Alcoa of Australia Limited

Myara North Geotechnical Investigation

Environmental Management Plan

March 2024

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1 Introduction

1.1 Background

Alcoa of Australia Ltd (Alcoa) operates two bauxite mines in Western Australia at Huntly and Willowdale which are located approximately 100km south-east of Perth. Alcoa propose to transition the Huntly Mine operations into the Myara North region which is located within the Jarrahdale State Forest 22. State Forest 22 is vested in the Conservation and Parks Commission and managed by the Department of Biodiversity, Conservation and Attractions (DBCA) under the *Conservation and Land Management Act 1984* (CALM Act).

The Huntly Mine is located within mineral lease ML1SA and operated in accordance with the *Alumina Refinery Agreement Act 1961*. Environmental approval for Huntly Mine and the associated Pinjarra Refinery was granted under Ministerial Statement 646, issued under Part IV of the *Environmental Protection Act 1986* (EP Act). The Myara North mine move is currently under assessment under Part IV of the EP Act as part of the Pinjarra Alumina Refinery Revised Proposal (assessment number 2253). Approval is anticipated in late 2025.

Alcoa intends to conduct a geotechnical investigation within the Myara North region to assist in refining designs for the proposed infrastructure including haul roads, workshops, site offices, parking, laydown areas and drainage infrastructure.

1.2 Scope

Alcoa has engaged Tetra Tech Coffey (TTC) to complete a geotechnical investigation which will include testing at a total of 116 locations (see Figure 1-1). The test types and potential disturbance extents are outlined in Table 1 with GPS coordinates provided in Appendix 1.

The geotechnical investigation is planned to commence as soon as the required regulatory approvals have been secured, as discussed in Section 1.3.

The geotechnical investigation will include:

- excavation and backfill of 100 test pits; and
- installation of 16 groundwater monitoring bores.

The test pits will involve temporary disturbance and be backfilled upon completion.

The groundwater bores will be installed to monitor groundwater levels and quality on a quarterly basis by Alcoa personnel or contractors for up to ten years. Ongoing access to the groundwater bores will also be required for periodic maintenance.

Test locations have been preferentially located on existing access roads, tracks and disturbed ground. Access to test locations for test equipment, including heavy machinery and light vehicles will be via existing DBCA access roads as far as possible. Existing informal access tracks will be used as a second preference with access through vegetation the last resort. Proposed access routes for this investigation are included in Figure 1-1.

A maximum of 20 ha of vegetation is anticipated to be disturbed for access and completion of the investigation.

1.3 Approvals

The following approvals are required prior to commencement of the geotechnical investigation:

- Section 101 Licence from the Director General of Biodiversity, Conservation and Attractions under the CALM Act to conduct activities within a State Forest;
- Part V Clearing Permit from the Department of Mines, Industry Regulation and Safety under the EP Act; and
- Water Corporation approval to conduct activities within the Reservoir Protection Zone of Serpentine Dam.

The Department of Water and Environmental Regulation has advised that no approval under Part IV of the EP Act is required for the geotechnical investigation.

1.4 Purpose of this Plan

The purpose this plan is to:

- Outline the measures to be implemented to protect the environment, forest users and heritage during the geotechnical investigation and subsequent groundwater monitoring; and
- Provide assurance to regulators and stakeholders that the potential environment and heritage risks can be appropriately managed.

The commitments in this management plan apply to both Alcoa personnel and contractors engaging in the activities described in the scope above.

1.5 Legal and Other Statutory Project Requirements

The contractor will be required to comply with the following legislation when completing the geotechnical investigation:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Biodiversity Conservation Act 2016* (BC Act);
- *Environmental Protection Act 1986*;
- *Conservation and Land Management Act 1984*; and
- *Metropolitan Water Supply, Sewerage and Drainage Act 1909*.

Figure 1-1: Myara North Geotechnical Investigation Proposed Test Locations

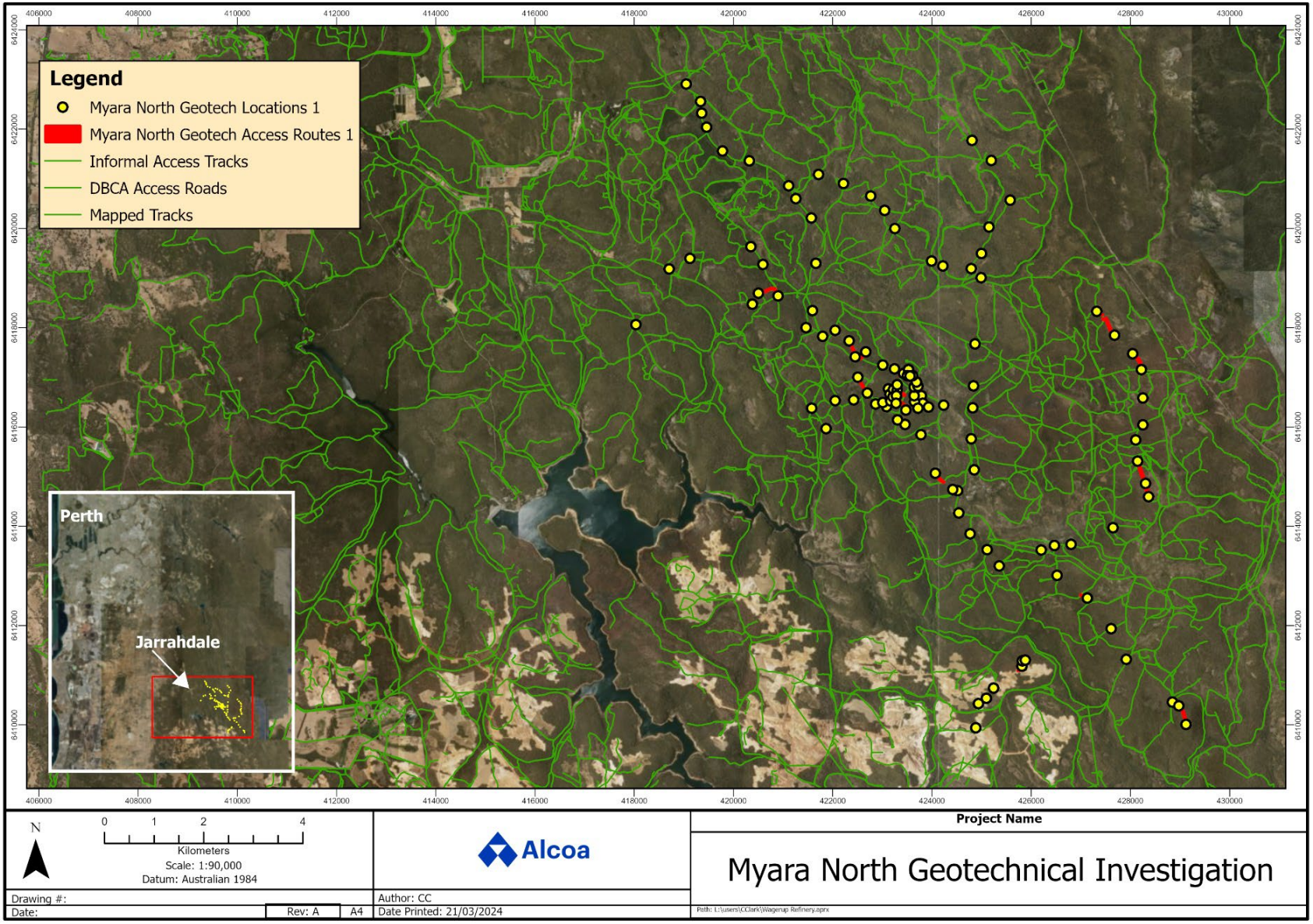


Table 1-1: Myara North Geotechnical Investigation Test Types and Disturbance

Investigation Type	Locations	Equipment Used	Access Disturbance	Test Disturbance	Remediation	Ongoing Disturbance
Dynamic Cone Penetrometer (DCP)	Up to 100 (a selection of the test pit locations in Appendix 1)	Hand held penetrometer Light vehicle to access test locations 	Personnel access only	Maximum 1m^2 total disturbance area 20mm diameter	Backfilling of penetration Replacement of leaf litter	None

Investigation Type	Locations	Equipment Used	Access Disturbance	Test Disturbance	Remediation	Ongoing Disturbance
Borehole Installation	16 (refer borehole locations within Appendix 1)	Light vehicle Drill rig Rigid 6-wheeler truck to transport water for drilling and drill cuttings in Intermediate Bulk Containers (IBCs) 	2.5m track width Rubber tyres Trees and large shrubs avoided Small shrubs pushed down	Maximum 100m^2 total disturbance area Excavated material temporarily stockpiled over 4m^2 footprint Installation of 100mm bore pipe topped with metal casing and concrete pad	Backfill of borehole with excavated material Excess excavated material to be spread over maximum 10m^2 disturbance area No covering of shrubs with excavated material Replacement of leaf litter	Quarterly light vehicle access to borehole to collect groundwater samples for a minimum of ten years post construction Ad hoc light vehicle access for maintenance purposes

Investigation Type	Locations	Equipment Used	Access Disturbance	Test Disturbance	Remediation	Ongoing Disturbance
Test Pit (in case of ground refusal, test pits may be replaced with additional boreholes)	100 (refer test pit locations within Appendix 1)	Light vehicle 8 tonne rubber-tracked excavator with blade 	3m track width Rubber tracked Trees and large shrubs avoided Small shrubs pushed down	Maximum 15m^2 total disturbance area Maximum 5m by 1m pit dug to 3m depth Excavated material temporarily stockpiled over 5m^2 footprint	Pit backfilled with excavated material after temporary stockpiling Backfilled pit to be level with surrounding ground Replacement of leaf litter	None

2 Existing Environment

2.1 Flora and Vegetation

Flora and vegetation surveys were undertaken in the Myara North region over multiple seasons in 2020, 2022 and 2023 in accordance with the Environmental Protection Authority (EPA) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (2016). The surveys included:

- Detailed and targeted surveys over two seasons in 2020 as documented in Pinjarra Alumina Refinery Revised Proposal Detailed Flora and Vegetation Survey for Huntly Mine – Myara North (Mattiske, 2021). Refer Appendix 2;
- Targeted pre-clearance survey for threatened and priority flora in spring 2022 as documented in Myara North Pre-Clearance Surveys 2022 (WEPL, 2023). Refer Appendix 3; and
- Targeted pre-clearance surveys for threatened and priority flora in spring 2023 as documented in Myara North Targeted Flora Survey (AECOM, 2024) and Targeted Flora Search Myara North Region 2023 (WEPL, 2024). Refer Appendices 4 and 5.

All of the geotechnical test locations and access routes have been subject to detailed and targeted surveys. The pre-clearance flora survey coverage is depicted in Figure 2.

No Threatened Ecological Communities (TECs) were identified within the Myara North region and none are likely to occur, based on the vegetation associations present. One Priority Ecological Community (PEC) was identified: granite communities of the northern jarrah forest.

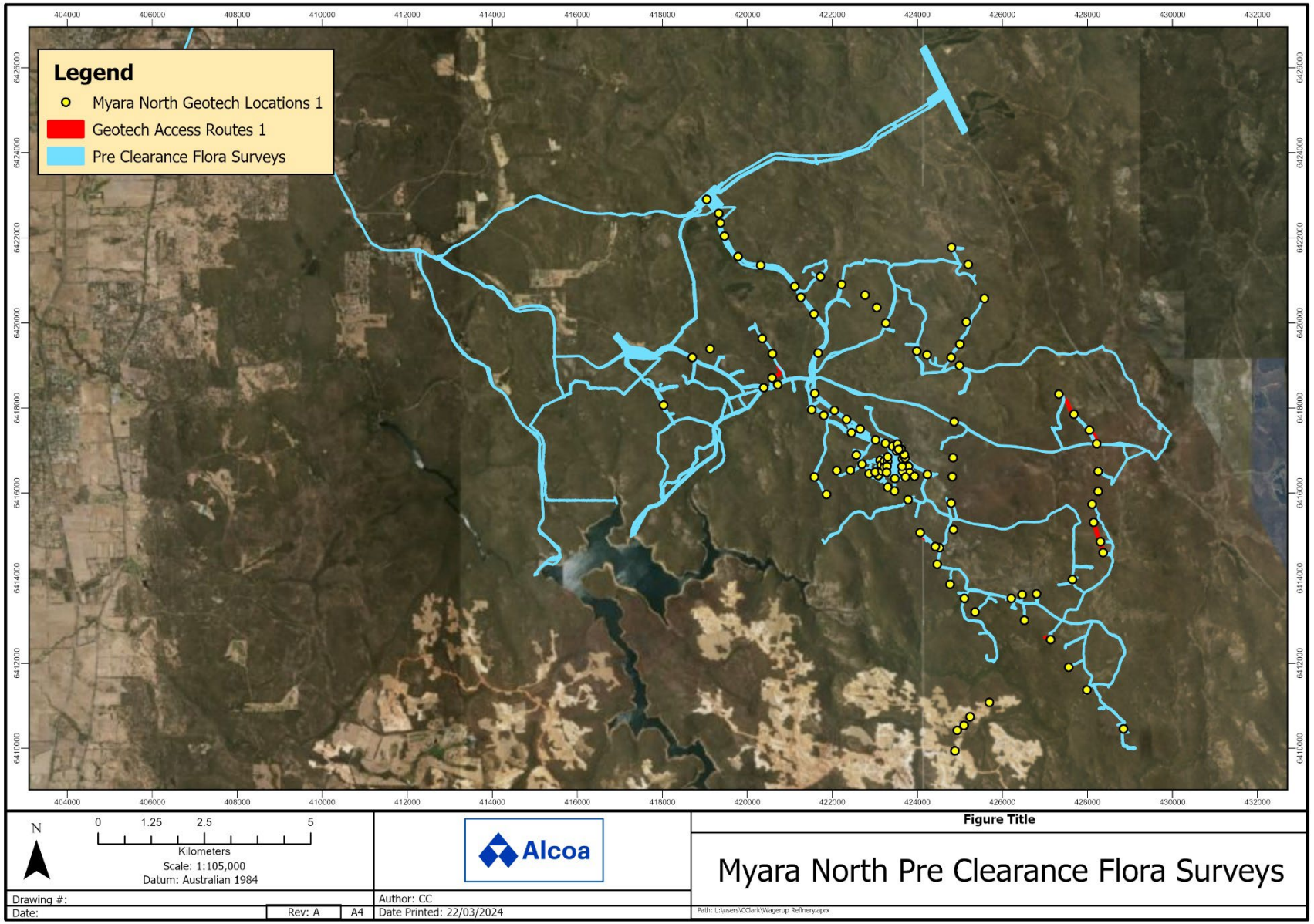
All geotechnical test locations and access routes have been located to avoid PEC occurrences.

Mattiske (2021) identified a total of 17 threatened flora species listed under State or Commonwealth legislation and 49 priority flora species as either recorded or likely to occur within the Myara North region. Eight priority flora species and zero threatened flora species were recorded within the Myara North region.

Targeted pre-clearance surveys for threatened and priority flora species with a high likelihood of occurrence were completed for the geotechnical test locations and access routes. Two priority flora species were identified: *Thysanotus anceps* (Priority 3) and *Pimelea rara* (Priority 4). All geotechnical test locations and access routes have been located to avoid priority flora records by at least 50m.

Test locations and access routes have been preferentially located within existing cleared/disturbed areas to minimise vegetation disturbance. They have also been located near existing access tracks where possible to minimise disturbance from equipment access.

Figure 2-1: Pre-Clearance Flora Surveys



2.2 Dieback

Dieback surveys have been completed across the Myara North region. The test locations are located within both dieback infested and dieback free areas. The geotechnical testing and ongoing groundwater sampling will be conducted in accordance with Alcoa's Dieback Management System and the Alcoa/DEC Working Arrangements.

2.3 Fauna

Multiple fauna surveys have been conducted within the Myara North region over multiple seasons in 2020 and 2024 in accordance with the EPA Technical Guidance - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (2020) and EPBC Act guidelines for threatened species likely to occur within the region. The surveys included:

- Detailed and targeted surveys over two seasons in 2020 as documented in Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine – Myara North (GHD, 2021). Refer Appendix 6;
- Targeted pre-clearance survey for conservation significant fauna in autumn 2023 as documented in Pre-Clearance Survey – Autumn, Myara North (GHD, 2023). Refer Appendix 7; and
- Targeted black cockatoo surveys in 2022, 2023 and 2024 as documented in Myara North Power/Water Alignments, Black Cockatoo Breeding Habitat Survey (Kirkby, 2022) and Myara North Power/Water/Boundary Alignments, Black Cockatoo Breeding Habitat Survey (Kirkby, 2024). Refer Appendices 8 and 9.

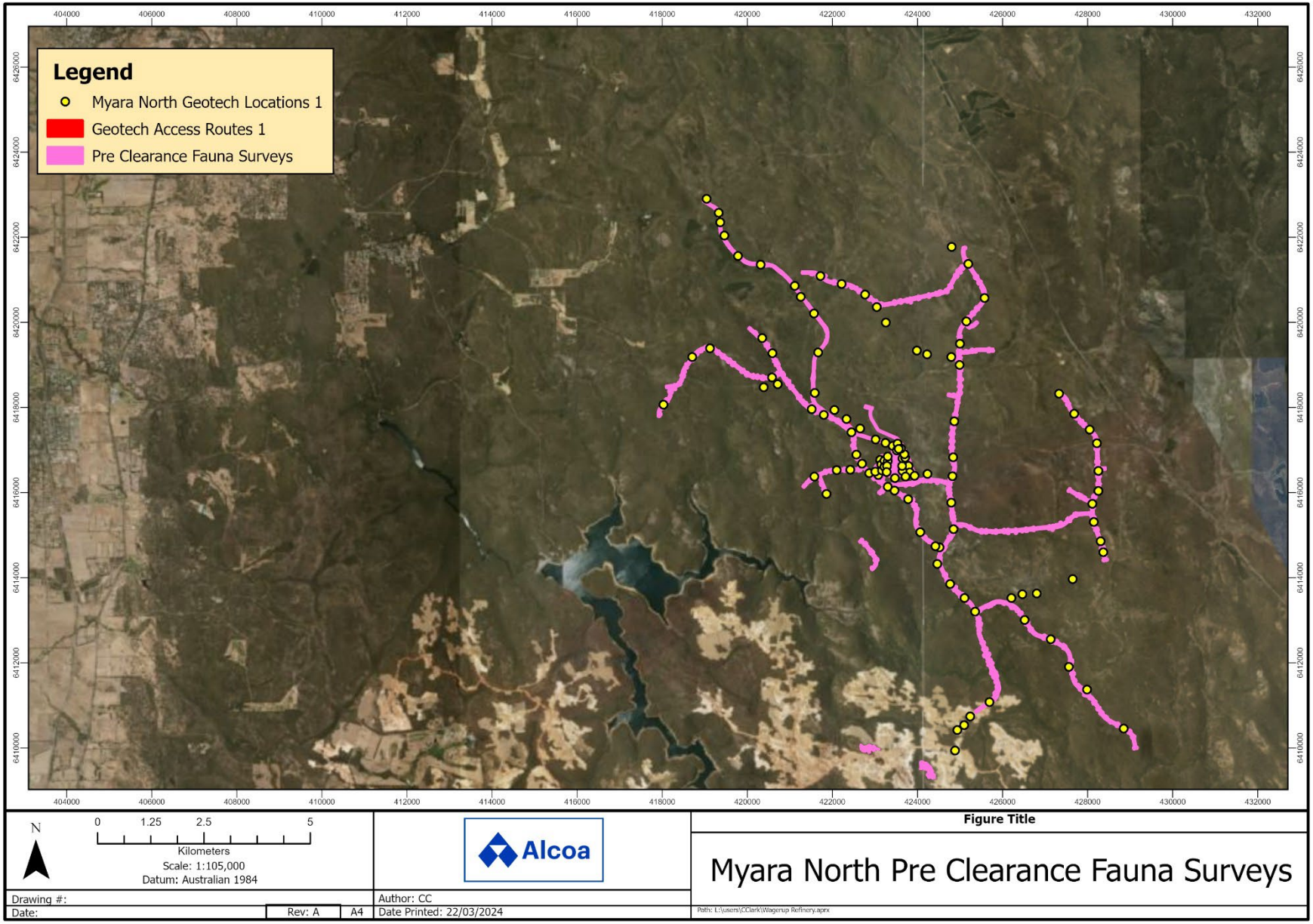
It should be noted that some of the geotechnical test locations and access routes have not been subject to a targeted surveys for conservation significant species likely to occur within the Myara North region. However, the survey coverage combined with the mitigation measures/controls outlined in Table 3-4 are deemed sufficient to identify and manage risks to these species.

The detailed fauna survey identified 13 conservation significant species as occurring or likely to occur within the region. The targeted pre-clearance survey recorded six significant fauna species:

- Baudin's and Forest Red-tailed Black Cockatoos (Endangered and Vulnerable respectively under the EPBC Act and BC Act);
- Chuditch (Vulnerable under the EPBC Act and BC Act);
- Quenda (Priority 4);
- Western Bush Wallaby (Priority 4); and
- South-Western Brush-Tailed Phascogale (Conservation Dependent as per

DBCA).

Figure 2-2: Pre-Clearance Fauna Surveys



- Western Brush Wallaby (Priority 4); and
- South-Western Brush-Tailed Phascogale (Conservation Dependent as per DBCA).

No Carter's Freshwater Mussels were identified within the Myara North region and due to the ephemeral nature of the streams present this species is unlikely to be present within the region (SLR, 2022).

The geotechnical test locations and access routes have been selected to avoid recorded black cockatoo nesting and potential nesting trees and other fauna burrows by at least 50m.

2.4 Heritage

The following Aboriginal and historic heritage surveys have been completed over the Myara North region:

- Pinjarra Alumina Refinery Revised Proposal Historical Archaeological Assessment Holyoake, Myara North and Pinjarra Alumina Refinery (Archae-aus, 2021b)
- Pinjarra Alumina Refinery Revised Proposal Aboriginal Archaeological Heritage Report - Myara North and Holyoake (Archae-aus, 2021a); and
- Ethnographic Assessment of Alcoa's Proposed Huntly Mine Expansion at Myara North, Western Australia (Archae-aus, 2022).

Several sites of historic (European), Aboriginal archaeological and Aboriginal ethnographic sites were identified during these surveys. The geotechnical test locations have been selected to avoid these sites by at least 50m. Access to these heritage sites will be maintained at all times during the geotechnical investigation.

The Department of Planning, Lands and Heritage (DPLH) shapefile for Aboriginal ethnographic site 3582 Serpentine River appears to intersect some of the test locations and access routes. Alcoa has consulted with representatives from the Gnaala Karla Booja Traditional Owner group who had no objections to mining within the Myara North region, subject to seeking Section 18 *Aboriginal Heritage Act 1972* approval to construct a haul road crossing over the Serpentine River. There will be no impact to the Serpentine River heritage site from the proposed geotechnical investigation.

2.5 Forest Access

State Forest 22 is used by the community for:

- Recreation;
- Firewood collection;

- Use of walking and bicycle trails, for example the Munda Biddi trail;
- Access to historic heritage sites, for example the Prisoner of War Camp; and
- Access to country by Noongar people for cultural purposes.

The forest is also accessed by the DBCA and the Water Corporation for activities associated with conservation, bushfire management and drinking water protection.

Access to State Forest 22 will be maintained at all times during the geotechnical investigation. There may be some temporary blockage of access tracks for safety purposes during testing, however all equipment will be packed up at the end of each day and access reinstated.

3 Environmental Risk Assessment

Alcoa has conducted an environmental risk assessment for the proposed geotechnical investigation, as requested by DBCA. The risk assessment follows the methodology outlined in the DWER's 2017 Guideline: Risk Assessments and Alcoa's risk assessment process. The likelihood, consequence and risk rating matrices are included in Tables 3-1, 3-2 and 3-3 below.

The risk assessment is included as Table 3-4 and identifies activities, receptors, potential impacts and management measures (controls) to be implemented to prevent adverse impacts. The risk rating is based on residual risk with management measures in place.

Table 3-1: Consequence Matrix

Consequence	Consequence Description	
	Environment	Health
Severe	On-site impacts: catastrophic Off-site impacts (local scale): high level Off-site impacts (wider scale): mid level Mid to long term or permanent impact to an area of high conservation value or special significance	Loss of life Adverse health effects: high level or ongoing medical treatment Local scale impacts: permanent loss of amenity
Major	On-site impacts: high level Off-site impacts (local scale): mid level Off-site impacts (wider scale): low level Short term impact to an area of high conservation value or special significance	Adverse health effects: mid level or frequent medical treatment Local scale impacts: high level impact to amenity
Moderate	On-site impacts: mid level Off-site impacts local scale: low level Off-site impacts wider scale: minimal	Adverse health effects: low level or occasional medical treatment Local scale impacts: mid level impact to amenity
Minor	On-site impacts: low level Off-site impacts (local scale): minimal Off-site impacts (wider scale): not detectable	Local scale impacts: low level impact to amenity
Slight	On-site impacts: minimal	Local scale impacts: minimal impacts to amenity

Table 3-2: Likelihood Matrix

Likelihood	Likelihood Description
Almost certain	The risk event is expected to occur in most circumstances.
Likely	The risk event will probably occur in most circumstances.
Possible	The risk event could occur at some time.
Unlikely	The risk event will probably not occur in most circumstances.
Rare	The risk event may only occur in exceptional circumstances.

Table 3-3: Risk Rating Matrix (Consequence x Likelihood)

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost Certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

Table 3-4: Risk Assessment

Activity	Receptor	Potential Impact	Management Measures (Controls)	Residual Consequence	Residual Likelihood	Residual Risk Rating
Heavy and light vehicle access to test locations	TECs/PECs	No impact likely to TECs as none have been recorded or identified as potentially occurring within the Myara North region. Disturbance to PEC granite communities of the northern jarrah forest. Spread of weeds decreasing condition of PEC granite communities of the northern jarrah forest. Decrease in vegetation condition as a result of bushfire.	• Detailed flora and vegetation survey completed for the Myara North region. • Granite outcrops have been identified across the Myara North region to a high degree of certainty by a combination of flora surveys, aerial photography and mining exploration drilling data. • Alcoa has assumed that all granite outcrops may meet the definition of the PEC even if they have not been subject to a detailed site walkover by a botanist. • Access routes have been preferentially located on existing DBCA access roads, tracks and disturbed areas and avoided all mapped granite outcrops by at least 50m. • TTC and subcontractors will be required to ensure all machinery, equipment and laydown areas are located on mapped disturbed access tracks or within access route polygons approved by DBCA and DMIRS. • All light and heavy vehicles and equipment to be clean on entry prior to entering State Forest 22 with completed Alcoa Mobile Equipment Hygiene Inspection Checklists completed to prevent the spread of weeds. • No work will occur on Total Fire Ban and/or Harvest and Vehicle Movement Ban days.	Slight	Unlikely	Low

Activity	Receptor	Potential Impact	Management Measures (Controls)	Residual Consequence	Residual Likelihood	Residual Risk Rating
	Threatened/ priority flora species	Eight priority flora species and zero threatened flora species were recorded within the Myara North region. Two Priority 4 flora species (*Thysanotus anceps* and *Pimelea rara*) have been recorded within the targeted flora surveys. Disturbance to individual plants of threatened or priority flora species. Spread of weeds leading to a decrease in threatened/priority flora species individuals. Decrease in threatened or priority flora populations as a result of bushfire started by equipment.	• Detailed and targeted flora and vegetation surveys completed for all geotechnical test locations and access routes, including targeted searches for threatened and priority flora species. • Access routes have been preferentially located on existing DBCA access roads, tracks and disturbed areas and avoided all threatened and priority flora records by at least 50m. • TTC and sub-contractors will be required to ensure all machinery, equipment and laydown areas are located on mapped disturbed access tracks or within access route polygons approved by DBCA and DMIRS. • All light and heavy vehicles and equipment to be clean on entry prior to entering State Forest 22 with completed Alcoa Mobile Equipment Hygiene Inspection Checklists completed to prevent the spread of weeds. • No work will occur on Total Fire Ban and/or Harvest and Vehicle Movement Ban days.	Slight	Unlikely	Low

Activity	Receptor	Potential Impact	Management Measures (Controls)	Residual Consequence	Residual Likelihood	Residual Risk Rating

	Threatened/ priority fauna species	Death/injury to mammal or reptile individuals.
		Death/injury to individuals of conservation significant fauna species.
		Disturbance to habitat of conservation significant fauna species such as black cockatoos, chuditch, quenda and quokka.
			• Detailed fauna surveys completed across the Myara North region, including targeted searches for conservation significant fauna species.
			• All vehicles and machinery to limit speeds to 40km/hr when driving within State Forest 22.
			• Access routes chosen to minimise vegetation disturbance and known habitat for conservation significant fauna.
			• Trees, large shrubs and hollow logs which may provide habitat for conservation significant fauna species will be avoided.
			• Appropriately experienced and licenced fauna spotter to inspect access routes and test locations just prior to use to identify potential habitat for conservation significant species such as:
			  ○ Trees with hollows potentially suitable for black cockatoos;
			  ○ Burrows for ground dwelling species such as chuditch, quenda and quokka.
			• Black cockatoos nesting within tree hollows are unlikely to be disturbed by vehicles and personnel passing by to reach geotechnical test locations.
			• Trees with hollows and burrows will be avoided by all vehicles, test equipment and personnel.
			• Appropriately experienced and licenced fauna spotter to be present during heavy vehicle and equipment access to test locations to act as a fauna spotter and relocate fauna if required.
				Slight	Possible	Low

Activity	Receptor	Potential Impact	Management Measures (Controls)	Residual Consequence	Residual Likelihood	Residual Risk Rating

	Soil	Spread of dieback causing ecosystem decline.
		
