

Hickman A.H., Smurthwaite A.J., Brown I.M. and Davy R. 1992, Bauxite Mineralization in the Darling Range, Western Australia. Geological Survey of Western Australia, Report 33. Department of Mines, Western Australia.

Hughes, J.D., Petrone, K.C. and Silberstein, R. 2012, Drought, groundwater storage and stream flow decline in southwestern Australia. *Geophysical Research Letters* 39, L03408.

Koch J. 2007, Restoring a jarrah forest understorey vegetation after bauxite mining in Western Australia. *Restoration Ecology* Vol. 15, No. 4 (Supplement), pp. S26–S39.

Macfarlane, C., Bond, C., White, D.A., Grigg, A.H., Ogden, G.N., Silberstein, R. 2010, Transpiration and hydraulic traits of old and regrowth eucalypt forest in southwestern Australia. *Forest Ecology and Management* 260, pp. 96–105.

- Macfarlane, C., Grigg, A., McGregor, R., Ogden, G. and Silberstein, R. 2018, Overstorey evapotranspiration in a seasonally dry Mediterranean eucalypt forest: response to groundwater and mining. *Ecohydrology* DOI:10.1002/eco.1971
- Majer J., Brennan K. and Moir M. 2007, Invertebrates and the Restoration of a Forest Ecosystem: 30 Years of Research following Bauxite Mining in Western Australia, *Restoration Ecology* Vol. 15, No. 4 (Supplement), pp. S104–S115.
- Mattiske Consulting, 2021a, Detailed Flora and Vegetation Survey for Huntly Mine – Myara North, currently being prepared for Alcoa of Australia Ltd.
- Mattiske Consulting, 2021b, Detailed Flora and Vegetation Survey for Huntly Mine - Holyoake, currently being prepared for Alcoa of Australia Ltd.
- Mattiske Consulting 2022, Targeted Flora Survey for Huntly Mine – Myara North and Holyoake, currently being prepared for Alcoa of Australia Ltd.
- Mauger, G.W., Day, J.E. and Croton, J.T. 1998, Hydrological and associated research related to bauxite mining in the Darling Range of Western Australia – 1997 review. Report prepared by the Bauxite Sub-committee of the Steering Committee for research on land use and water supply. Water and Rivers Commission Water Resource Technical Series Report No. WRT 26.
- McGregor, R 2019, Alcoa of Australia Limited Huntly Mine Operations 10 Year Mine Plan (2019-2028), 1st Edition.
- McGregor, R.A., Stokes, V.L. and Craig, M.D. 2014, Does forest restoration in fragmented landscapes provide habitat for a wide-ranging carnivore? *Animal Conservation* 17, pp. 467-475.
- Nichols O. and Grant D. 2007, Vertebrate Fauna Recolonization of Restored Bauxite Mines – Key Findings from Almost 30 Years of Monitoring and Research, *Restoration Ecology* Vol. 15, No. 4 (Supplement), pp. S116–S126.
- Pacific Environment Limited 2015, Peer Review – Pinjarra Refinery Modelling, Prepared for Alcoa of Australia Limited, Job ID20495, July.
- Petrone, K. C., Hughes, J. D., Van Neil, T. G., and Silberstein, R. P. 2010, Streamflow decline in southwestern Australia, 1950–2008. *Geophysical Research Letters*, 37, L11401.
- Silberstein, R. P., Aryal, S. K., Durrant, J., Pearcey, M., Braccia, M., Charles, S. P., ... McFarlane, D. J. 2012, Climate change and runoff in southwestern Australia. *Journal of Hydrology*, 475, pp. 441–455.
- Tacey, W.H. and Glossop, B.L. 1980, Assessment of topsoil handling techniques for rehabilitation of sites mined for bauxite within the jarrah forest of Western Australia. *Journal of Applied Ecology* 17, pp. 195-201.
- Water Research and Management (WRM) 2021, Aquatic Fauna Desktop Assessment Myara North and Holyoake Regions, currently being prepared for Alcoa of Australia Ltd.
- Weinstein P. 2015, Expert Peer Review of the Prevised Pinjarra Refinery Health Risk Screening Assessment.

https://www.alcoa.com/australia/en/pdf/20160323_peer_review_by_professor_philip_weinstein.pdf

Weinstein P. 2015, Expert Peer Review of the Prevised Pinjarra Refinery Health Risk Screening Assessment.

https://www.alcoa.com/australia/en/pdf/20160323_peer_review_by_professor_philip_weinstein.pdf

Willyams, D. 2015, Challenges in domesticating and propagating Jarrah forest geophytes for revegetation and ornamental horticulture. *Acta Horticulturae* 1104, pp. 229-236.

Wood 2019, Environmental Noise Impact Assessment for Pinjarra Refinery Efficiency Project, Prepared for Alcoa of Australia, Doc Ref:1403401-1-100, March.

Water Research and Management WRM 2020, Streamzone monitoring 2019. Cameron Corridor and O'Neil Project Areas. Report by Wetlands Research and Management, June 2020.