		Generation or deepening of existing wheel ruts from vehicle and equipment tyres resulting in soil compaction and erosion.
			• Alcoa has current dieback mapping across the Myara North region. This will be provided to TTC and subcontractors.
			• The DBCA access roads within the Myara North region are open to the public who are unlikely to practice dieback hygiene. Therefore, Alcoa will assume all DBCA access roads and informal tracks are dieback affected.
			• Alcoa will ensure that geotechnical testing is undertaken in dry weather conditions.
			• All Alcoa, TTC and subcontractors' vehicles and heavy equipment will be clean on entry with Mobile Equipment Hygiene Inspection Checklists completed for each vehicle or piece of heavy machinery.
			• When travelling off DBCA access roads or informal tracks into dieback free or uninterpretable areas all vehicles and heavy machinery will be brushed down first.
			• When crossing dieback boundaries in vegetated areas all vehicles and heavy machinery vehicles will be brushed down when moving from:
			  ○ Dieback infected to dieback free areas;
			  ○ Dieback infected to uninterpretable areas; and
			  ○ Uninterpretable to dieback free areas.
			• Use of tracked instead of wheeled equipment where possible to minimise the generation or exacerbation of wheel ruts.
			• Upon completion of the work access tracks will be ripped with a tyne to prevent soil compaction and erosion and promote natural recruitment of vegetation. DBCA Perth Hills District officers will be consulted to confirm the locations requiring ripping.
				Slight	Unlikely	Low

	Heritage sites	Disturbance to Aboriginal or historic heritage sites.	• Archaeological and ethnographic Aboriginal heritage and historic heritage surveys have been completed across the Myara North region. • Access routes have been preferentially located on existing DBCA access roads, tracks and disturbed areas and avoided all known heritage sites by at least 50m. • Alcoa pre-start briefing to TTC and subcontractors on potential Aboriginal heritage and historic heritage artefacts and procedures to address if found.	Slight	Unlikely	Low

Activity	Receptor	Potential Impact	Management Measures (Controls)	Residual Consequence	Residual Likelihood	Residual Risk Rating
Conducting dynamic cone penetrometer tests, test pits and groundwater bore installation Installing groundwater monitoring bores	TECs/PECs	No impact likely to TECs as none have been recorded or identified as potentially occurring within the Myara North region. Disturbance to PEC granite communities of the northern jarrah forest. Decrease in vegetation condition as a result of bushfire started by equipment.	• Detailed flora and vegetation survey completed for the Myara North region. • Granite outcrops have been identified across the Myara North region to a high degree of certainty by a combination of flora surveys, aerial photography and mining exploration drilling data. • Alcoa has assumed that all granite outcrops may meet the definition of the PEC even if they have not been subject to a detailed site walkover by a botanist. • Access routes have been preferentially located on existing DBCA access roads, tracks and disturbed areas and avoided all mapped granite outcrops by at least 50m. • TTC and subcontractors will be required to ensure all machinery, equipment and laydown areas are located on mapped disturbed access tracks or within access route polygons approved by DBCA and DMIRS. • No work will occur on Total Fire Ban and/or Harvest and Vehicle Movement Ban days.	Slight	Unlikely	Low
	Threatened/ priority flora species	Eight priority flora species and zero threatened flora species were recorded within the Myara North region. Two Priority 4 flora species (*Thysanotus anceps* and *Pimelea rara*) have been recorded within the targeted flora surveys. Disturbance to individual plants of threatened or priority flora species. Decrease in threatened or priority flora populations as a result of bushfire started by equipment.	• Detailed and targeted flora and vegetation surveys completed for all geotechnical test locations and access routes, including targeted searches for threatened and priority flora species. • Access routes have been preferentially located on existing DBCA access roads, tracks and disturbed areas and avoided all threatened and priority flora records by at least 50m. • TTC and sub-contractors will be required to ensure all machinery, equipment and laydown areas are located on mapped disturbed access tracks or within access route polygons approved by DBCA and DMIRS. • No work will occur on Total Fire Ban and/or Harvest and Vehicle Movement Ban days.	Slight	Unlikely	Low

Activity	Receptor	Potential Impact	Management Measures (Controls)	Residual Consequence	Residual Likelihood	Residual Risk Rating

	Threatened/ priority fauna species	Death/injury to mammal or reptile individuals.
		Death/injury to individuals of conservation significant fauna species.
		Disturbance to habitat of conservation significant fauna species such as black cockatoos, chuditch, quenda and quokka.
		Abandonment of eggs or chicks by black cockatoos due to noise from test equipment.
		Increased predation on native fauna by introduced fauna attracted by food waste.
			• Detailed fauna surveys completed across the Myara North region, including targeted searches for conservation significant fauna species.
			• Test locations chosen to minimise vegetation disturbance and known habitat for conservation significant fauna by at least 50m.
			• Appropriately experienced and licenced fauna spotter to inspect access routes and test locations just prior to use to identify potential habitat for conservation significant species such as:
			  ○ Trees with hollows potentially suitable for black cockatoos;
			  ○ Burrows for ground dwelling species such as chuditch, quenda and quokka.
			• Trees with hollows within 50m of test locations will be inspected by the fauna spotter to determine if any black cockatoo eggs or chicks are present. If eggs or chicks are present then the test will be relocated to at least 50m away. If the test location can't be relocated to a disturbed access track or area within the access route polygons approved by DBCA and DMIRS then it will postponed until such time as a fauna spotter can confirm that no eggs or chicks are present.
			• Trees with hollows and burrows will be avoided by all vehicles, test equipment and personnel.
			• Trees, large shrubs and hollow logs which may provide conservation significant fauna habitat will be avoided.
			• Appropriately experienced and licenced fauna spotter to be present to act as a fauna spotter and relocate fauna if required.
			• All excavations will be backfilled prior to leaving site to avoid fauna entrapment.
			• TTC and subcontractors will be required to remove all waste, including food waste, prior to leaving each test location.
				Slight	Possible	Low

Activity	Receptor	Potential Impact	Management Measures (Controls)	Residual Consequence	Residual Likelihood	Residual Risk Rating

	Soil	Spread of dieback causing ecosystem decline.
		Contamination of soil from hydrocarbon or chemical spills.
			• When travelling off DBCA access roads or informal tracks into dieback free or uninterpretable areas all vehicles and heavy machinery will be brushed down first.
			• When crossing dieback boundaries in vegetated areas all vehicles and heavy machinery vehicles will be brushed down when moving from:
			  ○ Dieback infected to dieback free areas;
			  ○ Dieback infected to uninterpretable areas; and
			  ○ Uninterpretable to dieback free areas.
			• Refuelling of light vehicles will be undertaken offsite or at Alcoa's designated refuelling bay at Myara.
			• Refuelling of the drill rig will need to occur onsite. Diesel for the drill rig will be stored in double skinned containers on support vehicles. Spill mats will be laid underneath the refuelling point and a spill kit kept on the support vehicle.
			• All wastes, including drill cuttings, will be removed from site and disposed of appropriately.
				Slight	Unlikely	Low

	Streams and Groundwater	Contamination of surface water or groundwater. Erosion of soil from cleared ground resulting in turbidity in streams.	• Refuelling of light vehicles will be undertaken offsite or at Alcoa's designated refuelling bay at Myara. • Refuelling of the drill rig will need to occur onsite. Diesel for the drill rig will be stored in double skinned containers on support vehicles. Spill mats will be laid underneath the refuelling point and a spill kit kept on the support vehicle. • All wastes, including drill cuttings, will be removed from site and disposed of appropriately. • Test holes will be backfilled with excavated material or surrounding topsoil to existing ground level with leaf litter respread. No stockpiles will remain onsite.	Slight	Unlikely	Low
	Heritage sites	Disturbance to Aboriginal or historic heritage sites.	• Archaeological and ethnographic Aboriginal heritage and historic heritage surveys completed across the Myara North region. • Test locations have been located to avoid heritage sites by at least 50m. • Alcoa pre-start briefing to TTC and subcontractors on potential Aboriginal heritage and historic heritage artefacts and procedures to address if found. • If any potential artefacts are found work will cease until Alcoa's Aboriginal heritage specialist can inspect the site and determine appropriate action.	Slight	Unlikely	Low

Activity	Receptor	Potential Impact	Management Measures (Controls)	Residual Consequence	Residual Likelihood	Residual Risk Rating
Accessing groundwater monitoring bores for sampling and maintenance	Threatened/ priority flora species	Disturbance to individual plants of threatened or priority flora species. Decrease in threatened or priority flora populations as a result of bushfire started by equipment.	• Ongoing vehicle access to groundwater bores for sampling and maintenance will only be allowed on existing DBCA access roads. Bores which are not located on DBCA access roads must be reached by foot to minimise potential disturbance to threatened/priority flora species. • No work will occur on Total Fire Ban and/or Harvest and Vehicle Movement Ban days.	Slight	Unlikely	Low
	Threatened/ priority fauna species	Death/injury to conservation significant fauna species. Increased predation on native fauna by introduced fauna attracted by food waste.	• All vehicles and machinery to limit speeds to 40km/hr when driving within State Forest 22. • TTC and subcontractors will be required to remove all waste, including food waste, prior to leaving each test location.	Slight	Possible	Low

4 Responsibilities

4.1 Alcoa Construction Coordinator

The Alcoa Construction Coordinator is responsible for:

- Reviewing and approving the TTC Job Safety Analysis Form;
- Coordinating a pre-start briefing with TTC;
- Ensuring incidents are investigated and recorded within Alcoa's incident management system; and
- Advising the Alcoa Environmental Representative of any incidents which relate to non-compliance with this plan or other environmental or heritage incidents.

4.1.1 Alcoa Environmental Representative

The Alcoa Environmental Representative will be responsible for:

- Reviewing the environmental and heritage elements of the TTC JSA;
- Attending the pre-start briefing with TTC to ensure all personnel are aware of the requirements of this plan;
- Monitoring Alcoa and TTC compliance with this plan;
- Investigating incidents relating to non-compliance with this plan or other environmental or heritage incidents; and
- Liaising with the DBCA and Water Corporation regarding the commencement and completion dates of work and other issues which may arise.

4.1.2 TTC Project Manager

The TTC Project Manager is responsible for:

- Defining environmental policies and objectives for this investigation;
- Providing adequate resources, in terms of human, time and financial, to fulfil its environmental responsibilities and ensure compliance with the requirements of this plan;
- Liaising with the Alcoa Construction Manager and TTC Supervisor when managing environmental issues;
- Conducting inspections to ensure TTC and subcontractor compliance with this plan;
- Reviewing the environmental performance of the investigation.

4.1.3 TTC Contractor Responsible Person

The TTC Contractor Responsible Person will be in the field at all times and will be responsible for:

- Preparing a JSA for Alcoa approval prior to commencement of work;
- Attending the pre-start briefing with Alcoa;
- Ensuring TTC and subcontractor employees comply with the requirements of this plan; and
- Reporting any incidents to the Alcoa Construction Manager as soon as possible.

4.1.4 TTC and Subcontractor Employees

All TTC and subcontractor employees will be responsible for

- Complying with all requirements of this EMP; and
- Immediately reporting all environmental incidents, non-compliances and near misses to the TTC Contractor Responsible Person.

5 Monitoring

The Alcoa Environmental Representative will monitor Alcoa personnel and contractor compliance with the requirements of this management plan. Non-compliances will be recorded as incidents in accordance with Section 6 below.

6 Incident Management

All incidents, non-compliances with this plan or other relevant Alcoa procedures, or stakeholder complaints will be recorded as incidents and investigated as part of Alcoa's Environmental Incident Reporting Guidelines. Incidents relevant to the scope of this Environmental Management Plan (EMP) will be reported to DBCA.

7 Stakeholder Consultation

Alcoa has consulted with the following stakeholders regarding the geotechnical investigation:

- DWER;
- Water Corporation; and
- DBCA.

This management plan will be submitted to the DBCA for review and approval as part of the Section 101 CALM Act Licence application.

8 Review

This management plan will be reviewed and updated:

- On receipt of comments from the DBCA as part of the Section 101 CALM Act Licence application assessment;
- Should the scope of the geotechnical investigation change significantly; or
- In the event of an environmental incident during the course of the geotechnical investigation or groundwater monitoring.

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Appendices

Appendix 1 - Geotechnical Test Locations (GDA94)

Test ID	Test Type	Easting (mGDA94)	Northing (mGDA94)
BHA1	Borehole	425692.16	6411070.12
KS-17	Test pit	424884.74	6409925.59
KS-18	Test pit	424934.77	6410412.45
KS-19	Test pit	425093.50	6410522.77
KS-20	Test pit	425240.30	6410731.02
TPA6	Test pit	425356.96	6413187.67
TPA7	Test pit	425110.10	6413513.02
TPA8	Test pit	424768.10	6413837.29
TPA9	Test pit	424470.13	6414309.65
TPA10	Test pit	424519.40	6414706.01
TPA11	Test pit	424851.71	6415126.28
TPA13	Test pit	424819.34	6416374.43
TPA14	Test pit	424837.68	6416815.97
TPA12	Test pit	424793.87	6415748.88
TPA15	Test pit	424867.13	6417661.28
BHRCA3	Borehole	424991.73	6418992.24
TPA17	Test pit	425000.53	6419485.27
TPA21	Test pit	424804.34	6421759.94
TPA18	Test pit	425150.81	6420015.09
TPA19	Test pit	425573.856	6420560.38
TPA20	Test pit	425193.49	6421359.41
TPB01	Test pit	424443.04	6414701.22
TPB02	Test pit	424066.69	6415054.63
BHRCB1	Borehole	423780.46	6415833.43
TPB04	Test pit	423459.81	6416039.49
TPB05	Test pit	423303.55	6416128.66
TPB06	Test pit	422862.10	6416446.83
TPB07	Test pit	422693.98	6416668.40
TPB08	Test pit	422559.10	6416883.04

WCBTP01	Test pit	422450.06	6417402.98
TPB09	Test pit	421799.13	6417815.08
BHRCB2	Borehole	421515.09	6417948.74
TPB11	Test pit	420713.61	6418534.26
TPB12	Test pit	420591.67	6419262.83
TPB13	Test pit	420347.70	6419623.07
TPC3	Test pit	428846.91	6410447.11
TPC7	Test pit	426522.73	6412994.26
TPWCC2	Test pit	427128.42	6412543.03
TPWCC1	Test pit	427982.81	6411361.09
MNBH-01	Borehole	423082.86	6416400.18
MNBH-02	Borehole	423009.49	6416481.55
MNBH-06	Borehole	423120.08	6416757.71
MNBH-07	Borehole	423152.91	6416649.27
MNBH-08	Borehole	423166.47	6416510.07
MNBH-09	Borehole	423224.18	6416741.59
MNBH-10	Borehole	423217.03	6416595.93
MNBH-11	Borehole	423414.90	6417082.35
MNBH-12	Borehole	423530.88	6417141.92
MNBH-13	Borehole	423726.63	6416571.36
MNBH-14	Borehole	423737.99	6416460.19
MN-01	Test pit	423789.02	6416615.33
MN-02	Test pit	423298.44	6416731.03
MN-10	Test pit	423814.67	6416465.85
MN-03	Test pit	423647.52	6416499.10
MN-04	Test pit	423639.47	6416614.17
MN-05	Test pit	423643.70	6416795.21
MN-06	Test pit	423713.96	6416809.16
MN-07	Test pit	423689.06	6416890.57
MN-08	Test pit	423610.54	6417024.44

MN-09	Test pit	423514.19	6416978.23
MN-11	Test pit	423298.57	6416839.57
MN-12	Test pit	423280.28	6416616.83
MN-13	Test pit	423275.71	6416468.33
TPFR-01	Test pit	423246.87	6417160.47
TPFR-02	Test pit	423012.64	6417233.33
TPFR-03	Test pit	422653.16	6417492.79
TPFR-04	Test pit	422330.85	6417720.22
TPFR-05	Test pit	422047.82	6417932.54
TPFR-06	Test pit	421588.39	6418333.06
TPFR-07	Test pit	421663.02	6419281.32
TPFR-09	Test pit	421114.67	6420847.59
WCFR-01	Test pit	421569.91	6420201.01
WCFR-02	Test pit	421257.46	6420587.88
WCFR-03	Test pit	420317.89	6421347.12
TPFR-11	Test pit	419778.88	6421550.05
WCFR-04	Test pit	419457.66	6422026.90
TPFR-12	Test pit	419361.18	6422340.18
WCFR-05	Test pit	419326.17	6422560.91
TPFR-13	Test pit	419045.49	6422893.14
TPJ02	Test pit	428304.29	6414847.01
TPJ03	Test pit	428145.32	6415301.16
TPJ04	Test pit	428106.22	6415724.46
TPJ05	Test pit	428251.75	6416031.78
TPJ07	Test pit	428219.41	6417144.43
TPJ06	Test pit	428249.50	6416496.79
TPJ08	Test pit	428044.7065	6417465.261
TPJ09	Test pit	427681.14	6417838.88
TPJ10	Test pit	427324.04	6418313.13
TPC04	Test pit	423927.90	6416385.88

TPC05	Test pit	424235.36	6416430.62
TPC01	Test pit	423473.65	6416329.88
TPC02	Test pit	423721.09	6416363.60
TPCC01	Test pit	422420.52	6416529.92
TPCC03	Test pit	421573.49	6416363.01
TPCC04	Test pit	421862.62	6415952.91
TPCC02	Test pit	422104.66	6416520.38
TPGG01	Test pit	420582.79	6418694.34
TPGG03	Test pit	419125.41	6419380.24
TPWCGG01	Test pit	418707.22	6419171.31
TPGG05	Test pit	418030.84	6418052.28
TPM07	Test pit	422763.88	6420642.26
TPM08	Test pit	422218.26	6420893.71
TPWCM02	Test pit	421714.58	6421078.81
T1	Test pit	426204.72	6413507.77
T2	Test pit	426468.16	6413599.09
T3	Test pit	426802.26	6413620.02
T5	Test pit	427649.25	6413959.97
T8	Test pit	424790.26	6419178.07
T9	Test pit	424223.035	6419234.75
T10	Test pit	423989.10	6419328.83
T13	Test pit	423256.10	6419986.59
T14	Test pit	423047.74	6420347.80
SARTP01	Test pit	420381.94	6418463.67
MNBH-15	Borehole	423556.84	6417010.55
T7	Test pit	428366.23	6414583.61
TPC5	Test pit	427557.77	6411895.08

Appendix 2 - Pinjarra Alumina Refinery Revised Proposal Detailed Flora and Vegetation Survey for Huntly Mine – Myara North (Mattiske, 2021)

ALCOA OF AUSTRALIA LIMITED

PINJARRA ALUMINA REFINERY REVISED PROPOSAL

DETAILED FLORA AND VEGETATION SURVEY

FOR HUNTLY MINE – MYARA NORTH

Prepared By

Mattiske Consulting Pty Ltd



DOCUMENT STATUS				
DOCUMENT REFERENCE: ALC2004/07/21				
VERSION	TYPE	AUTHOR/S	REVIEWER/S	DATE DISTRIBUTED
V1	Desktop - Internal review	Liam Rowles/ Jemima Wescombe	E. M. Mattiske	
V2	Desktop - Draft for client	Liam Rowles/ Jemima Wescombe	E. M. Mattiske	15/07/2020
V3	Desktop - Final report	E. M. Mattiske	E.M. Mattiske	5/08/2020
V4	Merged Report – Draft for client	E.M. Mattiske	E.M. Mattiske	03/02/2021
V5	Updated Report following review	E.M. Mattiske	E.M. Mattiske	12/04/2021
V6	Report following Edits	E.M. Mattiske	E.M. Mattiske	17/05/2021
V7	Final Report	E. M. Mattiske	E.M. Mattiske	18/07/2021

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LIST OF ABBREVIATIONS

BAM Act:	*Biosecurity and Agriculture Management Act 2007* (WA)
BC Act:	*Biodiversity Conservation Act 2016* (WA)
BOM:	Bureau of Meteorology
DAWE:	Department of Agriculture, Water and the Environment
DBCA:	Department of Biodiversity, Conservation and Attractions
DPIRD:	Department of Primary Industries and Regional Development
EP Act:	*Environmental Protection Act 1986* (WA)
EPA:	Environmental Protection Authority
EPBC Act:	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
MN:	Myara North survey area
IBRA:	Interim Biogeographical Regionalisation for Australia
PEC:	Priority ecological community
PMST:	Protected Matters Search Tool
TEC:	Threatened ecological community
TPFL:	Threatened and Priority Flora (WA Herbarium)
WAH:	Western Australian Herbarium (PERTH)

EXECUTIVE SUMMARY

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery by 5 per cent from 5.0 Million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite Mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel Region of Western Australia (WA), approximately 100 km southeast of Perth.

The Huntly Mine is located predominantly within the Shires of Murray, Serpentine-Jarrahdale and Boddington within the Peel Region of Western Australia. The Myara North mine area is south east of the town of Jarrahdale, and the Holyoake mine area is east of Dwellingup.

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

Mattiske Consulting Pty Ltd (Mattiske) was commissioned in May 2020 by GHD on behalf of Alcoa of Australia Ltd (Alcoa) to conduct a detailed flora and vegetation survey of the Myara North (MN) mine region. The MN survey area consists of the Myara North mine Development Envelope (DE) and adjacent conveyor and haul road corridors that connect the DE to the existing Huntly mine operations in the Myara North region.

Various databases were used to identify the possible occurrence of flora (including introduced, threatened and priority taxa) and threatened and priority ecological communities within the MN survey area. Vegetation plots established as part of this assessment were monitored in the spring months. Baseline vegetation grid mapping and targeted searches were completed over a much more diverse and spatially complex area than the permanent plots (i.e. landforms such as the slopes, ridges, swamps, broad valley systems, and outcrops), and as such, the six month monitoring window was considered comprehensive.

The MN survey area lies within the Interim Biogeographical Regionalisation for Australia (IBRA), with the survey area falling within the Northern Jarrah Forest subregion (JF1) of the Jarrah Forest (JAF) Region (DAWE 2020c). The geology of the region comprises lateritic duricrust, with drainage lines and occasional granite hills. The Northern Jarrah Forest subregion is characterised by Jarrah (*Eucalyptus marginata*) forest on ironstone gravels and Marri-Wandoo (*Corymbia calophylla* - *Eucalyptus wandoo*) woodlands on loamy soils, with sclerophyll understoreys.

Parts of the MN survey area and the nearby areas have previously been surveyed by E.M. Mattiske and Associates (Mattiske 1991 to 1993) and Mattiske Consulting Pty Ltd (Mattiske 1994 and 2019) at both a detailed level of flora studies and site-vegetation type mapping as well as at a regional mapping scale as part of the System 6 studies (Heddle et al. 1980) and the Regional Forest Agreement (RFA) project by Mattiske and Havel (1998). In addition, more local flora and vegetation values have been studied over some 40 years for a variety of clients including studies in the Wungong catchment north of the MN survey area (Mattiske Consulting 2009b, 2011b), the nearby Mt Cooke and 31 Mile Brook by Havel (1975a and 1975b), the recent re-mapping of 31 Mile Brook (Mattiske Consulting2011c), the extensive mapping for Alcoa within and near the MN survey area (E.M. Mattiske and Associates 1991 to 1993) and Mattiske Consulting Pty Ltd (1994 and 2019).

Potential Flora Values

The desktop assessment which was undertaken on the basis of a 20km radius using NatureMap (DBCA 2007-) and the Protected Matters Search Tool (DAWE 2020b) and a review of previous studies both within and near the MN survey area (E.M. Mattiske and Associated 1991 -1993 and Mattiske Consulting Pty Ltd (1994 – 2019).

The key findings from the desktop assessment were:

. 1454 vascular plant taxa, representative of 412 genera and 108 families, have the potential to occur within the MN survey area. The dominant families were Fabaceae (175 taxa), Proteaceae (121 taxa) and Myrtaceae (111 taxa). The dominant genera were *Acacia* (61 taxa), *Stylidium* (45 taxa) and *Drosera* (37 taxa).

. 17 threatened flora species and 49 priority flora species have the potential to occur in the MN survey area. These potential threatened and priority flora species were also related to underlying site preferences. The latter was based on information collated from Florabase (WAH 1998-), vegetation complexes and where available site-vegetation types. Several threatened species have only been recorded on the Swan Coastal Plain within the 20km radius and consequently are unlikely to occur in the MN survey area. The majority of potential Priority flora species were recorded in the main areas on granite outcrops (e.g. Mt Cooke, Mr Windsor and Mt Wells) to the north and east, and the eastern Jarrah forest in lower rainfall areas.

. A total of 192 introduced taxa have the potential to occur in the MN survey area. Ten of the introduced species are declared pest organisms pursuant to section 22 of the BAM Act. A further four of the introduced species are declared pest organisms pursuant to section 22 of the BAM Act, and are also listed as prohibited organisms pursuant to section 12 of the BAM Act. Ten of the introduced taxa are listed Weeds of National Significance. Another 12 of the introduced plant taxa with the potential to occur in the MN survey area have both High ecological impact and Rapid invasiveness ratings.

Recorded Flora Values

The survey efforts were undertaken over multiple years and seasons and therefore the coverage of the flora was considered to exceed the EPA (2016a and 2016b) guidance statements expectations. The flora and vegetation values were recorded in vegetation plots (20m x 20m with 20 x 2m x 2m quadrats within each plot), in regular recording sites (20m radius for trees and site parameters and 5m radius for understorey species in line with the methods defined in Havel (1975a and 1975b) and as used in previous site-vegetation type studies) and during targeted searches of the flora in the different landforms and soils. The vegetation plots were established in the spring months, the 2020 recordings on the grids was undertaken over a six month period and the targeted flora searches were undertaken over the six month period in all of the different landforms and soils.

The key findings from the detailed flora survey were:

. A total of 681 vascular taxa was recorded in the MN survey area and the adjacent areas.

. No Threatened flora species, pursuant to section 179 of the *EPBC Act* and as listed by DAWE (2020a) or pursuant to Part 2, Division 1 and Subdivision 2 of the *BC Act* and as listed by DBCA (2018a) were recorded during the detailed flora and vegetation survey of the MN survey area. The lack of threatened flora was a key outcome of the survey effort and as such reinforces the desktop assessment which found a moderate to low likelihood of threatened flora occurrence on the MN survey area.

. Fourteen Priority flora species as listed by DBCA (2018c) have been recorded in the MN survey area.

. During 2020, four Priority species were recorded within the specific MN survey area, namely *Acacia drummondii* subsp. *affinis* (P3), *Acacia horridula* (P3), *Conospermum scaposum* (P3) and *Stylidium scabridum* (P4).

. Additional Priority flora species (*Acacia oncinophylla* subsp. *oncinophylla, Boronia tenuis, Bossiaea modesta, Banksia recurvistylis, Grevillea crowleyae, Grevillea manglesii* subsp. *dissectifolia* and

Grevillea pimeleoides) were recorded on the fringes of the MN survey area and in nearby flora and vegetation studies in previous studies.

. The Priority flora species occur on the varying landform and soil groupings, namely - 41.9% in swamps, 58.1% on or near granite outcrops and 61.3% with lateritic gravelly soils.

. 58 introduced were recorded in the MN assessment. One of the introduced species is a declared pest organism pursuant to section 22 of the BAM Act, namely:**Gomphocarpus fruticosus* (DPIRD 2020). None of the introduced species are listed as a Weed of National Significance (WONS) (DAWE 2020d). Of the 58 introduced species, 8 have been ranked as High Ecological Impact by DPAW (2014) and 24 have been ranked as Rapid Invasiveness by DPAW (2014). **Gomphocarpus fructicosus* is associated with cleared and degraded, **Leptospermum laevigatum* is associated with areas near previous disturbance and tracks,**Watsonia meriana* is associated with valley floors and creek lines. The remainder are associated with degraded and completely degraded areas and fringes of road and tracks.

A key characteristic of the survey area is the shift in landforms and soils from west to east across the MN survey area and the latter is reflected in the change in the dominance of flora species that tolerate the broader valley systems, swamps and the outcrop areas. The summary of results from the plots and the recording sites as summarized by the site-vegetation types reflects this shift from species in the lateritic slopes and ridges and the broader valleys and outcrops.

Potential Vegetation Values

Based on the 20km radius database search, there are four threatened ecological communities (TECs) listed at Commonwealth level pursuant to sections 181 and 182 of the *EPBC Act* and listed by the DAWE (2020e) or at State level pursuant to Part 2 of the *BC Act* and as listed by DBCA (2018b) with the potential to occur within the MN survey area. None of the above mentioned TECs would occur in the MN survey area, as these threatened ecological communities are restricted to the Swan Coastal Plain and as such do not extend into the Jarrah forest area on the Darling Range associated with the Darling Plateau.

There is one botanical PEC, listed at State level (Granite Communities of the northern Jarrah Forest), which has been designated within the MN survey area. There is a potential that the site-vegetation types associated with granite outcrops (site-vegetation types G and R as defined by Mattiske utilising the definitions of Havel (1975a and 1975b) will have affinities with the PEC. Clarification of the latter affinities necessitated comparisons with the granite areas studied by Markey (1997) on the northern Darling Scarp (pers comm. J. Pryde DBCA). In this context there are some species that reflect the presence of exposed or shallow granite outcrops; however these species tend to occur on wider areas of granites and the differentiation on whether all granite areas in the southwest should be aligned is open to interpretation.

Recorded Vegetation Values

The survey efforts were undertaken over multiple years and seasons and the coverage of the vegetation was considered to exceed the EPA (2016a and 2016b) guidance statements expectations. The vegetation values were recorded in vegetation plots (20m x 20m with 20 x 2m x 2m quadrats within each plot), in regular recording sites and from aerial photographic imagery interpretations. The vegetation plots were established in the spring months, the 2020 recordings on the grids was undertaken over a six month period.

The key findings from the detailed vegetation survey were:

. 32 site-vegetation types were defined and mapped on the MN survey area. The delineation of the site-vegetation types was based on the interpretation of the ranking data for the flora species and the underlying landforms and soils.

. A range of analyses were on the vegetation plot data and a reliance was placed on keystone species as defined by Havel (1975a and 1975b) and as modified by Mattiske for the northern Jarrah forest. The continuum nature of the vegetation was reflected in the findings for the site-

vegetation types which occur on the lateritic slopes and ridges and the more distinct communities on the swamps and broader valley systems.

. The site-vegetation types were subdivided into six main groupings associated with site conditions which reflected landforms, soils and soil moisture levels. The site-vegetation types on the extreme sites such as granite outcrops and broad valley systems and swamps differ markedly from the forest and woodland areas on the slopes and ridges.

. No Threatened Ecological Communities (TECs) occur in the MN survey area.

. The only botanical Priority Ecological Community has some affinities with the values in G and R (and variants). There is a lack of clarity on the values that determine the presence of the Priority Ecological Community other than the association with the outcrops. On a local scale the outcrop areas are locally very variable from lithic complexes to heaths to open woodlands. The species as recorded by Markey (1997), on the granite outcrops to the west on the Darling Scarp, were compared with those recorded in the site-vegetation types G and R by Mattiske Consulting team in 2020. Of these the main keystone species include *Calothamnus quadrifidus, Borya sphaerocephala, Grevillea bipinnatifida, Allocasuarina humilis* and *Babingtonia camphorosmae*. Of these species the initial four species are associated with shallow soils and granite outcrops. The *Babingtonia camphorosmae* is associated with seasonally moister soils which may occur in a range of site conditions including near run-off areas near granite outcrops.

. A few areas supporting patches of larger trees were designated as potential fauna habitats. These sites supported a mixture of trees with a diameter at breast height greater than 50cm.

Potential Groundwater Dependent Ecosystems

The potential groundwater dependent ecosystems were determined on the basis of the vegetation complexes and when the more detailed site-vegetation type mapping was available the initial interpretations were updated. The dominant and key indicator species which occur in moister and wetter soils on the swamps and lower slopes of the valley systems underpinned the selection of the potential groundwater dependent ecosystems.

Old Growth Forest Areas

State Government mapping indicates that there is a number of patches of Old Growth Forest occurring in the area surrounding the MN survey area, with some occurring within 10 km of the survey area boundary to the north, south, east and west. A small section of Old Growth Forest intersects the survey area in the central part of the south-western boundary of the MN survey area. The survey did not identify any additional areas within the survey area that could potentially be un-mapped Old Growth Forest, based on Department of Parks and Wildlife criteria (DPAW 2017).

Vegetation Condition

The vegetation condition rating was adapted from the EPA (2016b) guidance statement and the earlier work by Keighery (1994) and Trudgen scale (1988), Appendix A5. The condition in the MN survey area was determined on the basis of previous harvesting (DBCA 2020 supplied data), dieback mapping (Glevan Consulting 2020), site-vegetation types as defined and mapped by Mattiske Consulting Pty Ltd, detailed data on logging debris, residual stumps and numbers and types of larger trees (>50cm Diameter at Breast Height). Whilst some forest areas were identified with patches of larger trees that have the potential values of some areas for fauna habitats. Less stumps and logging activities were recorded within the swamp areas and on lower sandier soils in the broader valley types; although dieback disease from *Phytophthora cinnanomi*) has influenced many of the valley systems in the MN survey area (Glevan Consulting 2020).

1. INTRODUCTION

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery by 5 percent from 5.0 Mtpa to 5.25 Mtpa and transition the Huntly Bauxite Mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel Region of Western Australia (WA), approximately 100 km southeast of Perth.

The Huntly Mine is located predominantly within the Shires of Murray, Serpentine-Jarrahdale and Boddington within the Peel Region of Western Australia. The Myara North mine area is south east of the town of Jarrahdale, and the Holyoake mine area is east of Dwellingup.

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

Mattiske Consulting Pty Ltd was commissioned in May 2020 by GHD on behalf of Alcoa of Australia Ltd (Alcoa) to conduct a detailed flora and vegetation survey of the MN region.

1.1. Location and Scope of Proposal

The MN survey area lies within tenement ML 1SA. The MN survey area consists of the MN mine Development Envelope (DE) and adjacent conveyor and haul road corridors that connect the DE to the existing Huntly mine operations at the Myara region, Figure 1. The MN survey area lies within the Northern Jarrah Forest subregion of the Southwest Botanical Province (Beard 1990), approximately 50 km south east of Perth, WA (Figure 1).

Parts of this region have previously been surveyed by Mattiske Consulting Pty Ltd between 1991 and 2020 at both a detailed level of site-vegetation type mapping as well as at a regional mapping scale as part of the Regional Forest Agreement (RFA) project by Mattiske and Havel (1998). These studies built on the earlier work of Havel (1975a and 1975b) in the northern Jarrah forest.

This report describes the potential and recorded flora and vegetation values of the MN survey area and places them within a local and regional context.

1.2. Environmental Legislation and Guidelines

The following key Commonwealth (federal) legislation relevant to this survey is the:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The following key Western Australian (state) legislation relevant to this survey includes the:

- *Biodiversity Conservation Act 2016* (BC Act);
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) and *Regulations 2013*;
- *Environmental Protection Act 1986* (EP Act); and
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

Furthermore, key Western Australian guidelines relevant to this survey are the:

- *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority [EPA] 2016a); and
- *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b); and.

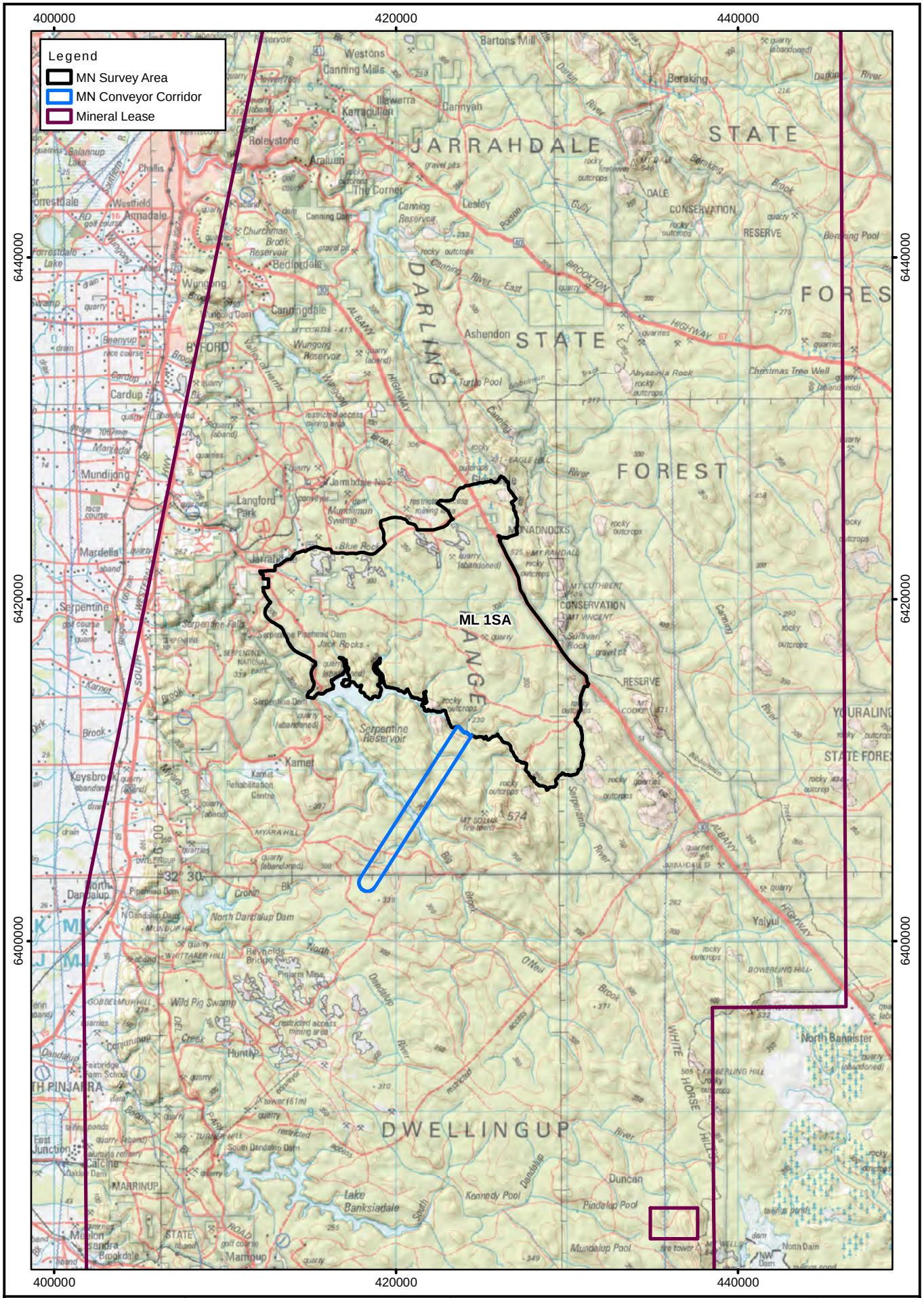
- *Commonwealth of Australia (2013) - Survey Guidelines for Australia's Threatened Orchids. Guidelines for detecting Orchids listed as "Threatened" under the Environment Protection and Biodiversity Conservation Act 1999.*

Definitions of flora and vegetation terminology commonly used throughout this report are provided in Appendix A1-A5.

2. OBJECTIVES

The objective of this assessment was to undertake a detailed flora and vegetation survey of the Myara North (MN) survey area, including:

- Undertake a desktop assessment of the potential native and introduced flora, threatened and priority flora, vegetation, threatened and priority ecological communities, vegetation condition, potential groundwater dependent ecosystems and old growth forests in the MN survey area;
- . Review the matters of local, regional, state and national conservation significance associated with the MN survey area;
- Undertake a detailed assessment of the flora and vegetation of the MN survey area, with an emphasis on native and introduced flora, threatened and priority flora, vegetation, threatened and priority ecological communities, vegetation condition, potential groundwater dependent ecosystems and old growth forests;
- Review previous literature and current databases associated with the MN survey area;
- Review the conservation status of the vascular plant species recorded by reference to current literature and current listings by the Department of Biodiversity, Conservation and Attractions (DBCA 2018a, 2018c) and plant collections held at the Western Australian Herbarium ([WAH] 1998 -), and plants listed by the Department of Agriculture, Water and the Environment [DAWE] (2020a) under the EPBC Act;
- Review the conservation status of the vegetation values recorded by reference to current literature and current listings by the Department of Biodiversity, Conservation and Attractions (DBCA 2020a, 2020c) Department of Agriculture, Water and the Environment [DAWE 2020e) under the EPBC Act;
- Prepare a report summarising the findings.


Legend
MN Survey Area
MN Conveyor Corridor
Mineral Lease
400000
420000
440000
6440000
6420000
6400000
ML 1SA
JARRAHDALE
DARLING RANGE
STATE FOREST
DWELLINGUP
Serpentine Reservoir
Serpentine Falls
Jarrahdale No 2
Wungong Reservoir
Canning Reservoir
Churchman Brook Reservoir
Bedfordale
Kelmscott
Armadale
Roleystone
Kenwick
Bartons Mill
Beraking
Darlington
Karragullen
Araluen
The Corner
Lesley
Ashendon
Canningdale
Mundijong
Langford
Cardup
Byford
Serpentine
Mardella
Keysbrook
Karnet
Yalyul
North Bannister
Duncan
Marrinup
Lake Banksiadale
Kennedy Pool
Pindalup Pool
Mundalup Pool
Wild Pig Swamp
Huntly
Reynolds Bridge
North Dandalup Dam
South Dandalup Dam
Serpentine Dam
Jack Rocks
Blue Rock
Mundlimun Swamp
Turtle Pool
Abyssinia Rock
Christmas Tree Well
Mt Randall
Mt Cuthbert
Mt Vincent
Mt Solus
Mt Cooke
Eagle Hill
Gobbelmup Hill
Bowerling Hill
Kitterling Hill
Myara Hill
Whittaker Hill
Twin Peaks Hill
Conjunup Creek
Cronin Brook
Myara Brook
Dandalup River
Serpentine River
Canning River
Albany Highway
Brookton Highway
Karnet Rehabilitation Centre
Pinjarra Mine
Darlington Reservoir
Canning Dam
Serpentine Pipehead Dam
North Dandalup Dam
South Dandalup Dam
Dandalup Dam
Lesley Gully
Poison Gully
Beraking Pool
Turtle Pool
Kennedy Pool
Pindalup Pool
Mundalup Pool
Lake Banksiadale
Jack Rocks
Sullivan Rock
Eagle Hill
Mt Curtis
Mt Randall
Mt Cuthbert
Mt Vincent
Mt Solus
Mt Cooke
Kitterling Hill
Bowerling Hill
Gobbelmup

3. METHODS

3.1. Desktop Assessment

The NatureMap (DBCA 2007-) and *EPBC Act* Protected Matters Search Tool (DAWE 2020b) databases were used to identify the possible occurrence of flora (including threatened and priority taxa) and threatened and priority ecological communities within the MN survey area.

Searches within NatureMap were centred on the point -32° 21' 54" S, 116° 10' 23" E. A search radius of 20 km. The search parameters used for the *EPBC Act* Protected Matters Search Tool search were the same as those for the NatureMap search. The databases of threatened and priority flora and ecological communities (DBCA 2007-, 2018a. 2018b, 2020a. 2020b) were arranged by CAD Resources (Carine, WA). In addition, any flora recorded by E. Mattiske and Associates) and Mattiske Consulting Pty Ltd (1991-2020) within or adjacent to the survey areas were included. Data was also supplied by the DBCA in 2020 on the timber harvesting and old growth forest records.

In addition, historical documentation and vegetation mapping of the Northern Jarrah forest subregion that provide resource material for the floristics and vegetation of the MN survey area was reviewed, including (E.M. Mattiske and Associates 1991 to 1993) and Mattiske Consulting Pty Ltd (1994 and 2019) reports on their flora and vegetation surveys in the MN survey area. Nomenclature of flora species was checked against and is consistent with Florabase (WAH 1998-).

3.2 Field Surveys

To maintain consistency with previous mapping of the area, enabling spatial and temporal comparisons, flora and vegetation were assessed using site-type classification based on Heddle *et al.* (1980). Sites were pre-designated using a 120 x 120 m grid system overlaid on the survey area. Additional opportunistic sites were surveyed when changes in the vegetation, representing communities which would otherwise have been missed, were encountered whilst walking between designated survey sites. Site data was used to define vegetation types for each survey site. This data was then used in combination with aerial imagery and field observations to map the vegetation of the survey area. Searches for threatened, priority or weed (introduced species) species were undertaken during the field survey work both during the grid survey work and through additional coverage of areas.

The following information was recorded at each vegetation assessment site:

GPS location	Easting, Northing and datum;
Soil types	gravels, sandy-gravels, sandy-loam-gravels, sandy-loams, loams, clay-loams, clays and peat;
Topography	ridge, upper slope, mid-slope, lower slope, valley floor and swamp;
Outcropping	type – granite, laterite, dolerite, and quantity – few, moderate, numerous;
Logging history	light, moderate or heavy, together with number of stumps within a 20 m radius;
Fire history	years since last fire; and
Dieback occurrence	*Phytophthora* spp. demarcation – field blazing, coloured flagging on trees, vegetation deaths, either old or recent.

At each site species were ranked according to the scale developed by Havel (1975a, 1975b). Tree and understorey species were assessed separately using the following method.

Tree species

Tree species (*Allocasuarina fraseriana, Banksia grandis, B. littoralis, B. seminuda, Corymbia calophylla, Eucalyptus marginata, E. megacarpa, E. patens, E. rudis, E. wandoo, Melaleuca preissiana, M. rhaphiophylla, Nuytsia floribunda, Persoonia elliptica, P. longifolia* and *Xylomelum occidentale*) were assessed within a 20m radius from the observation point using the following scale:

0 absent;

1 one or two trees;
2 three to five trees;
3 more than five trees, but contributing less than one third of the total stand;
4 between one third and one half of the total stand; or
5 more than one half of the total stand.

Understorey species

Understorey species were assessed within a 5m radius from the observation point using the following scale:

0 absent;
1 very rarely seen, only after a careful search;
2 present, observable, but in small numbers only;
3 common locally, but not uniform over the whole area;
4 common over the whole area; or
5 completely dominating the understorey.

The physiological stress was determined for each species within a 20m radius from the observation point and ranked according to the following scale.

0 healthy, no evidence of stress;
1 odd plant showing signs of stress, not dead;
2 one or two dead plants, near death;
3 scattered stressed plants, (2-4) dead plants around survey site;
4 susceptible plants dying or dead (> 4 plants); or
5 "graveyard" death

The vegetation and condition conditions rating was based on Keighery (1994) and Trudgen scale (1988), Appendix A5. The condition in the MN survey area was determined on the basis of previous harvesting (DBCA 2020 supplied data), dieback mapping (Glevan Consulting 2020), site-vegetation types as defined and mapped by Mattiske Consulting Pty Ltd, detailed data on logging debris, residual stumps and numbers and types of larger trees (>50cm Diameter at Breast Height), introduced species, degree of disturbance and stages of rehabilitation. Some condition states may be temporary and assessed on current status rather than potential condition state. In areas not traversed, interpretation was based on recent aerial photographic interpretation, previous studies in the area and extrapolation from adjacent areas. Some forest areas were identified with patches of larger trees that have the potential values of some areas for fauna habitats. These sites supported a mixture of trees with a diameter at breast height greater than 50cm. Although previous logging activities and fires may have influenced the flora and vegetation values, the underlying factors such as site tolerances and seasonal conditions have been delineated as key drivers of the flora and vegetation values by a range of authors in the northern Jarrah forest (Havel 1975a, 1975b, Heddle et al. 1980, Mattiske and Havel 1998, Havel 2000). The current state of rehabilitation areas was also considered in the condition rating and as indicated by Grant and Koch (2007) and Daws *et al*. (2021) may be influenced by a range of factors related to age of rehabilitation, site treatments that will influence the resulting structural and floristics on different areas. Consequently, condition states are related to a range of factors and criteria and in this context as such differ from the more generic one in the EPA (2016b) Guidance Statement.

All plant specimens collected during the field survey were dried and processed in accordance with the requirements of the Western Australian Herbarium (WAH). All plant specimens were identified through comparisons with pressed specimens housed at the WAH. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the WAH (1998-).

Twenty-two plots (plots 20m x 20m with 20 x 2m x 2m quadrats in each plot corner and in centre) were established in the dominant site-vegetation types. In each quadrat of each plot data was collected on densities and foliage cover for all species present in the quadrats. The location of each plot was designated

by a peg in the north-west corner and also by recording the northwest easting and northing (GDA94 Datum). This data was then combined with selected previous plot data collected by Mattiske teams and also Alcoa environmental teams within the MN survey area and nearby forest areas. This combined data set was then analysed (Section 3.3).

3.3 Data Analysis

Data analysis of recording sites was undertaken by reference to the interpretation of the presence of keystone species as developed and defined by Havel (1975a and 1975b) and as further developed by Mattiske over some 40 years of extensive vegetation mapping in the northern Jarrah forest. In addition, the position in the landscape, the type or landform and soils and the presence of granite outcrops were taken into consideration in the delineation of site-vegetation types. To enable integration with the surrounding vegetation mapping undertaken over these 40 years by Havel (1975b) and E. Mattiske and Associates (1988-1993) and Mattiske Consulting (2006-2019) the definition of the site-vegetation types were maintained with only slight changes to accommodate local variants.

The vegetation plot data (plots 20m x 20m with 20 x 2m x 2m quadrats in each plot corner and in centre) from the MN survey area and from the previous areas in close proximity to MN survey area from previous plot data in the Jarrahdale and Myara/Huntly areas were combined and analysed using the Plymouth Routines in Multivariate Ecological Research v7 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites on the basis of their species composition (Clarke and Gorley 2015). A range of analyses were undertaken including inclusion of presence/absence data, quantitative data. Introduced species, annual species were excluded from the data set prior to analysis. A range of analyses were undertaken on the plots and as a result a reliance was placed on presence/absence and quantitative foliage cover data keystone species as defined by Havel (1975a and 1975b) and as modified by Mattiske (1988 to 2019) for the northern Jarrah forest. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Hierarchical Clustering (CLUSTER) was used in conjunction with Similarity Profile (SIMPROF) and plot descriptions; combining these methods increased the understanding of plot inter-relations and thus the ability to interpret trends in the survey area.

3.4. Survey Limitations

A general assessment was made of the current survey against a range of factors that may have limited the outcomes and conclusions of this report (Table 1).

Table 1: Potential flora and vegetation survey limitations for the Myara North survey area

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (*i.e.* pre-existing background versus new material)	Minor constraint: Reference resources such as mapping by Beard (1979), Mattiske and Havel (1998), previous vegetation mapping completed for Alcoa by E.M Mattiske and Associates together with online flora and vegetation information, has provided an appropriate level of information for the current survey. In view of the lack of DBCA data within the defined PEC areas within the MN survey areas affinities with communities on granite outcrops on the Darling Scarp as defined by Markey (1997) raises some issues on which species and site-vegetation types associated with granite outcrops should be aligned with the PEC as defined by DBCA 2020a. A conservative approach was adopted and as such there was a reliance on the site-vegetation types G and R as defined by Havel (1975a, 1975b) and as defined and mapped previously in the northern Jarrah forest.
Scope (*i.e.* what life forms, *etc.*, were sampled)	Not a constraint: Vascular flora, which were the focus of the present survey was sampled on a close grid pattern within the survey area and with an additional 22 Myara plots (20m x 20m) which were integrated with the previous nearby plots near Jarrahdale (14 plots), on the previous mapped areas and in nearby Huntly and Myara forest areas (74 plots) as established by Alcoa which resulted in a total of 110 plots of which 28 occur within or on the fringes of the MN survey area.

Table 1: Potential flora and vegetation survey limitations for the Myara North survey area

Potential Survey Limitation	Impact on Survey
Proportion of flora collected and identified (based on sampling, timing and intensity)	Not a constraint: The survey areas has been sampled over multiple years from previous assessments near Jarrahdale and within the Huntly and Myara areas with the more recent work on the detailed records on the grid system, targeted tracks and extra targeted work on granite areas and in the permanent plots as established. The recent survey effort in the majority of the areas was undertaken in both winter, spring and summer months in 2020 (June to December 2020), with the majority of the work being undertaken in the spring months. The botanists undertaking the field surveys have had extensive experience working with the flora of the Jarrah forest. Any flora which could not be identified in the field was collected for subsequent identification. 91 of the taxa recorded were unable to be identified due to lack of flowering and fruiting material. The majority of the 91 species were unlikely to be threatened and priority flora species. Most of these species occurred as sterile plants (e.g. *Lomandra*, *Lepidosperma, Haemodorum* or *Drosera* species) in genera where conservation status of local species is not applicable.
Mapping reliability	Not a constraint: The vegetation was mainly assessed on a 120m x 120m grid pattern within the survey area. A total of 120 vegetation plots have been established by Alcoa and Mattiske (including an additional 22 plots within the 2020 MN survey area) and 13,556.79 kilometres were surveyed within the Huntly/Myara survey area. This together with over 6000 recording sites and the targeted and opportunistic survey sites (particularly near the granites and swamp areas) enabled intensive coverage of the values on the MN survey area and therefore the associated mapping of key flora values and the site-vegetation types with a high level of confidence.
Timing, weather, season, cycle	Not a constraint: The EPA (2016a) recommends that flora and vegetation surveys in the South – West Botanical Province be conducted in Spring (September-November). The intensive work undertaken in sections of MN has enabled coverage of different seasons with a concentration of effort in the spring months of 2020. The detailed survey work commenced in June and was completed largely by the end of November 2020. As indicated in Figure 2 the seasonal rains occurred in the winter months prior to survey work and although it was drier in some months the rans in May, September and November were higher than the long term averages and hence has not influenced the coverage of the flora. All of the survey sites on the grid systems were supplemented by a series of new and previous permanent plots (20m x 20m) and targeted work on the flora. The majority of the conservation significant flora can be recorded out of season with the exception of the Orchid species (which require flowering material, e.g. *Paracaleana granitica), Tetratheca phoenix, Pimelea rara* and *Stylidium ireneae*. However, the *Paracaleana granitica* and *Tetratheca phoenix* are associated with granitic outcrops which have been less disturbed by activities in the area. Further detailed work has been undertaken in the northern Jarrah forest and near creeklines in the adjacent Serpentine and Huntly area in different seasons (including spring months) and therefore the risks remain relatively low. These assessments have included multiple assessments of plots and transects in nearby Wungong catchment (2009b, 2011b) for the Water Corporation and also in plots for Alcoa.
Disturbances (fire flood, accidental human intervention, *etc.*)	Minor constraint: The majority of the survey area has been subject to previous logging activities and recreational activities, the vegetation of the survey area has been influenced to varying degrees by such activities. Sections of the survey area has been burned in recent years and consequently there was a need to rely on the key perennial species for site-vegetation type mapping. The dieback disease (*Phytophthora cinnamomi*) has also influenced the distribution of flora species in the MN survey area.
Access problems (*i.e.* ability to access survey area)	Not a constraint: Vehicle access through the MN area was only restricted in a small sections in the south that can be covered by foot traverses; although it did lead to a slight decrease in foot traverses and coverage. This southern areas was less diverse than the eastern and northern eastern broader valley systems.
Experience levels (*e.g.* degree of expertise in plant identification to taxon level)	Not a constraint: All botanists had direct and recent experience working in the Jarrah Forest and working for Alcoa and a range of other clients, and thus were familiar with the local flora and vegetation values. Dr Mattiske has more than 40 years of ecological experience in flora and vegetation studies in the southwest forests at a detailed floristic level, as well as detailed and regional vegetation assessment level. The experienced botanists in the Mattiske team included 3 members with more than 7 years in the Jarrah forest and the majority of the other botanists had more than 3 years of intensive Jarrah forest mapping and monitoring plot experience. Plant identifications were assisted by three botanists with more than 7 years working on the identification of flora from the Jarrah forest.

4. DESKTOP FINDINGS

The climate, geology, soils and landforms all influence the vegetation of the area and are described in this section. Potential flora, including threatened, priority and introduced species are described, along with possible vegetation communities, and placed within a local and regional context.

4.1. Climate

Beard (1990) described the climate of this area as being warm Mediterranean, with rainfall of 600 – 1200 mm per annum and 5 - 6 dry months per year. The closest weather station is the Jarrahdale and Karnet weather stations, approximately 1.6km and 11.1km from Jarrahdale town. Annual average rainfall at Jarrahdale (1991-2020) is 1169.2 mm (Bureau of Meteorology [BOM] 2021). Rainfall in 2020 was lower in June, July, August and October and higher in May, September and November (Figure 2). These fluctuations led to an extended spring season following peaks of rain in September and November 2020.

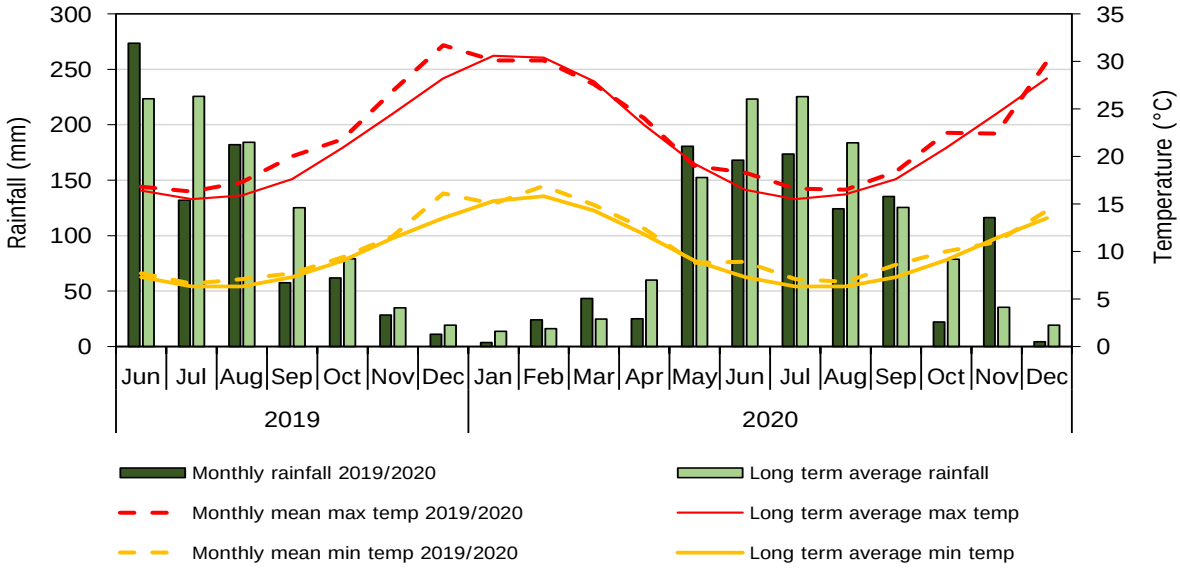


Figure 2: Climatic data for the Myara North survey area
Long term average rainfall and temperature from the Jarrahdale and Karnet weather station (ID 009023 and 009111 respectively, years 1991-2020) (BOM 2020).

4.2. DBCA Estates

The MN survey area is situated in State Forest, with the Serpentine National Park to the west of the survey area, and the Monadnocks Conservation Park to the east (Figure 3).

The Holyoake survey area occurs within the Regional Forest Agreement (RFA) area of the southwest forests DAWE (2020b) and as such was considered during the RFA process.

4.3. Geology, Soils and Topography

The MN survey area is situated within Beard's (1990) Northern Jarrah Forest subregion of the Southwest Province. The Northern Jarrah Forest subregion encompasses the area to the east of the Darling Scarp, overlying Archaean granite and metamorphic rocks of the Yilgarn Craton at an average elevation of 300 m (Beard 1990). The area is capped by extensive lateritic duricrust, dissected by drainage lines and broken

by occasional granite hills. In the eastern section, the laterite becomes deeply dissected until it compresses isolated remnants. The duricrusted plateau of the Yilgarn Craton is characterised by lateritic gravels, consisting of 5 m or more of ironstone gravels in a yellow sandy matrix, and related lateritic podzolic soils with ironstone gravels in a sandy surface horizon. These overlay mottled yellow-brown clay subsoils and hard setting loamy soils, which become evident in the east (Beard 1990).

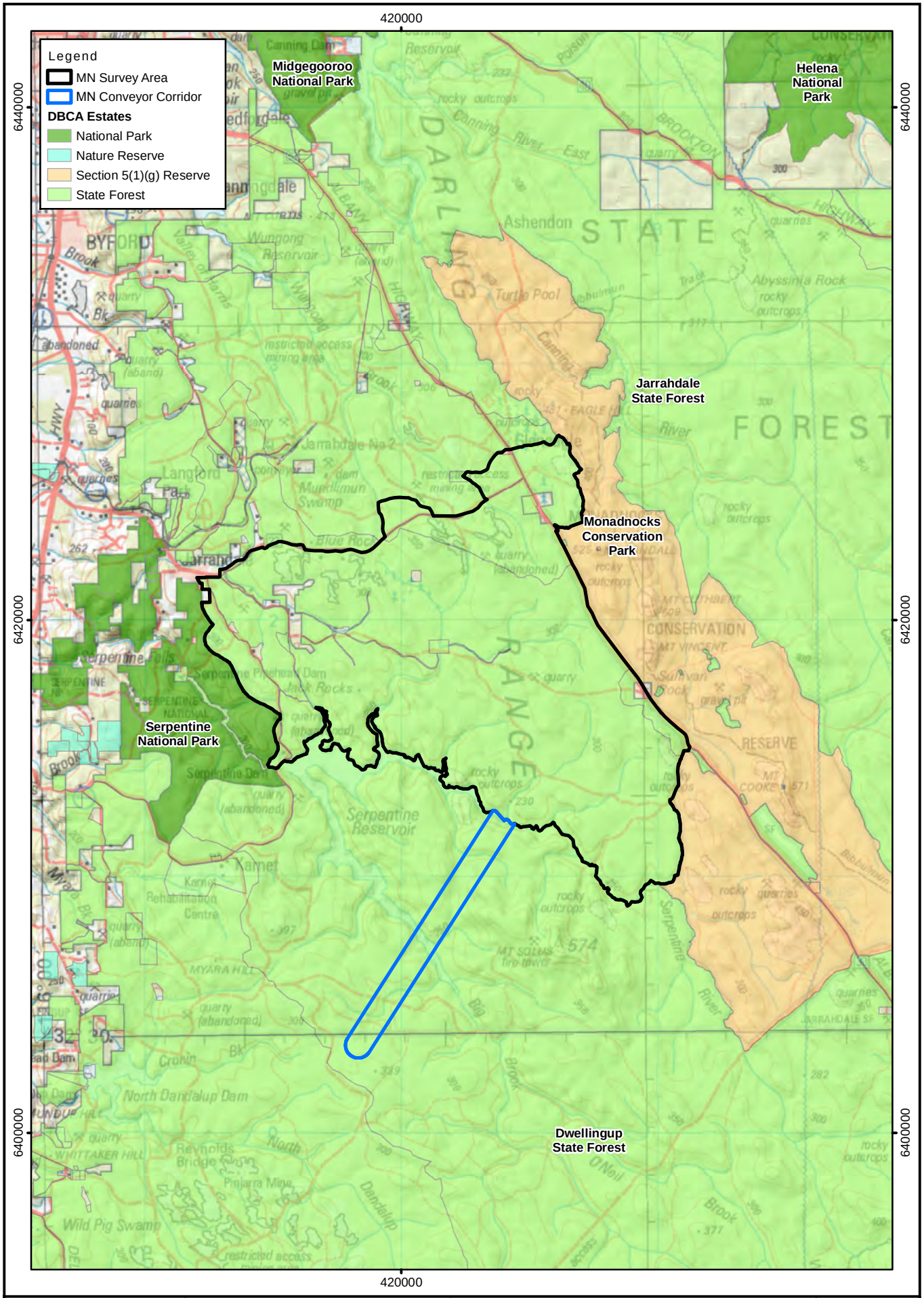
The Department of Primary Industries and Regional Development's (DPIRD) Land Systems present within the MN survey area (Figure 4, Table 2) includes:

1. Darling Plateau System (255Dp): Lateritic plateau. Duplex sandy gravels, loamy gravels and wet soils. Jarrah-marri-wandoo forest and woodland.

2. Murray Valleys System (255Mv): Western Darling Range from the Avon Valley to Harvey. Deeply incised valleys with red loamy earths, shallow duplexes and rock outcrop and Jarrah-marri-wandoo forest and woodland with mixed shrubland.

Table 2: Extent of Land Systems intersecting the Myara North survey area

Land System	Mapping Unit	Total Extent (ha)	Area of Intersection with the Myara North survey area (ha)	Area of Intersection with the Myara Conveyor Corridor (ha)	Proportion of Current Extent (%)
Darling Plateau System	255Dp	820265.76	15714.87	833.42	2.02
Murray Valleys System	255Mv	132642.63	1734.07	258.34	1.50



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Scale: 1:200,000
MGA94 (Zone 50)

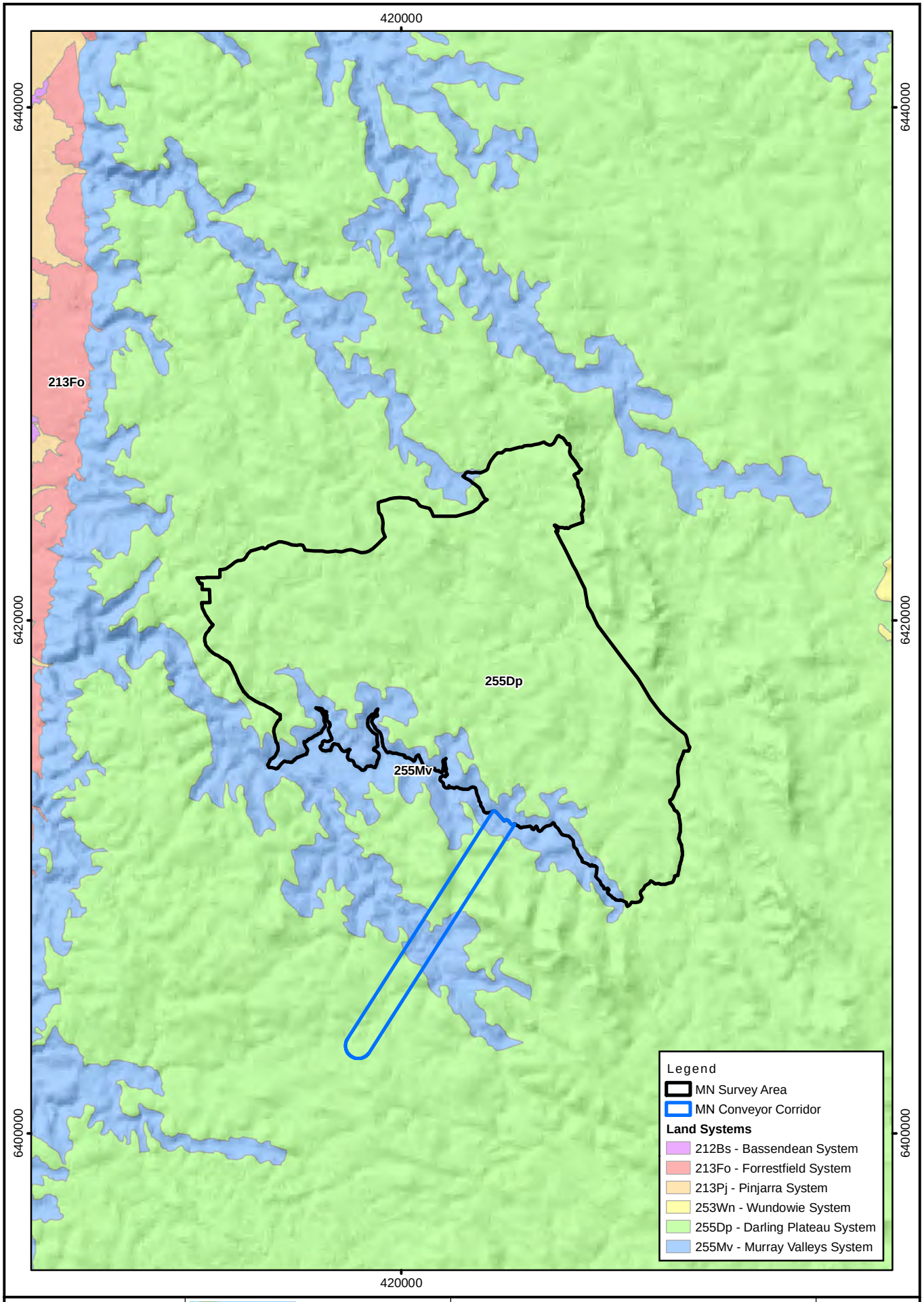
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DBCA Estates
Myara North survey area

Figure: **3**



N

0 1.5 3 km

Scale: 1:200,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F01_04

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Land Systems of the Myara North survey area

Figure: **4**

Furthermore, Western Australia is divided into twelve Systems, separated by natural and demographic boundaries (Department of Conservation and Environment 1980). The survey area lies within the Darling System (as known as System 6), which is further divided into provinces, with the survey area lying in The Darling Plateau province (Department of Conservation and Environment 1980).

The six underlying landform and soil units of the Darling Ranges of Darling Plateau were defined by Churchward and McArthur (1980) and have been updated into eleven soil landscape mapping units (DPIRD 2020 dataset) (Figure 5), namely:

Dwellingup: Gently undulating landscape with duricrust on ridges; sands and gravels in shallow depressions.

1097 Dwellingup Subsystem – Divides, lower to upper slopes and hillcrests. Duplex sandy gravels and loamy gravels with minor areas of shallow gravels, deep sandy gravels, yellow deep sands and yellow and pale deep sands, often gravelly.

3998 Dwellingup 2 Phase - Very gently to gently undulating terrain (<10%) with well drained, shallow to moderately deep gravelly brownish sands, pale brown sands and earthy sands overlying lateritic duricrust.

Murray: Deeply incised valleys with red and yellow earths on slopes; narrow alluvial terraces.

4738 Murray Subsystem - Deeply incised valley of the Murray River; red and yellow earths and minor duplex soils; occasional rock outcrops; narrow sandy terrace.

Yarragil: Valleys of the western part of the plateau; sandy gravels on the slopes; orange earth in swampy floors.

1187 Yarragil Subsystem - Shallow, narrow, upper valleys of the deeply dissected Murray, Bindoon and Helena units. Alluvial, clay and loam soils, moderately well drained, often gravelly, with some sands and loams. Salt prone. Woodland of *E. wandoo, E. accedens.*

4000 Yarragil 1 Phase - Very gentle to moderately inclined concave sideslopes. Moderately well drained yellow duplex soils and yellow and brown massive earths and gravels. Woodland of *E. wandoo, E. marginata, E. accedens. Casuarina obesa* on salt affected areas.

4003 Yarragil 4 Phase - Valley floors with some poorly drained mottled yellow duplex soils and gentle lower slopes with moderately well to well drained loamy and sandy earths, gravels and duplex soils. Low woodland of *E. wandoo, E. marginata* and *Acacia* spp..

6360 Yarragil Swamp Phase - Level to very gently inclined valley floors. Swampy river flats and terraces in granitic rocks; loamy and sandy duplex, wet soils, non-cracking clays and loams.

6820 Yarragil DpYGh Phase - Very gentle to moderately inclined (<20%) concave valley sideslopes. Moderately well drained yellow duplex soils and yellow and brown massive earths.

Other landform and soil units occurring in the survey area include:

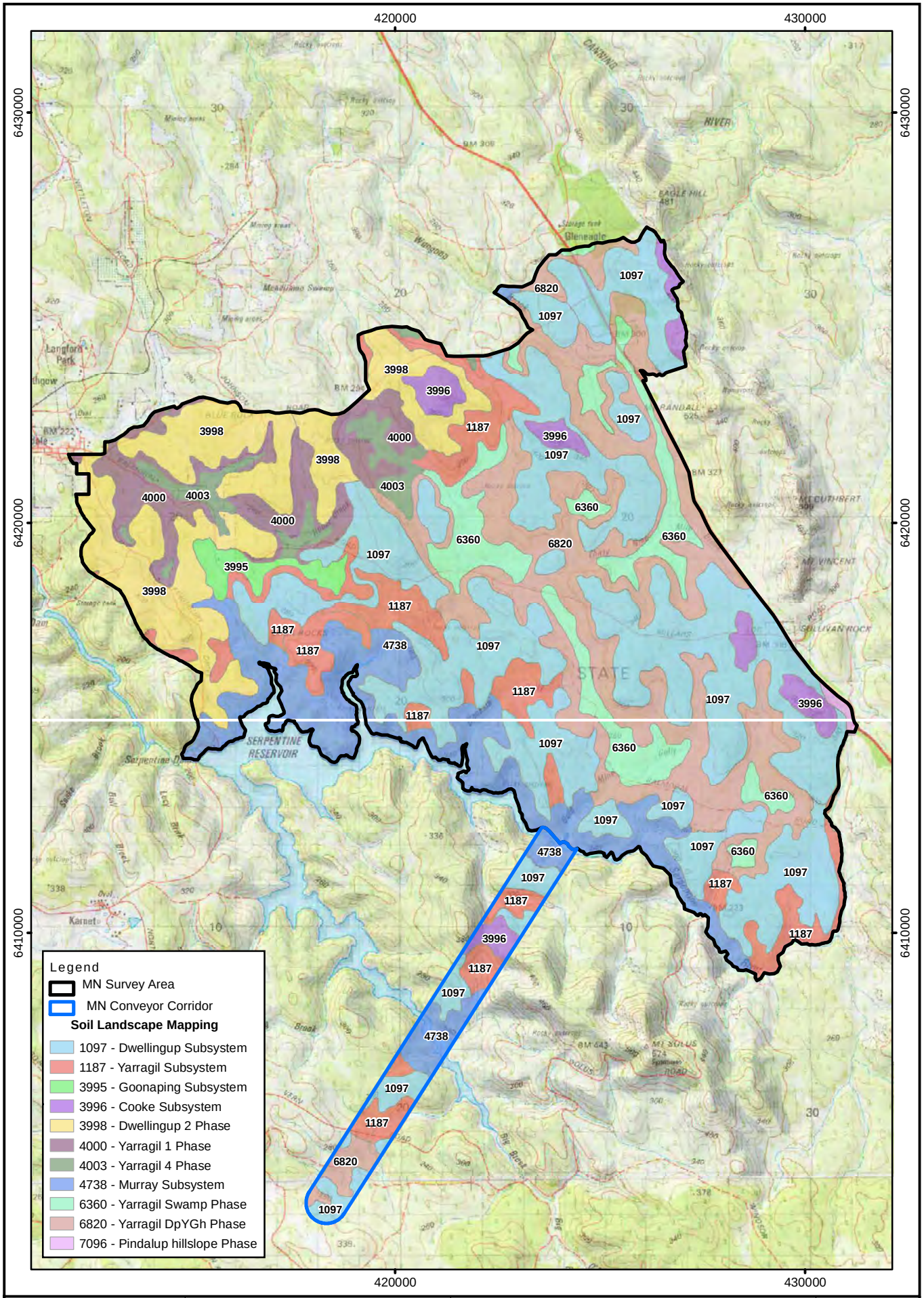
Goonaping: Shallow upland valleys with grey sands and some swamps.
3995 Goonaping Subsystem - Level to gently sloping imperfectly drained swampy margins with deep grey, yellowish brown or brown siliceous or bleached sands.

Cooke: Hills rising above general plateau level; mainly mantled by laterite with some rock outcrop.
3996 Cooke Subsystem - Crests and upper slopes dominated by granite outcrop and very shallow yellow duplex soils, and yellow and brown massive earths.

Pindalup: Valleys of the central part of the plateau; gravelly duplex soils on slopes; some rock outcrop; grey sands, duplex yellow soils and orange earths in broad floors.
7096 Pindalup hillslope Phase - Sideslopes of minor valleys.

Table 3: Extent of Soil Landscapes intersecting the Myara North survey area

Soil Landscape	Mapping Unit	Total Extent (ha)	Area of Intersection with the Myara North survey area (ha)	Area of Intersection with the Myara Conveyor Corridor (ha)	Proportion of Current Extent (%)
Dwellingup Subsystem	1097	231143.22	5513.57	359.48	2.54
Yarragil Subsystem	1187	71930.78	1509.00	276.00	2.48
Goonaping Subsystem	3995	1712.09	211.638	-	12.36
Cooke Subsystem	3996	14044.45	435.42	75.32	3.64
Dwellingup 2 Phase	3998	65466.40	2203.79	-	3.37
Yarragil 1 Phase	4000	13843.54	956.33	-	6.91
Yarragil 4 Phase	4003	5026.70	412.43	-	8.20
Murray Subsystem	4738	61549.36	1734.08	258.27	3.24
Yarragil Swamp Phase	6360	5373.88	1211.11	-	22.54
Yarragil DpYGh Phase	6820	22362.89	3226.71	122.70	14.98
Pindalup hillslope Phase	7096	16507.21	34.88	-	0.21
Total			17448.94	1091.77	



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0 1 2 km

Scale: 1:125,000
MGA94 (Zone 50)

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Landform and Soils
Myara North survey area

Figure: **5**

4.4. Regional Vegetation

The survey area is situated within Beard's (1990) Northern Jarrah Forest subregion of the Southwest Province. The Northern Jarrah Forest subregion is characterised by Jarrah (*Eucalyptus marginata*) forest on ironstone gravels and Marri-Wandoo (*Corymbia calophylla* - *Eucalyptus wandoo*) woodlands on loamy soils, with sclerophyll understoreys. Dell and Havel (1989) broadly classified the Jarrah Forest as an open forest in its northern extent and as a tall forest in its southern extent. In lower rainfall areas towards the east trees decrease in size, forming woodlands or low forests. This dry sclerophyllous forest typically comprises a dominant *Eucalyptus marginata* and *Corymbia calophylla* overstorey, a mid-storey of *Allocasuarina fraseriana* (Sheoak), *Banksia grandis* (Bull Banksia), *Persoonia longifolia* (Snottygobble), *Persoonia elliptica* (Spreading Snottygobble), and a groundcover of woody shrubs with grass trees *Xanthorrhoea preissii*, *Kingia australis* and the cycad *Macrozamia riedlei* (Dell and Havel 1989).

The Pre-European vegetation systems present within the MN survey area (Figure 6, Table 4) include:

1. West Darling System
   Vegetation Association 3.3: Medium forest, jarrah-marri.
   Vegetation Association 128.0: Bare areas, rock outcrops.

Table 4: Extent of pre-European vegetation associations intersecting the Myara North survey area

System	Vegetation Association	State-wide Pre-European Extent (ha)	Area of Intersection with the Myara North survey area (ha)	Area of Intersection with the Myara Conveyor Corridor	Proportion of Current Extent (%)
West Darling	3.3	686824.44	17418.60	1091.76	2.69
West Darling	128.0	2036.28	30.35	-	1.49

Heddle *et al*. (1980) defined and described the dominant pre-European vegetation of the Darling System in a series of vegetation complexes as part of the System 6 studies. Mattiske and Havel (1998) updated this initial more restricted mapping coverage to the wider south-west forest region as (Regional Forest Agreement vegetation complexes). Havel, J.J. (2000) summarized in greater detail the relationships between the landforms, soils and climatic conditions. Mattiske and Havel (1998) defined and described nine vegetation complexes in the MN survey area (Figure 7, Table 5). These include:

Cooke (Ce): Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* (subhumid zone) and open forest of *Eucalyptus marginata* subsp. *thalassica* - *Corymbia calophylla* (semiarid and arid zones) and on deeper soils adjacent to granite outcrops, closed heath of Myrtaceae - Proteaceae species and lithic complex on granite outcrops and associated soils in all climate zones, with some *Eucalyptus laeliae* (semiarid), and *Allocasuarina huegeliana* and *Eucalyptus wandoo* (mainly semiarid to periarid zones).

Dwellingup 1 (D1): Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.

Dwellingup 2 (D2): Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.

Goonaping (G): Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata* (humid zones) and *Eucalyptus marginata* subsp. *thalassica* (semiarid to periarid zones) on the sandy-gravels, low woodland of *Banksia attenuata* on the drier sandier sites (humid to periarid

zones) with some *Banksia menziesii* (northern arid and periarid zones) and low open woodland of *Melaleuca preissiana – Banksia littoralis* on the moister sandy soils (humid to periarid zones).

Murray 1 (My1): Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.

Pindalup (Pn): Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones.

Swamp (S): Mosaic of low open woodland of *Melaleuca preissiana – Banksia littoralis*, closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.

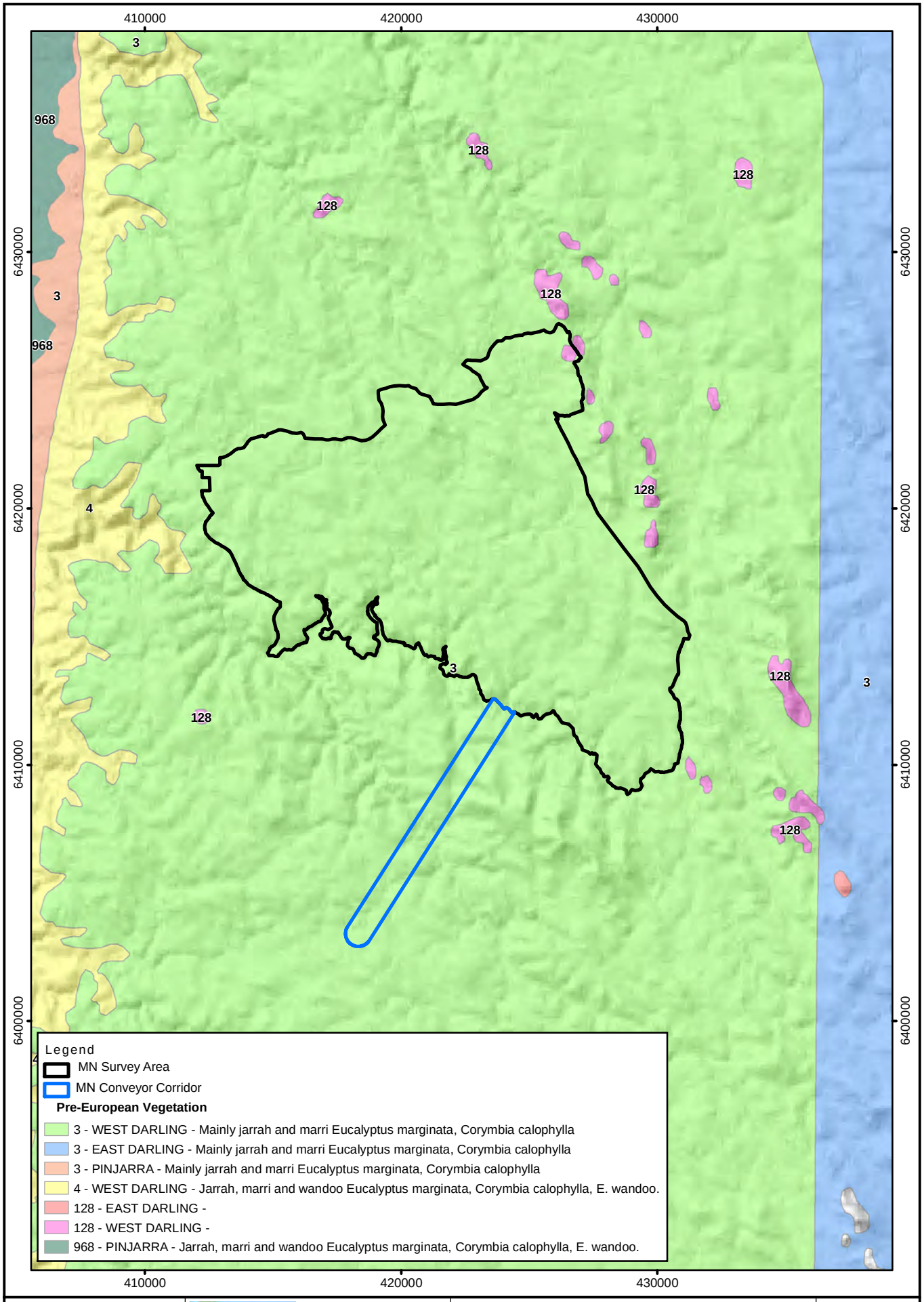
Yarragil 1 (Yg1): Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.

Yarragil 2 (Yg2): Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on slopes, woodland of *Eucalyptus patens – Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors in subhumid and semiarid zones.

Table 5: Extent of Vegetation Complexes intersecting the Myara North survey area

Vegetation Complex	Vegetation Class	Total Extent (ha)	Area of Intersection with the Myara North survey area (ha)	Area of Intersection with the Myara Conveyor Corridor	Proportion of Current Extent (%)
Cooke	Ce	51872.10	435.49	75.31	0.98
Dwellingup 1	D1	297624.85	2630.77	359.40	1.00
Dwellingup 2	D2	120755.00	4951.67	-	4.10
Goonaping	G	38871.59	304.21	-	0.78
Murray 1	My1	97562.81	1745.63	258.36	2.05
Pindalup	Pn	236540.59	34.91	-	0.01
Swamp	S	76245.98	1537.83	-	2.02
Yarragil 1	Yg1	113828.12	871.15	276.02	1.01
Yarragil 2	Yg2	71234.37	4937.29	122.67	7.10

More recently, the vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographical Regionalisation for Australia (IBRA), with the survey area falling within the Northern Jarrah Forest subregion (JF1) of the Jarrah Forest (JAF) Region (DAWE 2020c). The vegetation of the Northern Jarrah Forest subregion consists of Jarrah – Marri forest, with Bullich and Blackbutt in the valleys to the west, grading to Wandoo and Marri woodlands to the east. Heath vegetation is the common understorey of forests and woodlands and occurs on granite outcrops. The majority of the diversity between communities in this subregion occurs on lower slopes and near granite outcrops (Williams and Mitchell 2001).



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Scale: 1:200,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F01_07

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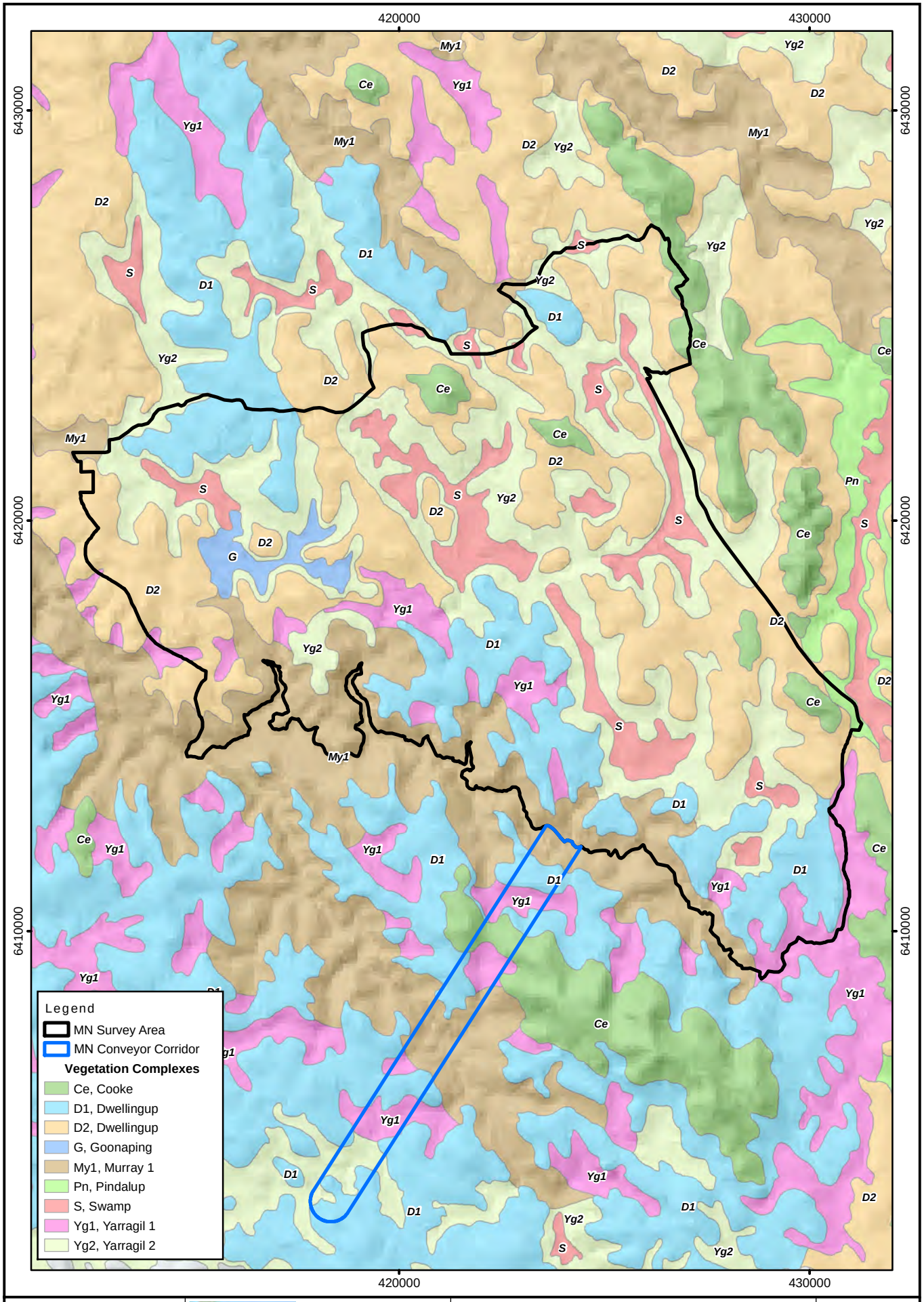
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Pre-European Vegetation
Myara North survey area

Figure: **6**



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0 1 2 km

Scale: 1:125,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F01_08

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Vegetation Complexes
Myara North survey area

Figure: **7**

4.5. Potential Flora

A total of 1454 vascular plant taxa, representative of 411 genera and 108 families, have the potential to occur within the MN survey area. This total was based on NatureMap (DBCA 2007-) and PMST (DAWE 2020b) searches and a summary of all previous data collected during previous surveys within and near MN survey area (E. M. Mattiske and Associates 1988-1993 and Mattiske Consulting Pty Ltd 2006-2019). The most commonly represented families were Fabaceae (175 taxa), Proteaceae (121 taxa) and Myrtaceae (111 taxa). The most commonly represented genera were *Acacia* (61 taxa), *Stylidium* (45 taxa) and *Drosera* (37 taxa).

4.5.1. Potential Threatened and Priority Flora

The PMST, DBCA and Herbarium database searches reported a total of 17 threatened flora species, pursuant to section 179 of the *EPBC Act* and as listed by DAWE (2020a) or pursuant to Part 2, Division 1 and Subdivision 2 of the *BC Act* and as listed by DBCA (2018a) have the potential to occur in the MN survey area.

The DBCA and Herbarium database searches reported a total of 49 priority flora species as listed by DBCA (2018c) have the potential to occur within the MN survey area as recorded within a 20km radius of the MN survey area (Appendix C, Table 6, Figure 8). The likelihood that these species would occur within the survey area was determined using the following criteria:

- Known records within a 20 km radius of the centre of the survey area (as described above). More recent, proximal and numerous records were ranked higher.
- Potential presence of suitable habitat and landforms for the species within the survey area (e.g. soil type, bedrock type, topography, drainage lines, vegetation).

The likelihood was ranked Low, Moderate or High based on current knowledge on database searches using Florabase (WAH 1998-), knowledge of the site preferences of the respective threatened and priority species available from the State Herbarium records and knowledge of the species from the experienced team members.

In summary, the likelihood assessment indicated that a total of no threatened species and 12 priority species have a high likelihood of occurring within the survey area, and 9 threatened species and 19 priority species have a moderate likelihood of occurring within the survey area (Table 6, Appendix C). Of the species with high and moderate likelihood of occurring, the species are mostly associated with swamps (41.9%) or granite outcrops (58.1%) and 61.3% with lateritic gravelly soils. The use of the 20km radius in baseline desktop searches included species that are restricted to the Swan Coastal Plain and a range of species that occur in the main areas on granite outcrops (e.g. Mt Cooke, Mr Windsor and Mt Wells) to the north and east, and the eastern Jarrah forest in lower rainfall areas.

No threatened flora species have a high likelihood of occurring in the MN survey area and the majority occur in areas near granite outcrops and within swamps and valley systems. This interpretation is reinforced by the concentration of threatened flora on the western fringes on the Swan Coastal Plain and Darling Scarp (western fringes of the Darling Ranges) within the 20km radius, Figure 8. Two non-vascular species *Amanita kalamundae* and *Xanthoparmelia darlingensis* were also delineated in the database search, Figure 8; although the scope of the current work did not include survey coverage of non-vascular plant species. *Amanita kalamundae* extends southwards throughout the forest to the southcoast area (Florabase WAH 1998-) and *Xanthoparmelia darlingensis* occurs as disjunct populations near Jarrahdale and the southcoast and as such may reflect the lack of research on non-vascular species in Western Australia.

TABLE 6: SUMMARY OF POTENTIAL THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA BY VEGETATION COMPLEXES, AND DOMINANT LANDFORM AND SOIL GROUPINGS

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Lateritic Soils on Uplands and Slopes	Granite Outcrops	Valley Systems and Swamps
Anthocercis gracilis	Solanaceae	T	V	Moderate	Not recorded within MN area previously or during 2020 and earlier studies. Recorded in Dwellingup 1 in wider Jarrah forest. Mainly near granites (Florabase records) and less likely in lateritic gravels.		X	
Diuris drummondii	Orchidaceae	T	V	Moderate	Not recorded within MN area previously or during 2020 and earlier studies. On swamps and not likely in lateritic soils.			X
Diuris micrantha	Orchidaceae	T	V	Moderate	Not recorded within MN area previously or during 2020 and earlier studies. On swamps and not likely in lateritic soils.			X
Eleocharis keigheryi	Cyperaceae	T	V	Moderate	Not recorded within MN area previously or during 2020 and earlier studies. On seasonally wetter areas and not likely in lateritic soils.			X
Grevillea flexuosa	Proteaceae	T	V	Moderate	Recorded in Cooke, Ce in wider Jarrah forest. Mainly associated with granites.		X	
Lasiopetalum pterocarpum	Malvaceae	T	E	Moderate	Recorded on Darling Scarp, DS2, Murray 1, My1 and Helena 1, He1, so may extend to granite outcrops. Not in lateritic soils.		X	
Verticordia fimbrilepis subsp. *fimbrilepis*	Myrtaceae	T	E	Moderate	Recorded in Swamps, S in wider Jarrah forest. Some potential in lateritic soils.	X		X
Verticordia plumosa var. *ananeotes*	Myrtaceae	T	E	Moderate	Not recorded within MN area North previously or during 2020 and earlier studies. Not likely in lateritic soils.			X

TABLE 6: SUMMARY OF POTENTIAL THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA BY VEGETATION COMPLEXES, AND DOMINANT LANDFORM AND SOIL GROUPINGS (continued)

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

-Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Lateritic Soils on Uplands and Slopes	Granite Outcrops	Valley Systems and Swamps
Andersonia sp. Saxatilis (F. & J. Hort 3324)	Ericaceae	P1	-	High	Recorded on Dwellingup, D2 and Cooke, Ce	X	X	
Calytrix simplex subsp. *simplex*	Myrtaceae	P1	-	Moderate	Recorded in Dwellingup 2, D2 within wider Jarrah forest. Potential in lateritic soils.	X		X
Paracaleana gracilicordata	Orchidaceae	P1	-	High	Not likely in lateritic soils as associated mainly with outcrops (may be localised small occurrences in Dwellingup2, D2, Pindalup, Pn) but more likely in Cooke, Ce.		X	
Paracaleana granitica	Orchidaceae	P1	-	High	Mainly on granite outcrops, not in lateritic soils, may be in other complexes if small localised outcrops that are small in size (Dwellingup 2, D2).		X	
Banksia recurvistylis	Proteaceae	P2	-	High	Recorded in Cooke, Ce and Dwellingup 2, D2 within wider Jarrah forest. Less likely in deeper lateritic soils.		X	
Grevillea crowleyae	Proteaceae	P2	-	High	Not recorded within MN previously or during 2020 and earlier studies. East of area in Dwellingup 2, D2.	X		
Grevillea manglesii subsp. *ornithopoda*	Proteaceae	P2	-	High	Recorded in Dwellingup 1, D1 and Murray 1, My1, less likely in deeper lateritic soils.		X	X
Millotia tenuifolia var. *laevis*	Asteraceae	P2	-	Moderate	Recorded in Dwellingup, D2. Potential in lateritic and granite soils.	x	X	
Tetratheca phoenix	Elaeocarpaceae	P2	-	Moderate	Recorded in mainly Cooke, Ce and occasionally in Dwellingup 4, D4 in wider Jarrah forest area. Most likely on granite. Not likely in deeper lateritic soils.		X	
Acacia drummondii subsp. *affinis*	Fabaceae	P3	-	Moderate	Potential in lateritic soils. Recorded in Yarragil 1 within wider Jarrah forest.	X		
Acacia horridula	Fabaceae	P3	-	Moderate	Recorded in Dwellingup, D2, Yarrail 1, Yg1, and Darling Scarp, DS2 in wider Jarrah forest. Potential in lateritic soils.	X	X	

TABLE 6: SUMMARY OF POTENTIAL THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA BY VEGETATION COMPLEXES, AND DOMINANT LANDFORM AND SOIL GROUPINGS (continued)

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

-Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Lateritic Soils on Uplands and Slopes	Granite Outcrops	Valley Systems and Swamps
Acacia oncinophylla subsp. *oncinophylla*	Fabaceae	P3	-	High	Recorded in Dwellingup 1, D1 in wider Jarrah forest. More likely on granites (Florabase, WAH 1998-)		X	
Andersonia sp. Audax (F. Hort, B. Hort & J. Hort 3179)	Ericaceae	P3	-	High	Recorded on Dwellingup 1, D1, Dwellingup 2, D2, Dwellingup 4, D4, Yarragil 2, Yg2, Swamp, S, Yarragil 2, Yg2 and Cooke, Ce. Potential in lateritic soils.	X	X	X
Conospermum scaposum	Proteaceae	P3	-	Moderate	Recorded in Yarragil 2, Yg2. Not likely in lateritic soils.			X
Grevillea manglesii subsp. *dissectifolia*	Proteaceae	P3	-	Moderate	Recorded in in Dwellingup, D1, Murray 1, My1, Cooke, Ce and Pindalup, Pn. Potential in lateritic soils.	X		X
Halgania corymbosa	Boraginaceae	P3	-	Moderate	Recorded in Darling Scarp 2, DS2. Potential in lateritic soils.	X	X	
Lasiopetalum glutinosum subsp. *glutinosum*	Malvaceae	P3	-	Moderate	Recorded in Dwellingup 1, Darling Scarp 2, DS2 and Murray 1, My1 in wider area. Potential in lateritic soils.	X	X	
Petrophile filifolia subsp. *laxa*	Proteaceae	P3	-	Moderate	Recorded in Yarragil 1, Yg1 in wider area. Not likely in lateritic soils.			X
Pithocarpa corymbulosa	Asteraceae	P3	-	Moderate	Recorded in Yarragil 2, Yg2, Dwellingup 2, D2 and Swamp, S. Not likely in deeper lateritic soils.		X	
Stackhousia sp. Red-blotched corolla (A. Markey 911)	Celastraceae	P3	-	Moderate	Recorded north of MN in Dwellingup 2, D2 in wider Jarrah forest. Potential for occurrence in lateritic soils.	X	X	
Synaphea pandurata	Proteaceae	P3	-	Moderate	Recorded in Pindalup, Pn, Swamp, S and Dwellingup 2, D2 in wider Jarrah forest and earlier studies.	X		X

TABLE 6: SUMMARY OF POTENTIAL THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA BY VEGETATION COMPLEXES, AND DOMINANT LANDFORM AND SOIL GROUPINGS (continued)

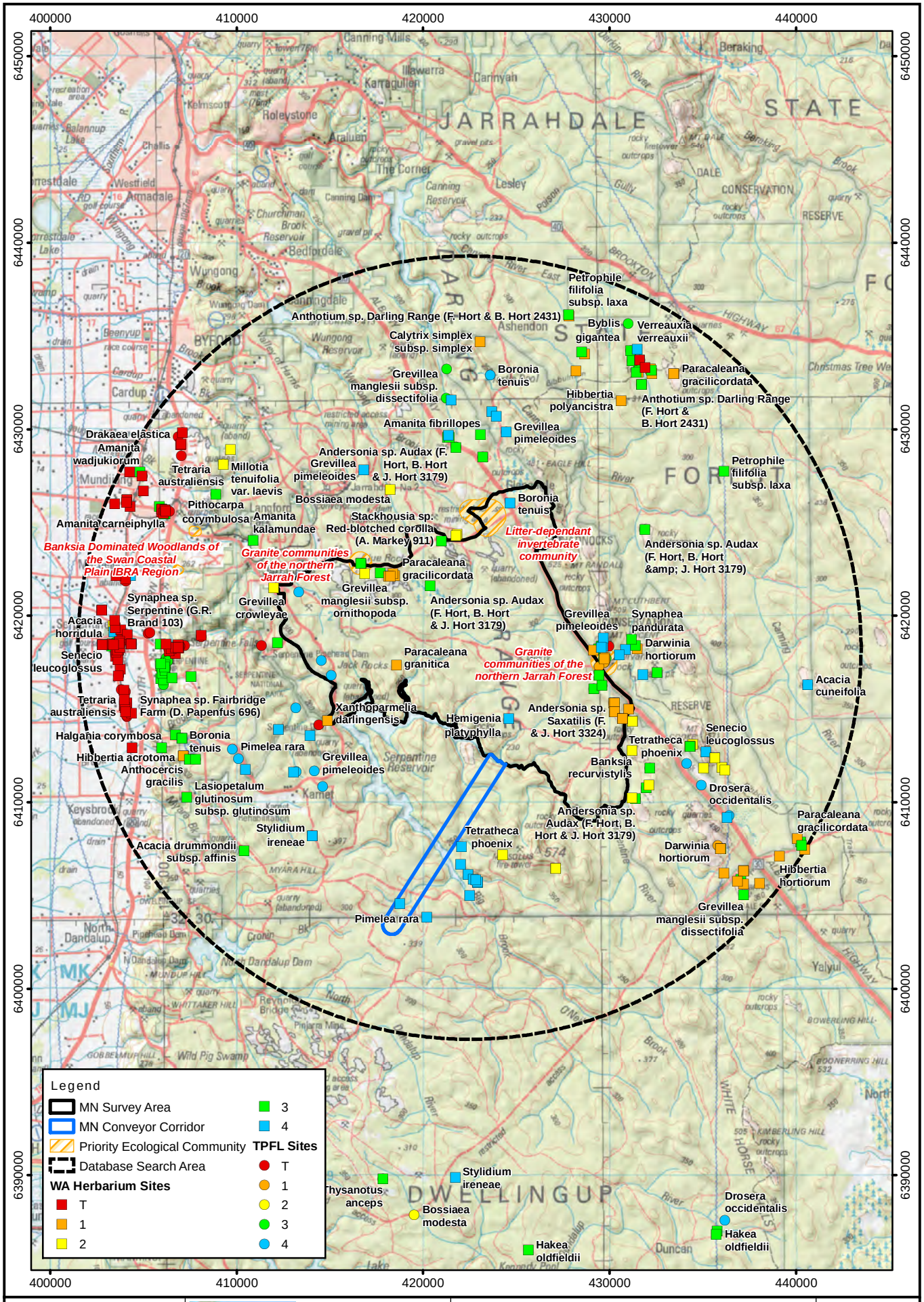
Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

-Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Lateritic Soils on Uplands and Slopes	Granite Outcrops	Valley Systems and Swamps
Thysanotus anceps	Asparagaceae	P3	-	Moderate	Recorded in Murray 1, My1 and Dwellingup, D1 in wider Jarrah forest. Potential for occurrence in lateritic soils.	X		X
Boronia tenuis	Rutaceae	P4	-	High	Recorded in Dwellingup 2, D2, Yarragil 1, Yg1 and Murray 1, My1 in wider Jarrah forest. Potential in lateritic soils in valleys and on granite outcrops.	X	X	
Chorizema ulotropis	Fabaceae	P4	-	Moderate	Recorded in Dwellingup 1, D1 and Dwelllingup 2, D2 within wider Jarrah forest. Potential in lateritic soils.	X	X	X
Grevillea pimeleoides	Proteaceae	P4	-	High	Recorded in Murray 1, My1, Dwellingup, D1, Dwellingup, D2, Pindalup, Pn and Cooke, Ce in wider Jarrah forest. Although on outcrops, there is potential in lateritic soils.	X	X	
Hemigenia platyphylla	Lamiaceae	P4	-	High	Recorded in Dwellingup 1, D1. Less likely in deeper lateritic soils. Potential in sandy-gravels.	X	X	
Lasiopetalum cardiophyllum	Malvaceae	P4	-	Moderate	Recorded on sandy gravels and further east in wider Jarrah forest. May occur in lateritic soils.	X		X
Parsonsia diaphanophleba	Apocynaceae	P4	-	Moderate	Recorded in Murray 1, My1 and Yarragil 1, Yg1 in wider Jarrah forest. Less likely in lateritic soils.			X
Pimelea rara	Thymelaeaceae	P4	-	High	Recorded in Dwellingup, D1, Dwellingup 2, D2, Murray 1, My1, Yarragil 1, Yg1, Yarragil 2, Yg2, and to a lesser degree Cooke, Ce in wider Jarrah forest. Potential to occur in lateritic soils.	X		
Stylidium ireneae	Stylidiaceae	P4	-	Moderate	Recorded in Yarragil 1, Yg1 and Yarragil 2, Yg2 in wider Jarrah forest ranked as moderate. Not likely in lateritic soils.			X
Stylidium scabridum	Stylidiaceae	P4	-	Moderate	Less likely in lateritic soils, although was recorded in Dwellingup complexes.			X

Eight threatened flora species, *Anthocercis gracilis* (T), *Diuris micrantha* (T), *Diuris drummondii* (T), *Eleocharis keigheryi* (T), *Grevillea flexuosa* (T), *Lasiopetalum pterocarpum* (T), *Verticordia fimbrilepis* subsp. *fimbrilepis* (T) and *Verticordia plumosa* var. *ananeotes* (T), had a moderate likelihood of occurring in the MN survey area. Although raised in initial reviews, *Caladenia huegelii* (T) has been considered to have a low likelihood of occurring in any of the vegetation complexes within the MN survey area, due to it primarily occurring in the Swan Coastal Plain and an isolated population in the northern Jarrah Forest near Toodyay. Seven of these eight threatened flora species with a moderate likelihood occur in either seasonally moister soils or near granite outcrops. Eleven threatened flora species had a low likelihood of occurring in the MN survey area (Appendix C).

Twelve priority flora species, *Andersonia* sp. Saxatilis (F. & J. Hort 3324) (P1), *Paracaleana gracilicordata* (P1), *Paracaleana granitica* (P1), *Banksia recurvistylis* (P2), *Grevillea crowleyae* (P2), *Grevillea manglesii* subsp. *ornithopoda* (P2), *Acacia oncinophylla* subsp. *oncinophylla* (P3), *Andersonia* sp. Audax (F. Hort, B. Hort & J. Hort 3179) (P3), *Boronia tenuis* (P4), *Grevillea pimeleoides* (P4), *Hemigenia platyphylla* (P4) and *Pimelea rara* (P4), had a high likelihood of occurrence, mainly due to previous records in the area and suitable habitat. Nineteen priority flora species had a moderate likelihood of occurrence (Table 6, Appendix C).

All potential threatened and priority flora are listed in Appendix C, along with their State and Federal Conservation Codes (see Appendix A for definitions), a description and an assessment of the likelihood of their occurrence in the MN survey area.



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Scale: 1:275,000
MGA94 (Zone 50)

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Date: March 2021 | Rev: A | A4

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DBCA Threatened and Priority Flora and Priority Ecological Communities

Figure: **8**

4.5.2. Potential Introduced (Weed) Species and Declared Pest (Plant) Organisms

A total of 192 introduced taxa from 51 families and 127 genera may potentially exist in the MN survey area, based on NatureMap (DBCA 2007-), the *EPBC Act* Protected Matters Search Tool (DAWE 2020b) search results (Appendix D) and records from Mattiske Consulting Pty Ltd (1991-2020) surveys. Ten of these species, * *Asparagus asparagoides*, **Gomphocarpus fruticosus*, **Moraea flaccida*, **Rubus fructicosus* aggregate (**Rubus anglocandicans*, **Rubus laudatus*, **Rubus ulmifolius*, **Rubus ulmifolius* var. *ulmifolius*), **Solanum elaeagnifolium, *Tamarix aphylla* and **Zantedeschia aethiopica*, are declared pest organisms pursuant to section 22 of the BAM Act. A further four of the introduced species, **Chrysanthemoides monilifera*, **Chrysanthemoides monilifera* subsp. *monilifera*, **Lantana camara* and **Salvinia molesta*, are declared pest organisms pursuant to section 22 of the BAM Act, and are also listed as prohibited organisms pursuant to section 12 of the BAM Act. Ten of the introduced taxa, **Asparagus asparagoides, *Chrysanthemoides monilifera* subsp. *monilifera, *Genista monspessulana, *Lantana camara, *Lycium ferocissimum, *Rubus fruticosus* aggregate, **Salix* spp. (except *S. babylonica*, *S.* x *calodendron* & *S.* x *reichardtii*), **Salvinia molesta, *Solanum elaeagnifolium,* and **Tamarix aphylla,* are listed Weeds of National Significance (DAWE 2020d).

**Asparagus asparagoides*, **Moraea flaccida, *Solanum elaeagnifolium, *Tamarix aphylla* and **Zantedeschia aethiopica* have no control category and a declared pest organism keeping category of Exempt for the whole of Western Australia (DPIRD 2020). **Rubus anglocandicans*, **Rubus laudatus*, **Rubus ulmifolius* and **Rubus ulmifolius* var. *ulmifolius* fall into the control category of C3 –Management and have a declared pest organism keeping category of Exempt for the whole of Western Australia (DPIRD 2020). **Gomphocarpus fruticosus* falls into the control category of C3 – Management but does not have a declared pest organism keeping category. **Chrysanthemoides monilifera* subsp. *monilifera* and **Salvinia molesta* fall into the control category of C2 – Eradication and a declared pest organism keeping category of Prohibited for the whole of Western Australia (DPIRD 2020). **Chrysanthemoides monilifera* and **Lantana camara* fall into the control category of C1 – Exclusion and a declared pest organism keeping category of Prohibited for the whole of Western Australia (DPIRD 2020).

Declared pest organisms with a control category of C3 – Management should have a form of management applied that alleviate the harmful impact of the organism, reduce the numbers or distribution or prevent or contain the spread of the organism (DPIRD 2020). A declared pest category of Exempt requires no permits or conditions for keeping, although there may be other requirements under the *Biosecurity and Agriculture Management Act 2007*. Organisms in this category may also be regulated by legislation such as the *Biodiversity Conservation Act 2016* administered by DBCA. Declared pest organisms with a control category of C1 – Exclusion should be excluded from part or all of Western Australia. Declared pest organisms with a control category of C2 – Eradication should be eradicated from part or all of Western Australia. A declared pest organism with the keeping category of Prohibited can only be kept under permit for scientific research, public display or education purposes, by entities approved by the state authority (DPIRD 2020).

An assessment of the likelihood that the 18 significant weed species (Weeds of National Significance and/or declared pest organisms) would occur within the MN survey area (Appendix D) was determined using the following criteria:

- Known records within a 20 km radius of the centre of the survey area (as described above). More recent, proximal and numerous records were ranked higher.
- Potential presence of suitable habitat and landforms for the species within the survey area (e.g. soil type, bedrock type, topography, drainage lines, vegetation).

The likelihood was ranked Low, Moderate or High.

Based on this assessment, 13 of the significant weed species had a moderate likelihood, and five had a low likelihood, of occurring in the MN survey area.

4.6. Potential Groundwater Dependent Ecosystems

The potential groundwater dependent ecosystems (GDEs) were determined initially in the desktop assessment on the basis of the extent of the vegetation complexes (Mattiske Consulting 2020). The version of GDEs based on the vegetation complexes was refined following the site-vegetation type mapping of the MN survey area (see Section 5.9). In view of the extensive flora and vegetation studies in the northern Jarrah Forest the more detailed mapping of the site-vegetation types provides a more specific and comprehensive indication of areas of vegetation that occur on seasonally moister and wetter soils.

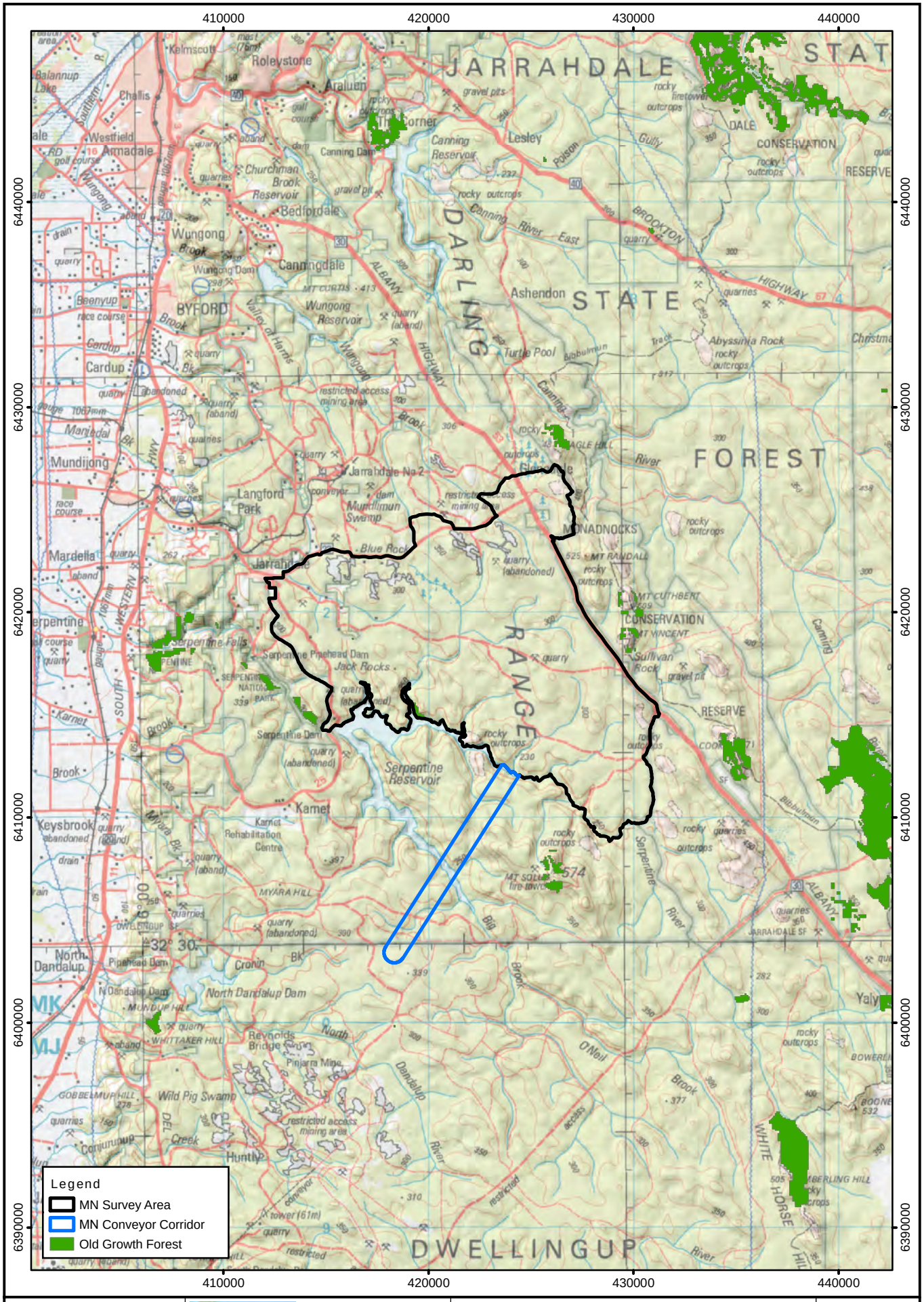
Key indicator plant species that are generally accepted as indicators of moister soils and, hence, potential groundwater dependent ecosystems include – *Banksia littoralis, Hakea varia, Acacia divergens, Pultenaea skinneri, Boronia molloyae, Thomasia paniculata, Astartea scoparia, Eucalyptus rudis, Hypocalymma cordifolium, Melaleuca preissiana, Melaleuca rhaphiophylla, Melaleuca viminea, Baumea* and *Leptocarpus species* and *Taxandria linearifolia. Babingtonia camphorosmae* and *Hypocalymma angustifolium* indicate seasonal moister soils and as such are significant in determining local conditions.

4.7. Old Growth Forests

DBCA mapping indicated that there are a number of patches of old growth forests occurring in the area surrounding the MN survey area, with some occurring within 10 km of the survey area boundary to the north, south, east and west (Figure 9). A small section of old growth forest intersects the survey area in the central part of the south-western boundary of the MN survey area (Figure 9).

Due to the proximity of the MN survey area to the township of Jarrahdale and the Perth population it is unlikely that there will be additional old growth forests in the survey area. Jarrahdale had a timber mill until 1997 after some 125 years of operation (https://www.jarrahdale.com/a-history-of-jarrahdale-western-australia, Dell, Havel and Malajczuk 1989).

The data as presented on the history of harvesting (supplied from period of pre 1920 to 2016) in the area reflects the age of logging on the MN survey area, see Figure 10. These results as supplied by DBCA (2020) reflect the increased logging in the northern section of the MN area and as such reflect previous activities in the area. The areas west of Jarrahdale and a few locations south of Jarrahdale have not been logged for some time. The cleared areas and dam areas reflect early historical clearing efforts. The red areas reflect layering of datasets.



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MGA94 (Zone 50)

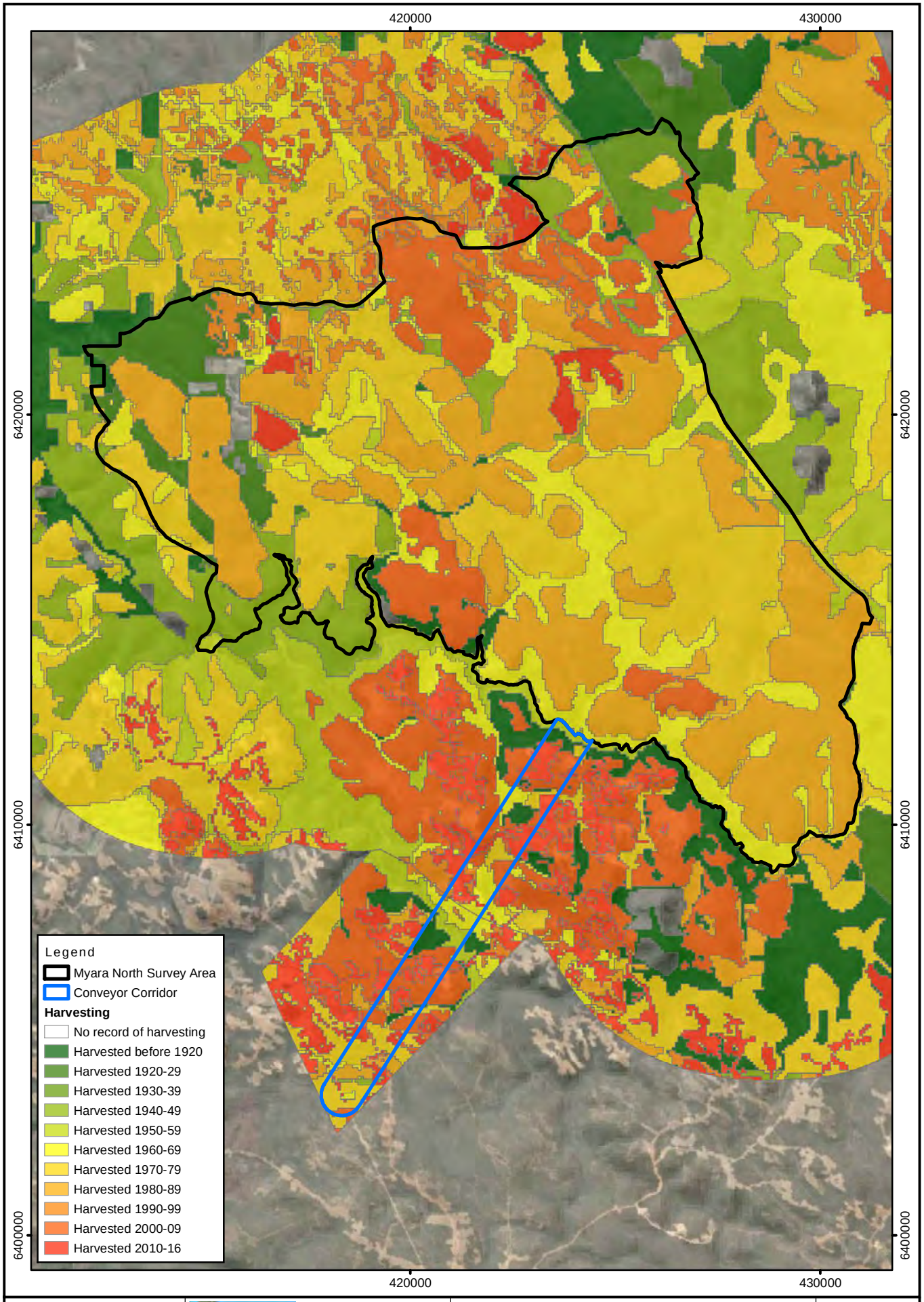
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Old Growth Forests (as defined by DBCA 2020)

Figure: **9**



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CAD Ref: a1992_MyNth_F01_11

Date: May 2021 | Rev: A | A4

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Harvest History (as defined by DBCA 2020)

Figure: **10**

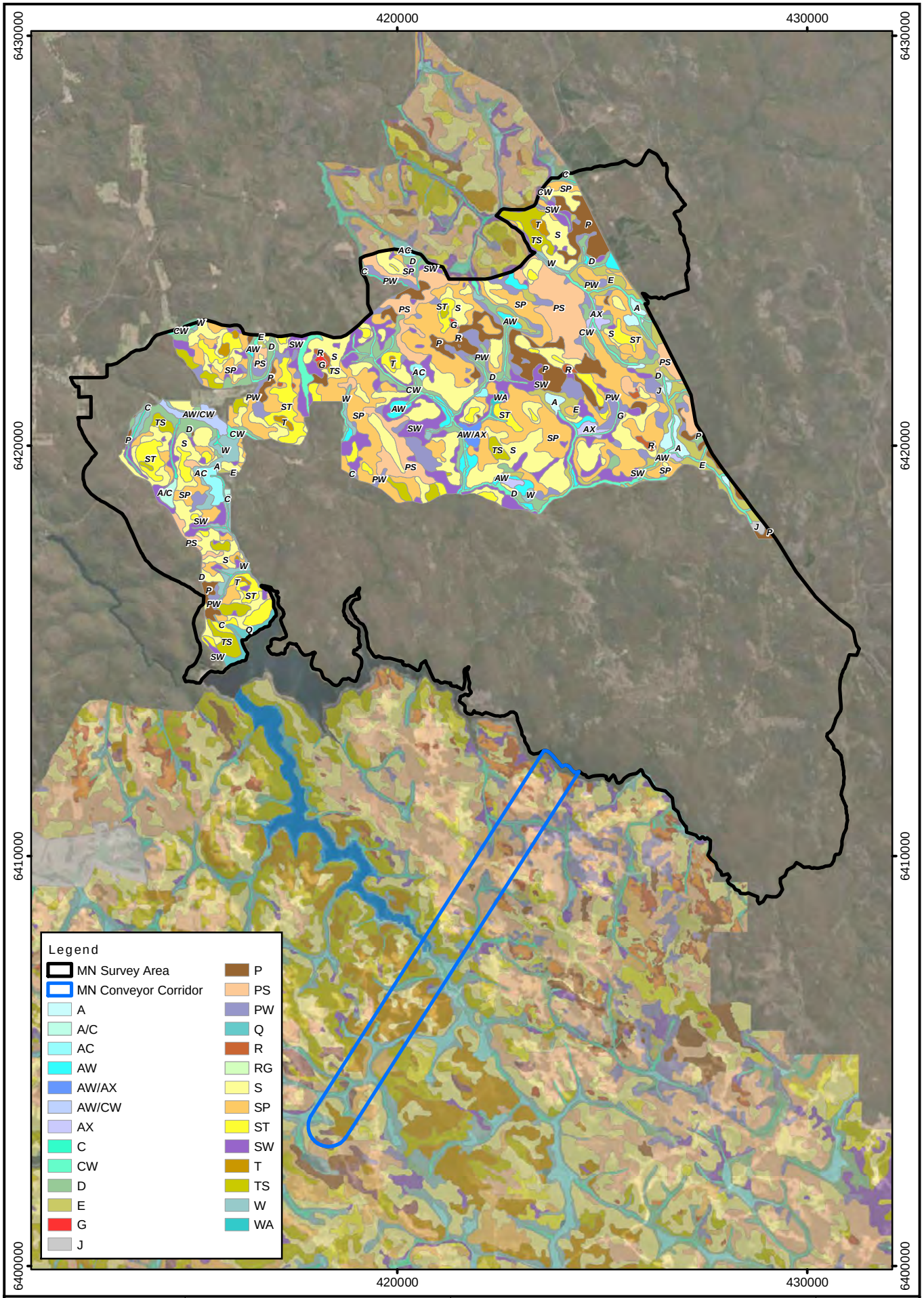
4.8. Previous Surveys

Over the past forty years, Mattiske Consulting has previously mapped the vegetation associated with the Jarrahdale, Huntly (including previous eastern Myara extensions) (E.M. Mattiske and Associates 1988, 1992, 1993 and Mattiske Consulting Pty Ltd 2009, 2011, 2012 and 2019). The most recent local and specific flora and vegetation studies relevant to this current survey, were surveys of the Myara region of the Huntly Mine 2012 and 2019. The Myara survey area (Mattiske Consulting Pty Ltd 2012) report, was compiled from field data collected from 2008, 2009, 2010, 2011 and 2012. During the 2012 survey no threatened flora were recorded, but six priority flora were recorded. These priority species were; *Acacia drummondii* subsp. *affinis* (P3), *Calothamnus rupestris* (P4 in 2012, no longer listed as a priority), *Cyathochaeta teretifolia* (P3), *Senecio leucoglossus* (P4), *Stylidium ireneae* (P4) and *Stylidium longitubum* (P4). The 2019 survey identified three priority 4 flora species; *Grevillea pimeleoides*, *Lasiopetalum cardiophyllum* and *Senecio leucoglossus*. Twenty-three vegetation types were defined and mapped within the MN survey area.

A total of 23 site-vegetation types were defined and mapped in the northern section of the MN survey area by E.M. Mattiske and Associated (1992). This mapping covered the Chandler, South Jarrahdale and Kingsbury Drive areas. The dominant site-vegetation types were P, PS, S, SP, ST and SW (Appendix E for descriptions). Together these covered some 66.34% of the survey area reflecting the dominance of lateritic soils supporting varying types of *Eucalyptus marginata - Corymbia calophylla* with mosaics of *Allocasuarina fraseriana*. The more extreme sites associated with swamps (types A, C, AC, AW and AX and variants) or granite outcrops (types G, RG and R) covered less than 11% and 1% of the area respectively, Figure 11 and Table 7. This is likely to change for the eastern part of MN survey area in view the extensive areas of granite outcrops. The potential presence of several threatened and priority flora species associated with these granite areas are more likely to occur in the eastern section of the MN survey area.

Table 7: Summary of Previous Site-vegetation Types (SVT) mapped by E.M. Mattiske and Associates (1992)

SVT Code	Description	Area_ Ha	% Total
A	Open Woodland of *Melaleuca preissiana* with dense understorey of Myrtaceae species, *Hakea varia* and sedge species on swamp areas.	74.85	1.13
A/C	Mosaic of A and C site-vegetation types.	19.74	0.30
AC	Open Woodland of *Melaleuca preissiana - Banksia littoralis* with dense understorey of Myrtaceae species on swamps and creeklines.	52.07	0.79
AW	Open woodland of *Eucalyptus patens - Corymbia calophylla – Eucalyptus marginata – Banksia littoralis* with low mixed understorey on sandy to loam soils on valley floors.	120.49	1.82
AW/AX	Mosaic of AW and AX site-vegetation types.	21.19	0.32
AW/CW	Mosaic of AW and CW site-vegetation types.	37.87	0.57
AX	Open Woodland *of Eucalyptus rudis – Melaleuca preissiana* with dense understorey of mixed *Melaleuca* species on clay soils in swamps.	43.44	0.66
C	Woodland of *Melaleuca* species - *Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines.	55.11	0.83
CW	Woodland to Open Forest of *Eucalyptus patens - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	298.95	4.52
D	Open Forest of *Eucalyptus marginata - Corymbia calophylla* on lower slopes with mixed low understorey species, including *Babingtonia camphorosmae* and *Acacia extensa* on clay loams to gravelly clay-loams.	371.80	5.62
E	Open Forest to Woodland of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Kingia australis, Mesomelaena tetragona* and *Babingtonia camphorosmae* on sandy gravels on lower slopes.	268.80	4.06
G	Mosaic of Open Woodland of *Eucalyptus marginata – Corymbia calophylla*, mixed Proteaceae – Myrtaceae heath and Lithic Complex associated with granite outcrops.	8.88	0.13
J	Open Woodland to open forest of *Eucalyptus marginata, Corymbia calophylla* and *Eucalyptus patens* over *Mesomelaena tetragona, Leptocarpus scariosus, Babingtonia camphorosmae* and *Stirlingia latifolia* on broad sandy-loam flats valley slopes.	9.47	0.14
P	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii* and *Adenanthos barbiger* and low shrubs, herbs and sedges on sandy gravels.	412.19	6.23
PS	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger* and *Grevillea wilsonii* on sandy gravel soils.	505.96	7.65
PW	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii, Adenanthos barbiger, Babingtonia camphorosmae* and *Hypocalymma angustifolium* on moister sandy gravels.	364.41	5.51
Q	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Eucalyptus patens* on lower slopes with mixed understorey species, including *Trymalium odoratissimum* subsp. *odoratissimum, Acacia extensa* and *Phyllanthus calycinus* on seasonally moister loamy soils.	37.62	0.57
R	Open Woodland of *Eucalyptus marginata - Corymbia calophylla* on fringes of granite outcrops or shallow soils.	33.38	0.50
RG	Open Woodland of *Eucalyptus marginata - Corymbia calophylla* with patches of Heath of Proteaceae – Myrtaceae species on fringes of granite outcrops or shallow soils.	0.65	0.01
S	Open Forest of *Eucalyptus marginata - Banksia grandis – Allocasuarina fraseriana* with scattered understorey, including *Adenanthos barbiger, Leucopogon capitellatus* and *Styphelia tenuiflora* on gravels and sandy-gravels.	1174.78	17.76
SP	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Banksia grandis* with scattered understorey, including *Adenanthos barbiger* and *Leucopogon capitellatus* on sandy-gravels to gravelly soils.	1300.38	19.65
ST	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon capitellatus, Leucopogon verticillatus, Lasiopetalum floribundum* and *Styphelia tenuiflora* on sandy-gravelly soils.	400.01	6.05
SW	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Hypocalymma angustifolium* and *Styphelia tenuiflora* on seasonally moister sandy-gravelly soils.	595.63	9.00
T	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly soils.	38.23	0.58
TS	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly to gravelly soils.	216.91	3.28
W	Open Forest of *Eucalyptus marginata - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Acacia extensa* and *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.	144.45	2.18
WA	Open woodland of *Eucalyptus patens - Corymbia calophylla – Eucalyptus marginata – Banksia littoralis* including *Hypocalymma angustifolium* and range of *Myrtaceae* species on sandy loam lower slopes.	8.82	0.13
Total		6618.08 Ha	



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Scale: 1:125,000
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Previous Site-Vegetation Type Mapping in Myara North survey area

Figure: **11**

4.9. Potential Threatened and Priority Ecological Communities

There are four threatened ecological communities (TECs) listed at Commonwealth level pursuant to sections 181 and 182 of the *EPBC Act* and listed by the DAWE (2020e) or at State level pursuant to Part 2 of the *BC Act* and as listed by DBCA (2018b) with the potential to occur within the MN survey area.

The threatened ecological communities with the potential to occur within the survey area are:

- 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 mentioned TECs would occur in the MN survey area, as these threatened ecological communities are restricted to the Swan Coastal Plain and as such do not extend into the Jarrah forest area on the Darling Ranges.

There are two priority ecological communities (PECs), as listed at State level by DBCA (2020a) that occur within the MN survey area (Figure 8); only one of these is a botanical PEC. The PEC on the granite outcrops has potential to occur elsewhere in the survey area. The litter dependent invertebrate PEC is not a botanical community and is not addressed further in this report.

The priority ecological communities that occur in the MN survey area are:

- Granite communities of the northern Jarrah forest (P3)
    - Jarrahdale area – Monadnocks, Blue Rock; insufficient information to distinguish discrete community type/s (DBCA 2020a).
- Litter Dependant Invertebrate Community of the northern Jarrah Forest (P2)
    - Chandler Block, Northern Jarrah Forest; insufficient evidence that this is a discrete community type (DBCA 2020a).

4.10. Wetlands of International Importance (Ramsar)

The Peel-Yalgorup System, a listed Ramsar Wetland of International Importance, is located in the City of Mandurah local government area and consists of shallow estuaries, freshwater marshes and coastal saline lakes that include the Harvey Estuary, Peel Inlet, Lake McLarty, Lake Mealup and ten Yalgorup National Park wetlands (DAWE 2020f). The fringing vegetation is mainly samphire, rushes, sedges and paperbark communities. The Peel-Yalgorup System supports a wide variety of waterbirds, invertebrates and estuarine and marine fish and is considered the most important area for waterbirds in south-western Australia (DAWE 2020f). Whilst these potential values were recognized in the PMST database search (DAWE 2020b) these wetlands occur west of the survey area and not in the MN survey area.

5. FIELD STUDIES FINDINGS

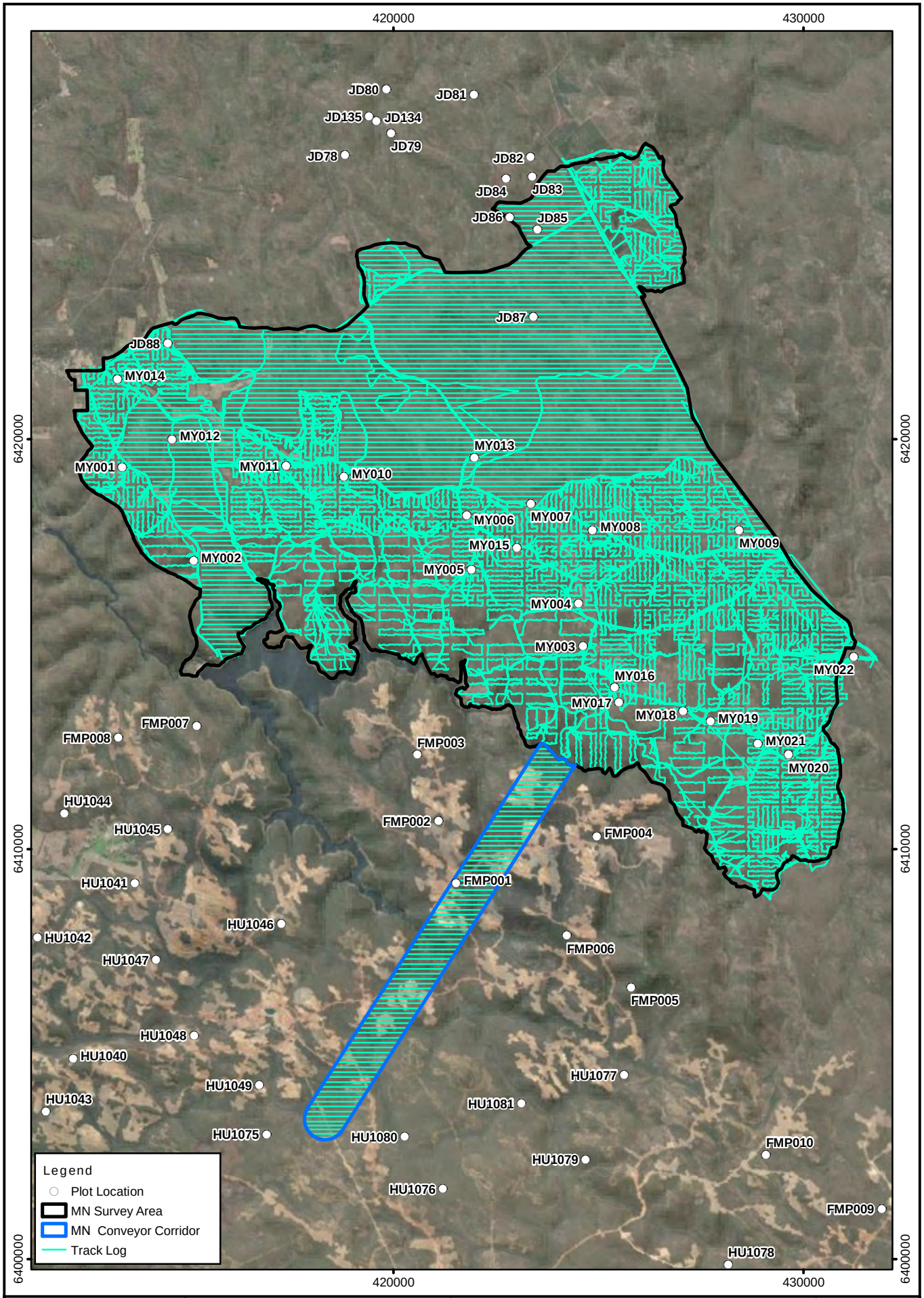
The following text summarises the key findings from recent studies in 2020 as well as the previous datasets collected from flora and vegetation studies within and near the MN survey area; which includes recording sites for vegetation mapping, vegetation plot measurements and opportunistic and targeted assessments.

5.1 Survey Effort

The survey efforts has been undertaken over a decade from multiple studies with the major effort in 2020 which when combined with the depth of previous studies in adjacent areas for both Alcoa and also other clients leads to the conclusion that the work exceeds the current EPA Guidance Statement (2016a and 2016b) expectations for flora and vegetation studies.

The survey effort to date has included (see Figure 12):

- A total of 302 field assessment days in 2020 which when combined with earlier studies in the northern section and on the corridor amounts to more than 360 field assessment days and as such provides a comprehensive coverage of all areas;
- 13,556.79 kilometres of foot transects which includes all previous mapping efforts in the MN survey area;
- 6121 recording sites in 2020 on a grid system which varied slightly from 120m x 120m with some sites closer than this average and some slightly wider. If all sites on the northern section and those on the corridor are included the number of recording sites exceeds 6400 recording sites. This pattern of recording is consistent with previous ecological studies in the northern Jarrah forest for both Alcoa but also other clients in nearby areas such as 31 Mile Creek on the southern edges of the Canning River (north-west of current survey area), the Wungong catchment to the west and the extensive mapping undertaken for Alcoa over several decades to the west and south of the MN survey area;
- 22 permanent plots within the recently mapped MN area, 74 permanent plots in the Myara and Huntly area, 10 forest permanent plots in the wider Myara and Huntly areas and 14 in the Jarrahdale area (including those within the northern section of the current MN survey area); resulting in a total of 120 plots within the Myara/Huntly Region. These plots covered replicates of the dominant forest areas and representative plots in other key site-vegetation types. Nineteen plots from nearby MN survey area were included with the previous plots and the Myara plots as established in 2020 within the MM survey area. As indicated in the previous section the recording sites enabled increased coverage of the outcrop, swamp and valley systems for the flora than the plots;
- targeted searches were undertaken throughout the survey area during the broader vegetation mapping but also on additional extreme sites that were variable within the broader Yarragil and Swamp vegetation complexes and on the granite and outcropping areas in the MN survey area. The coverage of the flora on the granite and swamp areas relied on the recording sites rather than plots as these areas were locally variable and patchy in both structural and floristic components;
- detailed and consistent data collection on position in the landscape, soils, flora, vegetation and vegetation condition; and
- consistent interpretation in line with previous site-vegetation studies where there is a greater reliance on key indicator species and a series of site parameters rather than the accepted clustering and groupings. Such an approach differs from the EPA guidance statement, but if the NVIS approach was followed the dominance of some tree and understorey species in the analyses would lead to a less comprehensive delineation of biodiversity values and also be inconsistent with the approach adopted on all other Alcoa leases where detailed flora and vegetation studies have been undertaken in the past by the Mattiske team and site personnel. In summary, the survey effort easily exceeds the expectations of the EPA Guidance Statement (2016a, 2016b).



N

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Scale: 1:125,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F05_01

Date: March 2021 | Rev: B | A4

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Tracks and Plots in North Myara survey area

Figure: **12**

5.2 Flora

The range of flora collected to date on the MN survey area is summarized in Table 8, Appendices F, H and I. As the survey efforts were undertaken over multiple years and also seasons the coverage of the flora was considered to exceed the EPA (2016a and 2016b) guidance statements expectations. The recent vegetation plots were established in the spring months and as the recordings on the grids was undertaken over a 6 month period the coverage of the flora in more diverse and spatially more complex areas such as the swamps, broad valley systems and the outcrops was considered to be comprehensive.

From the field studies associated with mapping and the plots a total of 543 taxa and 438 taxa respectively (see Table 8) were recorded. A total of 681 taxa from 69 families, 231 genera were recorded in the MN survey area in 2020 on the basis of plots, targeted searches and recording sites.

Table 8: Summary of Flora Species on the Myara North survey areas

(see Appendices F, H and I)

Source	Families	Genera	Native Taxa	Introduced Taxa
Myara Plots 2020	55	172	438	17
Myara/Huntly Regional Forest Plots	55	160	360	18
Myara Vegetation Mapping 2020	65	199	543	15
Myara/Huntly Regional Mapping	73	246	731	38
Nature Map Potential Flora Species (Appendix B)	94	351	1168	149
Nature Map and Additional Potential and recorded Species (see Appendix B)	108	412	1454	192

The occurrence of species in the respective site-vegetation types within the plots and the recordings sites are summarized in Appendices H and I.

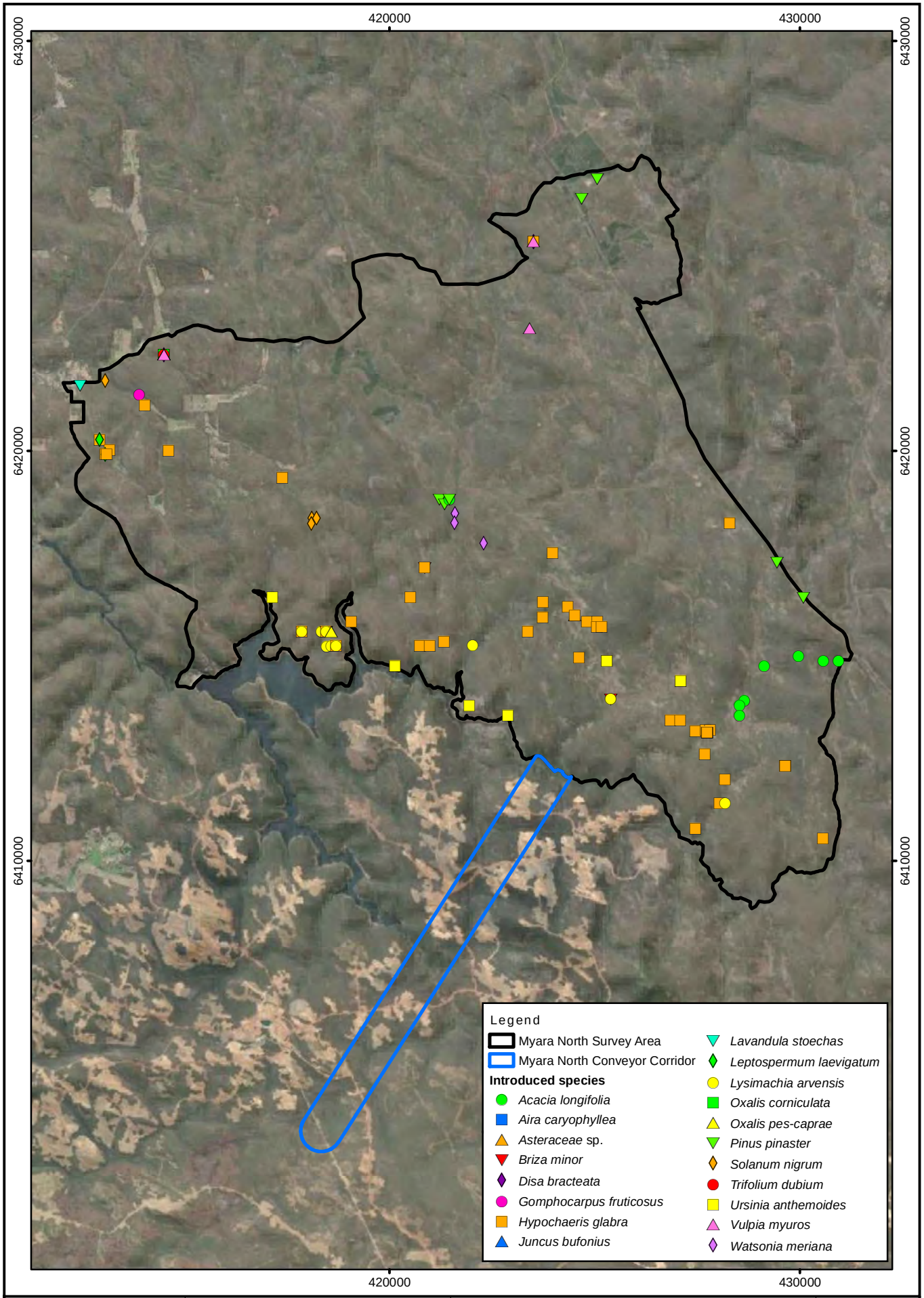
5.3 Introduced Flora Species

The detailed flora and vegetation survey included baseline weed mapping. A total of 58 introduced were recorded in the MN survey. One of the introduced species are declared pest organisms pursuant to section 22 of the BAM Act, namely:**Gomphocarpus fruticosus,* Appendix G (DPIRD 2020), Figure 13. None of the introduced species are listed as a Weed of National Significance (WONS) (DAWE 2020d). Of the 58 introduced species, 8 have been ranked as High Ecological Impact by DPAW (2014), Appendix G, and Table 9. Of the 58 introduced species, 24 have been ranked as Rapid Invasiveness by DPAW (2014) Appendix G.

Many of these species are short lived annuals or associated with the cleared or plantation areas. The species that are either declared weeds (DPIRD 2020) or have a High Ecological Impact are summarised in Table 9. Of these the **Gomphocarpus fructicosus* is found near cleared and degraded areas, **Leptospermum laevigatum* is found within previous disturbance and tracks,**Watsonia meriana* is associated with valley floors and creek lines. The remainder are associated with degraded and completely degraded areas and fringes of road and tracks.

Table 9: Summary of Weeds of National Significance, Declared Weeds or Introduced Flora with a High Ecological Impact (see Appendix G)

	SPECIES	WONS Weeds (DAWE 2020d)	Weeds Status (DPIRD 2020)	EI (DPAW 2014)
*	*Gomphocarpus fruticosus*	N	Declared Pest - s22(2)	U
*	*Acacia dealbata* subsp. *dealbata*	N	Permitted -s11	H
*	*Leptospermum laevigatum*	N	Permitted -s11	H
*	*Watsonia meriana*	N	Permitted -s11	H
*	*Avena fatua*	N	Permitted -s11	H
*	*Cynodon dactylon*	N	Permitted -s11	H
*	*Oxalis pes-caprae*	N	Permitted -s11	H
*	*Plantago lanceolata*	N	Permitted -s11	H
*	*Romulea rosea*	N	Permitted -s11	H



N

0 1 2 km

Scale: 1:125,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F09_01

Date: April 2021 | Rev: A | A4

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Introduced Species

Myara North Survey Area

Figure: **13**

5.4 Threatened and Priority Flora

No Threatened flora species, pursuant to section 179 of the *EPBC Act* and as listed by DAWE (2020a) or pursuant to Part 2, Division 1 and Subdivision 2 of the *BC Act* and as listed by DBCA (2018a) were recorded during the detailed flora and vegetation survey of the MN survey area. The location of known populations from DBCA (WAH and TPFL 2020c) records and from recent assessments are illustrated on Figures 16.3 to 16.9 and overlain on the site-vegetation types. The lack of threatened flora is key outcome of the survey effort and as such reinforces the desktop assessment which found a moderate to low likelihood of threatened flora occurrence and the occurrence of the threatened in the western area on the Swan Coastal Plain, rather than the Darling Ranges on the Darling Plateau.

Fourteen Priority flora species as listed by DBCA (2018c) have been recorded in the MN survey area (Appendices H and I), Table 10, Figures 16.3 to 16.9. Additional Priority flora species (*Acacia oncinophylla* subsp. *oncinophylla, Boronia tenuis, Bossiaea modesta, Banksia recurvistylis, Grevillea crowleyae, Grevillea manglesii* subsp. *dissectifolia* and *Grevillea pimeleoides*) were recorded on the fringes of the MN survey area, Table 10, Figures 16.3 to 16.9. The populations and numbers of plants are summarized in Table 10.

The results summarized reflect the importance of the granite outcrop areas (G) and the sandier and sandy-gravel soils (D, DA, E, P, PW, PS), Table 10. A few of the Priority species occur on the more gravelly soils (S, SP and T). A further summary for all of these species is provided in Appendices C, H and I and Table 10. Several species (*Pimelea* sp., *Thysanotus* sp. and *Stylidium* sp.) lacked definitive flowering and fruiting material and as such could not be confirmed that these were not Priority species.

There is a higher concentration of the Priority flora species on the eastern fringes of the MN survey area supports species that are more tolerant of sandier soils and outcrops.

TABLE 10: SUMMARY OF THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. The absence in the Vegetation Complex and Site-Vegetation Type (SVT) columns reflects the absence within the Myara North survey area. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Vegetation complex Occurrence within Myara North survey area	SVT Codes within Myara Survey Area	No. Populations & No. Plants
Anthocercis gracilis	Solanaceae	T	V	Moderate	Not recorded within MN area previously or during 2020 and earlier studies. Recorded in Dwellingup 1 in wider Jarrah forest. Mainly near granites (Florabase records) and less likely in lateritic gravels.			
Diuris drummondii	Orchidaceae	T	V	Moderate	Not recorded within MN area previously or during 2020 and earlier studies. On swamps and not likely in lateritic soils.			
Diuris micrantha	Orchidaceae	T	V	Moderate	Not recorded within MN area previously or during 2020 and earlier studies. On swamps and not likely in lateritic soils.			
Eleocharis keigheryi	Cyperaceae	T	V	Moderate	Not recorded within MN area previously or during 2020 and earlier studies. On seasonally wetter areas and not likely in lateritic soils.			
Grevillea flexuosa	Proteaceae	T	V	Moderate	Recorded in Cooke, Ce in wider Jarrah forest. Mainly associated with granites.			
Lasiopetalum pterocarpum	Malvaceae	T	E	Moderate	Recorded on Darling Scarp, DS2, Murray 1, My1 and Helena 1, He1, so may extend to granite outcrops. Not in lateritic soils.			
Verticordia fimbrilepis subsp. *fimbrilepis*	Myrtaceae	T	E	Moderate	Recorded in Swamps, S in wider Jarrah forest. Some potential in lateritic soils.			
Verticordia plumosa var. *ananeotes*	Myrtaceae	T	E	Moderate	Not recorded within MN area North previously or during 2020 and earlier studies. Not likely in lateritic soils.			

TABLE 10: SUMMARY OF THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA (continued)

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. The absence in the Vegetation Complex and Site-Vegetation Type (SVT) columns reflects the absence within the Myara North survey area. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Vegetation complex Occurrence within Myara North survey area	SVT Codes within Myara Survey Area	No. Populations & No. Plants
Andersonia sp. Saxatilis (F. & J. Hort 3324)	Ericaceae	P1	-	High	Recorded on Dwellingup 2, D2 and Cooke, Ce	Recorded in Dwellingup 2, D2 and Cooke, Ce. Potential on granites and lateritic soils.	G	4 (Estimated 6270)
Calytrix simplex subsp. *simplex*	Myrtaceae	P1	-	Moderate	Recorded in Dwellingup 2, D2 within wider Jarrah forest. Potential in lateritic soils.			
Paracaleana gracilicordata	Orchidaceae	P1	-	High	Not likely in lateritic soils as associated mainly with outcrops (may be localised small occurrences in Dwellingup 2, D2, Pindalup, Pn) but more likely in Cooke, Ce.	Recorded on Dwellingup 2, D2 on mainly granite.	G S	6 (Estimated 567)
Paracaleana granitica	Orchidaceae	P1	-	High	Mainly on granite outcrops, not in lateritic soils, may be in other complexes if small localised outcrops that are small in size (Dwellingup 2, D2).	Recorded on Dwellingup 2, D2, Pindalup, Pn, and Murray 1, My1 mainly on granite.	G T D P	7 (Estimated 759)
Banksia recurvistylis	Proteaceae	P2	-	High	Recorded in Cooke, Ce and Dwellingup 2, D2 within wider Jarrah forest. Less likely in deeper lateritic soils. Recorded just east of survey area.			
Grevillea crowleyae	Proteaceae	P2	-	High	Not recorded within MN previously or during 2020 and earlier studies. East of area in Dwellingup 2, D2 and just south of Jarrahdale.			
Grevillea manglesii subsp. *ornithopoda*	Proteaceae	P2	-	High	Recorded in Dwellingup 1, D1 and Murray 1, My1, less likely in deeper lateritic soils.	Recorded on Dwellingup 1, D1, mainly on granite.	G	1 (unknown)

TABLE 10: SUMMARY OF THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA (continued)

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. The absence in the Vegetation Complex and Site-Vegetation Type (SVT) columns reflects the absence within the Myara North survey area. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Vegetation complex Occurrence within Myara North survey area	SVT Codes within Myara Survey Area	No. Populations & No. Plants
Millotia tenuifolia var. *laevis*	Asteraceae	P2	-	Moderate	Recorded in Dwellingup 2, D2. Potential in lateritic and granite soils.			
Tetratheca phoenix	Elaeocarpaceae	P2	-	Moderate	Recorded in mainly Cooke, Ce and occasionally in Dwellingup 4, D4 in wider Jarrah forest area. Most likely on granite. Not likely in deeper lateritic soils.			
Acacia drummondii subsp. *affinis*	Fabaceae	P3	-	Moderate	Potential in lateritic soils. Recorded in Yarragil 1 within wider Jarrah forest.	Recorded on Dwellingup 1, D1, mainly on lateritic soils associated with Dwellingup 2, D2, Cooke, Ce and Yarragil, Yg2	S PS D	3 (Estimated 5 to 10)
Acacia horridula	Fabaceae	P3	-	Moderate	Recorded in Dwellingup2, D2, Yarragil 1, Yg1, and Darling Scarp, DS2 in wider Jarrah forest. Potential in lateritic soils.	Recorded in Swamp, S.	AD	1 (Estimated 2-5)
Acacia oncinophylla subsp. *oncinophylla*	Fabaceae	P3	-	High	Recorded in Dwellingup 1, D1 in wider Jarrah forest. More likely on granites (Florabase, WAH 1998-). On northern fringes of MN.			
Andersonia sp. Audax (F. Hort, B. Hort & J. Hort 3179)	Ericaceae	P3	-	High	Recorded on Dwellingup 1, D1, Dwellingup 2, D2, Dwellingup 4, D4, Yarragil 2, Yg2, Swamp, S, Yarragil 2, Yg2 and Cooke, Ce. Potential in lateritic soils.	Recorded on Cooke, Ce, Dwellingup 2, D2, and Swamp, S in wider range of soils.	G E P PL	4 (Estimated 17646)
Conospermum scaposum	Proteaceae	P3	-	Moderate	Recorded in Yarragil 2, Yg2. Not likely in lateritic soils.	Recorded on Yarragil, Yg2 in broad valleys.	DA	1 (Estimated 2-5)

TABLE 10: SUMMARY OF THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA (continued)

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. The absence in the Vegetation Complex and Site-Vegetation Type (SVT) columns reflects the absence within the Myara North survey area. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Vegetation complex Occurrence within Myara North survey area	SVT Codes within Myara Survey Area	No. Populations & No. Plants
Grevillea manglesii subsp. *dissectifolia*	Proteaceae	P3	-	Moderate	Recorded in in Dwellingup, D1, Murray 1, My1, Cooke, Ce and Pindalup, Pn. Potential in lateritic soils. Recorded just east of survey area in D site-vegetation type.			
Halgania corymbosa	Boraginaceae	P3	-	Moderate	Recorded in Darling Scarp 2, DS2. Potential in lateritic soils.			
Lasiopetalum glutinosum subsp. *glutinosum*	Malvaceae	P3	-	Moderate	Recorded in Dwellingup 1, Darling Scarp 2, DS2 and Murray 1, My1 in wider area. Potential in lateritic soils.			
Petrophile filifolia subsp. *laxa*	Proteaceae	P3	-	Moderate	Recorded in Yarragil 1, Yg1 in wider area. Not likely in lateritic soils.			
Pithocarpa corymbulosa	Asteraceae	P3	-	Moderate	Recorded in Yarragil 2, Yg2, Dwellingup 2, D2 and Swamp, S. Not likely in deeper lateritic soils.			
Stackhousia sp. Red-blotched corolla (A. Markey 911)	Celastraceae	P3	-	Moderate	Recorded north of MN in Dwellingup 2, D2 in wider Jarrah forest. Potential for occurrence in lateritic soils.	Dwellingup 2, D2.	PS	1 (unknown)
Synaphea pandurata	Proteaceae	P3	-	Moderate	Recorded in Pindalup, Pn, Swamp, S and Dwellingup 2, D2 in wider Jarrah forest and earlier studies.			
Thysanotus anceps	Asparagaceae	P3	-	Moderate	Recorded in Murray 1, My1 and Dwellingup 1, D1 in wider Jarrah forest. Potential for occurrence in lateritic soils. Recorded south of survey area in SP site-vegetation type.			
Boronia tenuis	Rutaceae	P4	-	High	Recorded in Dwellingup 2, D2, Yarragil 1, Yg1 and Murray 1, My1 in wider Jarrah forest. Potential in lateritic soils in valleys and on granite outcrops.	Recorded on Dwellingup 2, D2 on Kinsella Road on fringes of survey area.	PL	1 (on fringes of survey area)
Chorizema ulotropis	Fabaceae	P4	-	Moderate	Recorded in Dwellingup 1, D1 and Dwelllingup 2, D2 within wider Jarrah forest. Potential in lateritic soils.			

TABLE 10: SUMMARY OF THREATENED AND PRIORITY FLORA RECORDED IN THE MYARA NORTH SURVEY AREA (continued)

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; DAWE 2020a) conservation code definitions. The absence in the Vegetation Complex and Site-Vegetation Type (SVT) columns reflects the absence within the Myara North survey area. A range of species were included in the 20km radius desktop search and depending on location (based collections in State Herbarium - Florabase) and also site conditions were ranked as likelihood of Low, Moderate or High. SVT Code – site-vegetation code based on Havel (1975a and 1975b).

Species	Family	SCC	FCC	Likelihood of Occurrence	20km Radius Search Vegetation complex outside Occurrence	Vegetation complex Occurrence within Myara North survey area	SVT Codes within Myara Survey Area	No. Populations & No. Plants
Grevillea pimeleoides	Proteaceae	P4	-	High	Recorded in Murray 1, My1, Dwellingup1, D1, Dwellingup2, D2, Pindalup, Pn and Cooke, Ce in wider Jarrah forest. Although on outcrops, there is potential in lateritic soils. Recorded just east and south-west of survey area.			
Hemigenia platyphylla	Lamiaceae	P4	-	High	Recorded in Dwellingup 1, D1. Less likely in deeper lateritic soils. Potential in sandy-gravels.	Recorded in Dwellingup, D1.	PW	1 (Estimated 100)
Lasiopetalum cardiophyllum	Malvaceae	P4	-	Moderate	Recorded on sandy gravels and further east in wider Jarrah forest. May occur in lateritic soils.			
Parsonsia diaphanophleba	Apocynaceae	P4	-	Moderate	Recorded in Murray 1, My1 and Yarragil 1, Yg1 in wider Jarrah forest. Less likely in lateritic soils.			
Pimelea rara	Thymelaeaceae	P4	-	High	Recorded in Dwellingup, D1, Dwellingup 2, D2, Murray 1, My1, Yarragil 1, Yg1, Yarragil 2, Yg2, and to a lesser degree Cooke, Ce in wider Jarrah forest. Potential to occur in lateritic soils.	Recorded on Yarragil 1, Yg1, Dwellingup, D2, and Yarragil 2, Yg2 on slopes and valleys.	D ST S	3 (Estimated 132)
Stylidium ireneae	Stylidiaceae	P4	-	Moderate	Recorded in Yarragil 1, Yg1 and Yarragil 2, Yg2 in wider Jarrah forest ranked as moderate. Not likely in lateritic soils.	Recorded in Yarragil 1, Yg1	CW	1 (Estimated2-5)
Stylidium scabridum	Stylidiaceae	P4	-	Moderate	Less likely in lateritic soils, although was recorded in Dwellingup complexes.	Recorded on Dwellingup 1, D1, Dwellingup 2, D2, Yarragil, Yg2, Goonaping, G in range of soils and site conditions.	D S PS P CW	6 (Estimated 107)

5.5 Potential Range Extensions

The following flora species occur as range extensions to current records on Florabase (WAH 1998-):

- *Xanthosia tasmanica* occurs mainly south of the MN survey area;
- *Stachystemon virgatus* occurs to the north-east of the MN survey area;
- *Acacia browniana* var. *endlicheri* and *Acacia browniana* var. *intermedia* occurs to the east of the MN survey area;
- *Cyrtostylis robusta* has been recorded in monitoring plots in Jarrahdale and Huntly/Myara area. As such this species occurs east of a population on the escarpment and also as an extension from southern forest areas and the identification may have been misapplied in plots in the past in the wider Huntly/Myara area.
- *Conospermum scaposum* (P3) occurs mainly to the north-east of the MN area and as such are potential range extensions to the populations as defined on Florabase.
- *Empodisma gracillimum* has been recorded in the wider Huntly/Myara plots near the MN survey area. As such this species is an extension from southern forest areas and the identification may have been misapplied in plots in the past in the wider Huntly/Myara area.
- *Chorizema ilicifolium* has been recorded in the wider Huntly/Myara plots near the MN survey area. As such this species is a large extension from southern forest coastal areas and the identification may have been misapplied in plots in the past in the wider Huntly/Myara area.

All of these species are either range extensions from the east or the south and as such warrant further study in coming years. Of these species the Priority flora species *Conospermum scaposum* (P3) occurred in the DA site-vegetation type associated with lower slopes on the broad valley systems.

5.6 Site-vegetation Types

The interpretation of the vegetation in relation to underlying landforms, soils and climate is further analysed and summarized in Havel (2000). This approach has been used for some 45 years and as such to deviate from such an approach and rely on other approaches would negate the effort to date and the ability to align the findings with other areas in the northern Jarrah forest. This approach was discussed with representatives of the EPA, DWER and DBCA prior to commencement of the survey. It is acknowledged that the approach deviates somewhat from the strict application of EPA (2016) guidance statements, however the continuation of the site-vegetation approach ensures a consistent delineation of the biodiversity values across the Huntly Mine, and provides adequate information to support impact assessment. So whilst such an approach might be perceived by assessors to deviate from the EPA guidance statements, to not adopt the site-vegetation approach would diminish the delineation of the biodiversity values in the MN survey area. In addition the ranking of species and condition of species in the field has increased the intensity and coverage of the sites within the MN survey area.

The Jarrah forest on the slopes and ridges consists of a continuum of species that change in response to subtle changes in the underlying landform, soils and local site conditions. An analysis of the respective plots within the MN area and adjacent areas was analysed using Primer 7 with the Bray-Curtis algorithm (Clarke and Gorey 2015), Figures 14 and 15. The plots on the more marked extreme sites such as swamps and broad sandy valleys reflected lower similarity than the site-vegetation types (P, S, T and their variants) on the slopes and ridges. The approach adopted in the cluster analysis is usually applied to floristic analyses rather than the approach adopted defining site-vegetation types where subtle differences in keystone species and site conditions which were defined by Havel (1975a and 1975b) in earlier studies of the northern Jarrah forest and later refined and developed by Mattiske since 1979. The concentration of plots occurred on the more dominant site-vegetation types on the lateritic sandy-gravels and gravels on the slopes and ridges and as such reflect the continuum nature of the vegetation with subtle changes in underlying site conditions being reflected by changes in rankings and presence or absence of respective keystone species, Figures 14. As indicated on the MDS there is a shift from those on the sandier drier sites of the S and PS types (grouping "c") to the sites associated with the moister and wetter sites (A, CW, E/D and DA types in groupings "m" and "a"). The other key factor appears to relate to the shift from the

sandier types such as PS, SP and DA (groupings "b" and "e" and "c" to the TS and ST types and CW on loamier soils (groupings "d" and "h" and "k"). The species occurrence, density and foliage cover for the respective plots within the main site-vegetation types is summarised in Appendix J. The maps as presented in Figures 16.3 to 16.9 reflect the shift from west to east with more undulating slopes and valley systems in the western and southern areas and less undulating slopes and valley systems in the eastern and north-eastern areas.

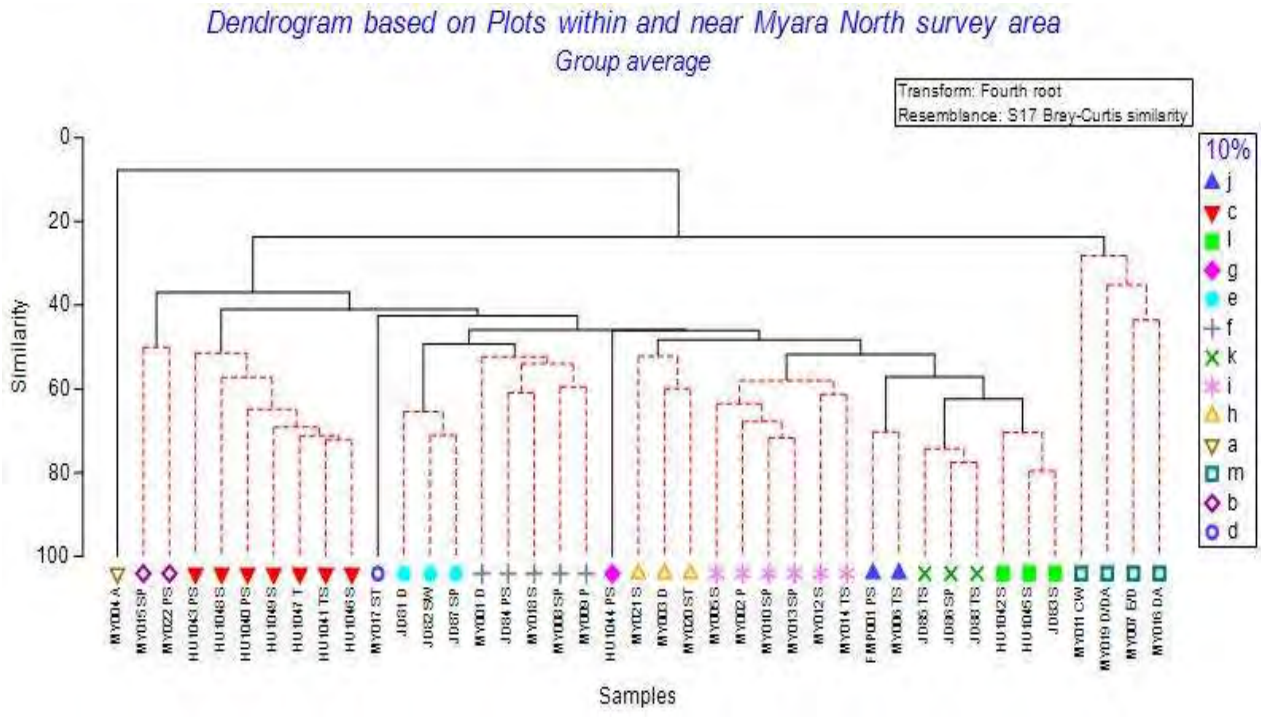


Figure 14: Dendrogram based on Plots within and near Myara North survey area

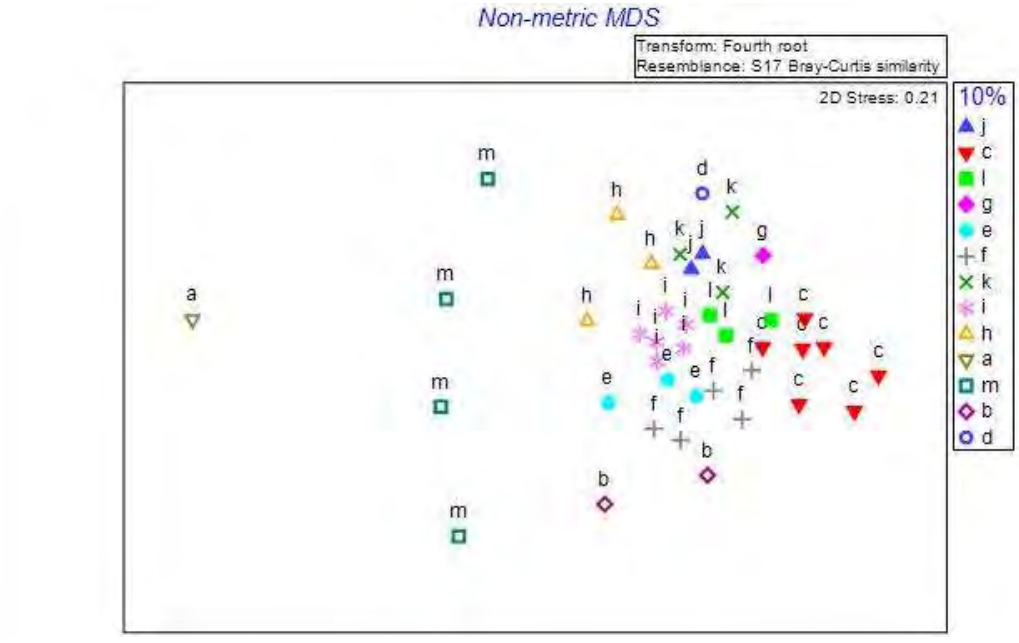


Figure 15: Non-Metric MDS based on Plots within and near Myara North survey area

Context mapping is provided for the conveyor corridor, in accordance with EPA (2016) guidance. The mapping is based on pre-mining mapping for the Myara region and Alcoa mapping of mined and rehabilitated areas, and has not been subject to detailed survey as part of the MN survey. A total of 32 site-vegetation types have been recorded at specific sites in the MN survey area, Table 11 and Figures 16.1 to 16.9.

The site-vegetation types were subdivided into six main groupings associated with site conditions which reflected landforms, soils and soil moisture levels, Table 11. The site-vegetation types on the extreme sites such as granite outcrops and broad valley systems and swamps differ markedly from the forest and woodland areas on the slopes and ridges. The delineation of the site-vegetation types was based on the earlier work of Havel (1975a and 1975b) and as such rely on key site and species indicators. Whilst Mattiske has refined these initial site-vegetation types there is still a reliance on the original work of Havel (1975a and 1975b). The initial code is the dominant site-vegetation type code and the second code (where added) reflects some local influence of secondary key stone species. These site-vegetation types were developed in consultation with Dr David Goodall. In the 1970's Dr Havel and Dr Goodall undertook extensive analyses to delineate and differentiate the key species and site parameters that assist in the division of the continuum of the dominant trees of *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri).

The G, G1, G2, RG and R site-vegetation types are associated with the granite outcrop areas as indicated in 5.4 above these areas support a range of conservation significant species. The larger more spatially extensive areas of granite outcrops were integrated and mapped as the Cooke vegetation complex by Heddle et al. (1950) and Mattiske and Havel (1998). . On a local scale the outcrop areas are locally very variable from lithic complexes to heaths to open woodlands. The species as recorded by Markey (1997) on the granite outcrops were compared with those recorded in the site-vegetation types G and R by Mattiske Consulting team in 2020. Of these the main keystone species include *Calothamnus quadrifidus, Borya sphaerocephala, Grevillea bipinnatifida, Allocasuarina humilis* and *Babingtonia camphorosmae*. Of these species the initial four species are associated with shallow soils and granite outcrops. The *Babingtonia camphorosmae* is associated with seasonally moister soils which may occur in a range of site conditions including near run-off areas near granite outcrops. The other native species recorded by Markey (1997) are more widespread and less site specific. The only current Priority Ecological Community is associated with the G, G1, G2, RG and R site-vegetation types. Not all of the areas as delineated and mapped by Mattiske in 2020 have been high-lighted by DBCA (2020a), see Figure 8. There is a lack of clarity on the values that determine the presence of the Priority Ecological Community other than the association with the outcrops.

The series of site-vegetation types associated with the broader valley systems which dominate the Yarragil 2 and Swamp vegetation complexes as defined by Mattiske and Havel (1998) provide a spatial diversity that supports a range of species (see Appendix H). There is potential for some of these site-vegetation types to be groundwater dependent ecosystems. The dominant site-vegetation types on the lateritic slopes and ridges include types P, PS, SP, S, ST, T and TS. Although these areas tend to be more extensive in local areas, these types also support other values associated with fauna habitat values (e.g. Black Cockatoos in the larger Jarrah, Blackbutt and Marri trees in these areas). The other areas of significance are the localised site-vegetation types that support specific and localised flora species. Examples of these more restricted communities are the site-vegetation types E and J that occur in more restricted areas within the broader valleys.

The remaining codes (CL, CL Other, Rehab, Dam and PL) are associated with modified environments.

Table 11: Summary of Site-vegetation Types (SVT) on the Myara North Survey Area

Note: where no area designated this site-vegetation type has been recorded at the isolated site but the area was too localised to map separately at the scale required for presentation.

	SVT Code	SVT Description	Myara North Survey Area (ha)	Myara North Corridor Area (ha)	Proportion of Survey Area (%)
Swamps and Broad Valleys	A	Tall shrubland of mixed *Melaleuca* spp., *Taxandria linearifolia, Hypocalymma angustifolium, Pericalymma ellipticum* with emergent *Melaleuca preissiana* on clay-loams in seasonally wet valley floors.	130.27	-	0.70
	AC	Open Woodland of *Eucalyptus rudis – Melaleuca preissiana - Eucalyptus patens - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on broad swamps and water-courses.	341.32	51.47	2.12
	AD	Low open woodland of *Eucalyptus rudis* and *Eucalyptus marginata* over *Banksia littoralis, Hakea prostrata* and *Pericalymma ellipticum* over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.	289.73	-	1.56
	AW	Low open woodland of *Eucalyptus patens* and *Melaleuca preissiana* over *Banksia littoralis, Hakea prostrata* and *Taxandria linearifolia* over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.	115.09	-	0.62
	AW/AX	Localized patchy mosaic of AW and AX.	21.19	-	0.11
	AW/CW	Localized patchy mosaic of AW and CW.	20.27	-	0.11
	WA	Open Forest of *Eucalyptus megacarpa - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Banksia littoralis* and occasional *Melaleuca preissiana* over *Acacia extensa* and *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.	8.82	-	0.05
	AX	Open woodland of *Eucalyptus rudis* over *Acacia saligna, Melaleuca incana* subsp. *incana* and *Hypocalymma angustifolium* on clay- loams on valley floors.	43.44	-	0.23
	D	Open Forest of *Eucalyptus marginata -Corymbia calophylla – Eucalyptus patens - Alllocasuarina fraseriana - Hakea prostrata* with *Xylomelum occidentale* on lower slopes with mixed low understorey species, including *Babingtonia camphorosmae, Daviesia decurrens, Davieisa preissii* and *Acacia extensa* on clay loams to gravelly clay-loams.	1106.58	0.81	5.97
	DA	Open Forest of *Eucalyptus marginata -Corymbia calophylla – Eucalyptus patens - Alllocasuarina fraseriana - Hakea prostrata* and *Xylomelum occidentale* on lower slopes with patches of *Melaleuca preissiana, Banksia littoralis* over mixed low understorey species, including *Babingtonia camphorosmae* and *Astartea scoparia* on clay loams to gravelly clay-loams.	168.88	-	0.91
	DG	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Pericalymma ellipticum, Grevillea bipinnatifida, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes with localized patches of outcropping.	11.77	1.75	0.07
	E	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona, Kingia australis, Leptospermum erubescens* and *Babingtonia camphorosmae* on sandy to sandy-loam soils on slopes.	328.34	-	1.77
	J	Open Woodland to open forest of *Eucalyptus marginata, Corymbia calophylla* and *Eucalyptus patens* over *Mesomelaena tetragona, Leptocarpus scariosus, Babingtonia camphorosmae* and *Stirlingia latifolia* on broad sandy-loam flats valley slopes.	34.05	-	0.18
Valley Floors and Lower Slopes	C	Woodland to Open Forest of *Eucalyptus patens – Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	51.34	-	0.28
	CW	Woodland to Open Forest of *Eucalyptus patens – Eucalyptus megacarpa - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.	472.83	56.05	2.85
	W	Open Forest of *Eucalyptus megacarpa - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.	230.37	108.97	1.83
	Q	Open Forest of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* with mixed understorey species, including *Trymalium odoratissimum* subsp. *odoratissimum*, *Acacia extensa* and *Phyllanthus calycinus* on loam soils on lower slopes.	28.91	-	0.16

Table 11: Summary of Site-vegetation Types (SVT) on the Myara North Survey Area (continued)

	SVT Code	SVT Description	Myara North Survey Area (ha)	Myara North Corridor Area (ha)	Proportion of Survey Area (%)
Tahom	M	Open woodland of *Eucalyptus wandoo* over *Trymalium ledifolium, Macrozamia riedlei* and *Hakea lissocarpha* on clay loams with some gravel on mid to upper slopes and ridges.	3.43	-	0.02
	P	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Styphelia nitens, Grevillea wilsonii, Leucopogon capitellatus* on sandy gravels.	1225.88	1.70	6.62
	PG	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Grevillea wilsonii, Leucopogon capitellatus Grevillea bipinnatifida, Allocasuarina humilis, Babingtonia camphorosmae* and *Hypocalymma angustifolium* on sandy gravels.	-	-	-
	PJ	Open woodland of *Eucalyptus marginata - Corymbia calophylla – Allocasuarina fraseriana* over *Stirlingia latifolia* and *Lepidosperma* spp. on sandier patches on sandy-loam soils on slopes.	-	-	-
	PT	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Leucopogon verticillatus, Pteridium esculentum* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravels.	102.54	15.86	0.64
	TP	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Allocasuarina fraseriana - Banksia grandis* on sandy-loams to sandy-gravels with scattered understorey, including *Clematis pubescens, Adenanthos barbiger, Leucopogon verticillatus, Pteridium esculentum* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravels.	-	-	-
	PS	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Leucopogon capitellatus* on gravels and sandy gravels.	3450.48	127.10	19.30
	SP	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Grevillea wilsonii* and *Leucopogon capitellatus* on sandy-gravels to gravelly soils.	1304.55	58.30	7.35
	S	Open Forest of *Eucalyptus marginata - Banksia grandis – Allocasuarina fraseriana* with scattered understorey, including *Adenanthos barbiger, Leucopogon capitellatus* and *Styphelia tenuiflora* on gravels and sandy-gravels.	3165.01	106.50	17.64
	ST	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon capitellatus, Leucopogon verticillatus, Pteridium esculentum, Lasiopetalum floribundum* and *Styphelia tenuiflora* on sandy-gravelly soils.	969.45	0.09	5.23
	TS	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly to gravelly soils.	779.46	87.36	4.68
	T	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly soils.	304.74	125.36	2.32

Table 11: Summary of Site-vegetation Types (SVT) on the Myara North Survey Area (continued)

	SVT Code	SVT Description	Myara North Survey Area (ha)	Myara North Corridor Area (ha)	Proportion of Survey Area (%)
Slopes with higher seasonal soil moisture	SW	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Hypocalymma angustifolium* and *Styphelia tenuiflora* on seasonally moister sandy-gravelly soils.	774.52	12.64	4.25
	PW	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii, Adenanthos barbiger, Babingtonia camphorosmae* and *Hypocalymma angustifolium* on sandy gravels.	582.62	22.89	3.27
Outcrop Areas	R	Open Woodland of *Eucalyptus marginata - Corymbia calophylla* on fringes of granite outcrops or shallow soils over mixed understorey species reflecting shallow soils over granite.	365.69	12.30	2.04
	RG	Localised patchy mosaic of R and G site-vegetation types.	0.65	-	0.004
	G/G1	Mosaic of Open Woodland of *Eucalyptus marginata – Corymbia calophylla* on the fringes of outcrops ranging to open heath communities of Proteaceae-Myrtaceae species and lithic complexes on the outcrop areas.	268.17	20.27	1.56
	G2	Woodland of *Allocasuarina huegeliana* and associated herbs and low shrubs on shallow granite outcrops.	-	-	-
Other Areas	CL	Cleared		224.26	1.21
	CL Other	Cleared Other	198.83	-	1.07
	PL	Plantation	162.22	-	0.87
	Rehab	Rehabilitation Areas	387.47	53.07	2.38
	DAM	Dam	-	5.02	-

Code	Description of Site-Vegetation Types
A	Tall shrubland of mixed *Melaleuca* spp., *Taxandria linearifolia, Hypocalymma angustifolium, Pericalymma ellipticum* with emergent *Melaleuca preissiana* on clay-loams in seasonally wet valley floors.
AC	Open Woodland of *Eucalyptus rudis – Melaleuca preissiana - Eucalyptus patens - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on broad swamps and water-courses.
AD	Low open woodland of *Eucalyptus rudis* and *Eucalyptus marginata* over *Banksia littoralis, Hakea prostrata* and *Pericalymma ellipticum* over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.
AW	Low open woodland of *Eucalyptus patens* and *Melaleuca preissiana* over *Banksia littoralis, Hakea prostrata* and *Taxandria linearifolia* over low shrubs and herbs on leached sands over sandy-gravel on lower slopes.
AW/AX	Localized patchy mosaic of AW and AX.
AW/CW	Localized patchy mosaic of AW and CW.
WA	Open Forest of *Eucalyptus megacarpa - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Banksia littoralis* and occasional *Melaleuca preissiana* over *Acacia extensa* and *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.
AX	Open woodland of *Eucalyptus rudis* over *Acacia saligna, Melaleuca incana* subsp. *incana* and *Hypocalymma angustifolium* on clay- loams on valley floors.
D	Open Forest of *Eucalyptus marginata -Corymbia calophylla – Eucalyptus patens - Alllocasuarina fraseriana - Hakea prostrata* with *Xylomelum occidentale* on lower slopes with mixed low understorey species, including *Babingtonia camphorosmae, Daviesia decurrens, Davieisa preissii* and *Acacia extensa* on clay loams to gravelly clay-loams.
DA	Open Forest of *Eucalyptus marginata -Corymbia calophylla – Eucalyptus patens - Alllocasuarina fraseriana - Hakea prostrata* and *Xylomelum occidentale* on lower slopes with patches of *Melaleuca preissiana, Banksia littoralis* over mixed low understorey species, including *Babingtonia camphorosmae* and *Astartea scoparia* on clay loams to gravelly clay-loams.
DG	Open forest of *Corymbia calophylla* and *Eucalyptus marginata* over *Hakea lissocarpha, Macrozamia riedlei, Pericalymma ellipticum, Grevillea bipinnatifida, Acacia alata, Babingtonia camphorosmae, Hypocalymma angustifolium* and *Phyllanthus calycinus* on clay-loams on lower slopes with localized patches of outcropping.
E	Open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over *Mesomelaena tetragona, Kingia australis, Leptospermum erubescens* and *Babingtonia camphorosmae* on sandy to sandy-loam soils on slopes.
J	Open Woodland to open forest of *Eucalyptus marginata, Corymbia calophylla* and *Eucalyptus patens* over *Mesomelaena tetragona, Leptocarpus scariosus, Babingtonia camphorosmae* and *Stirlingia latifolia* on broad sandy-loam flats valley slopes.
C	Woodland to Open Forest of *Eucalyptus patens – Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.
CW	Woodland to Open Forest of *Eucalyptus patens – Eucalyptus megacarpa - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.
W	Open Forest of *Eucalyptus megacarpa - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.
Q	Open Forest of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* with mixed understorey species, including *Trymalium odoratissimum* subsp. *odoratissimum, Acacia extensa* and *Phyllanthus calycinus* on loam soils on lower slopes.
M	Open woodland of *Eucalyptus wandoo* over *Trymalium ledifolium, Macrozamia riedlei* and *Hakea lissocarpha* on clay loams with some gravel on mid to upper slopes and ridges.
P	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Styphelia nitens, Grevillea wilsonii, Leucopogon capitellatus* on sandy gravels.
PG	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Grevillea wilsonii, Leucopogon capitellatus Grevillea bipinnatifida, Allocasuarina humilis, Babingtonia camphorosmae* and *Hypocalymma angustifolium* on sandy gravels.
PJ	Open woodland of *Eucalyptus marginata - Corymbia calophylla – Allocasuarina fraseriana* over *Stirlingia latifolia* and *Lepidosperma* spp. on sandier patches on sandy-loam soils on slopes.

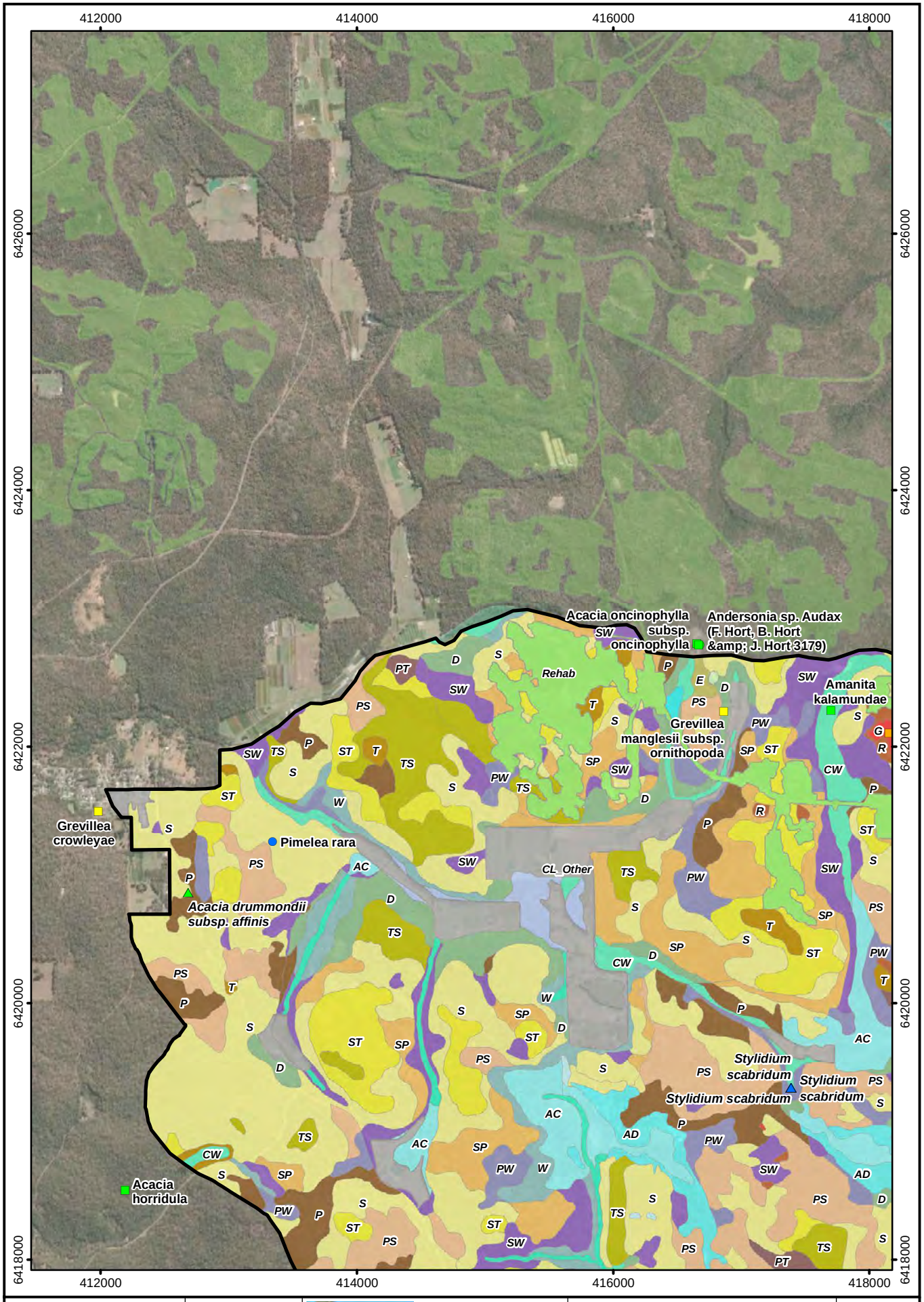
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Myara North Survey Area
Vegetation Legend

Figure:
16.1



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F06_01

Date: May 2021 | Rev: B | A4

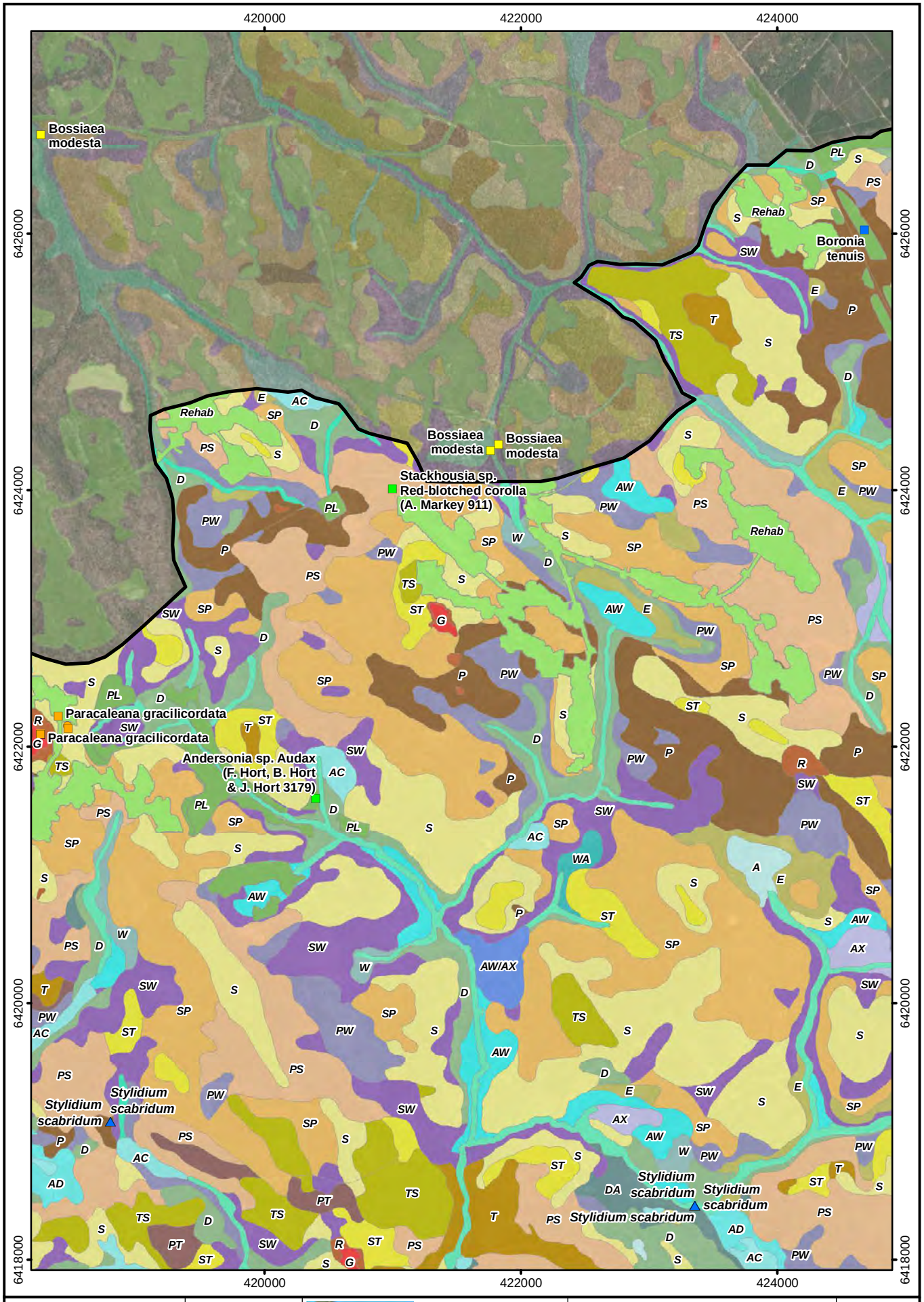
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Site-vegetation Types in North Myara Area

Sheet 4 of 10

Figure: **16.3**



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F06_01

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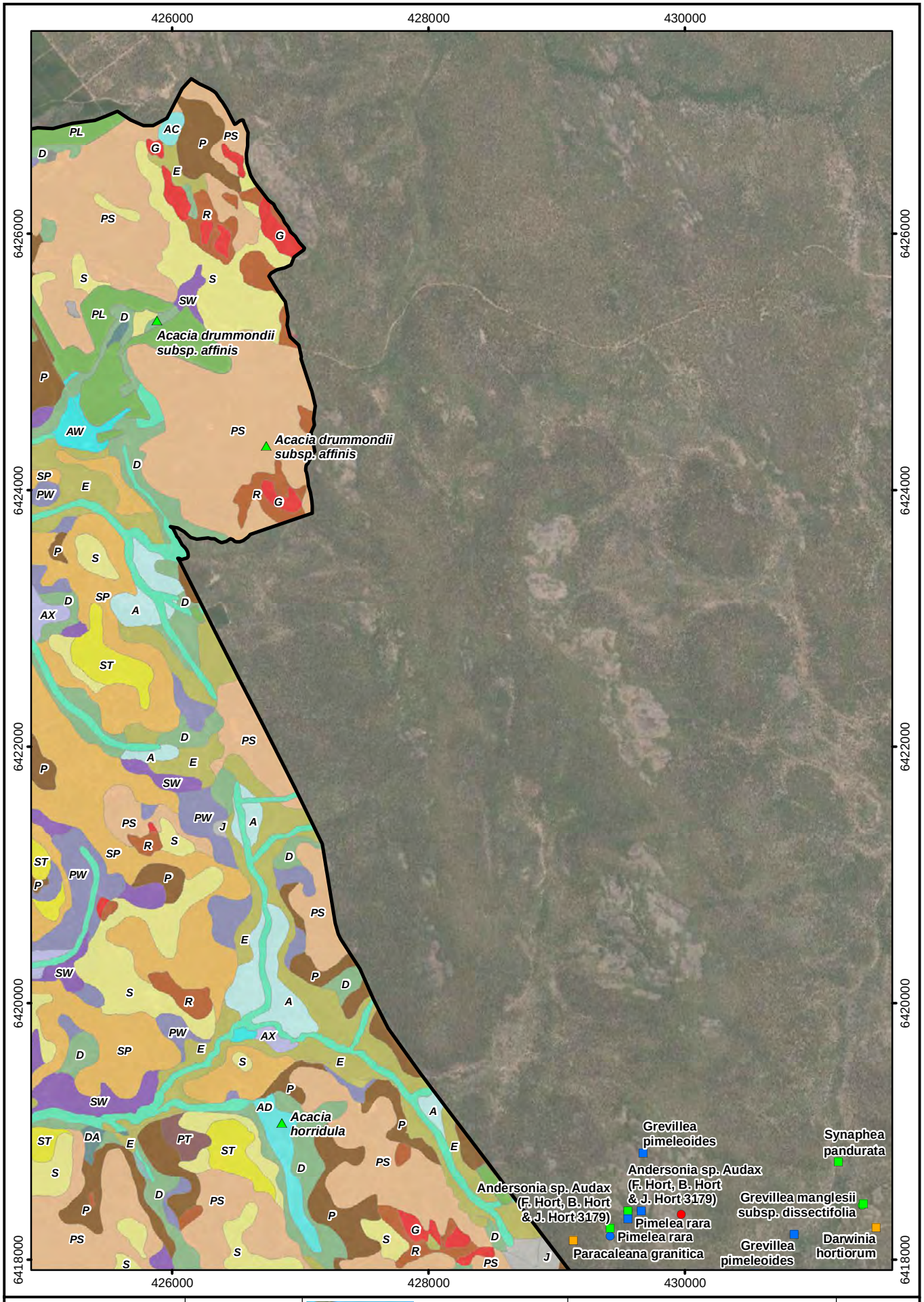
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Site-vegetation Types in North Myara Area

Sheet 5 of 10

Figure: **16.4**



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

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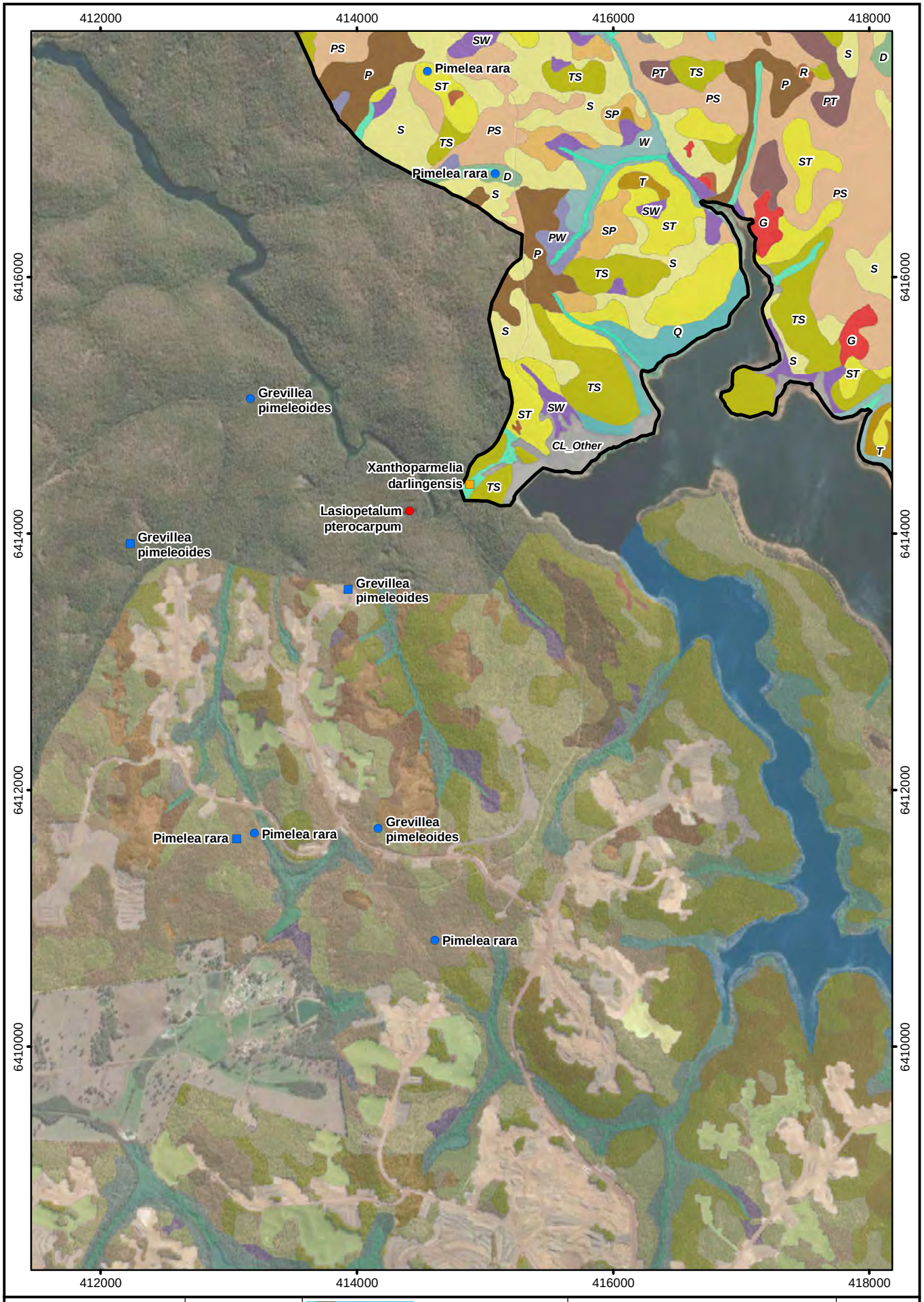
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Site-vegetation Types in North Myara Area

Sheet 6 of 10

Figure: **16.5**



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

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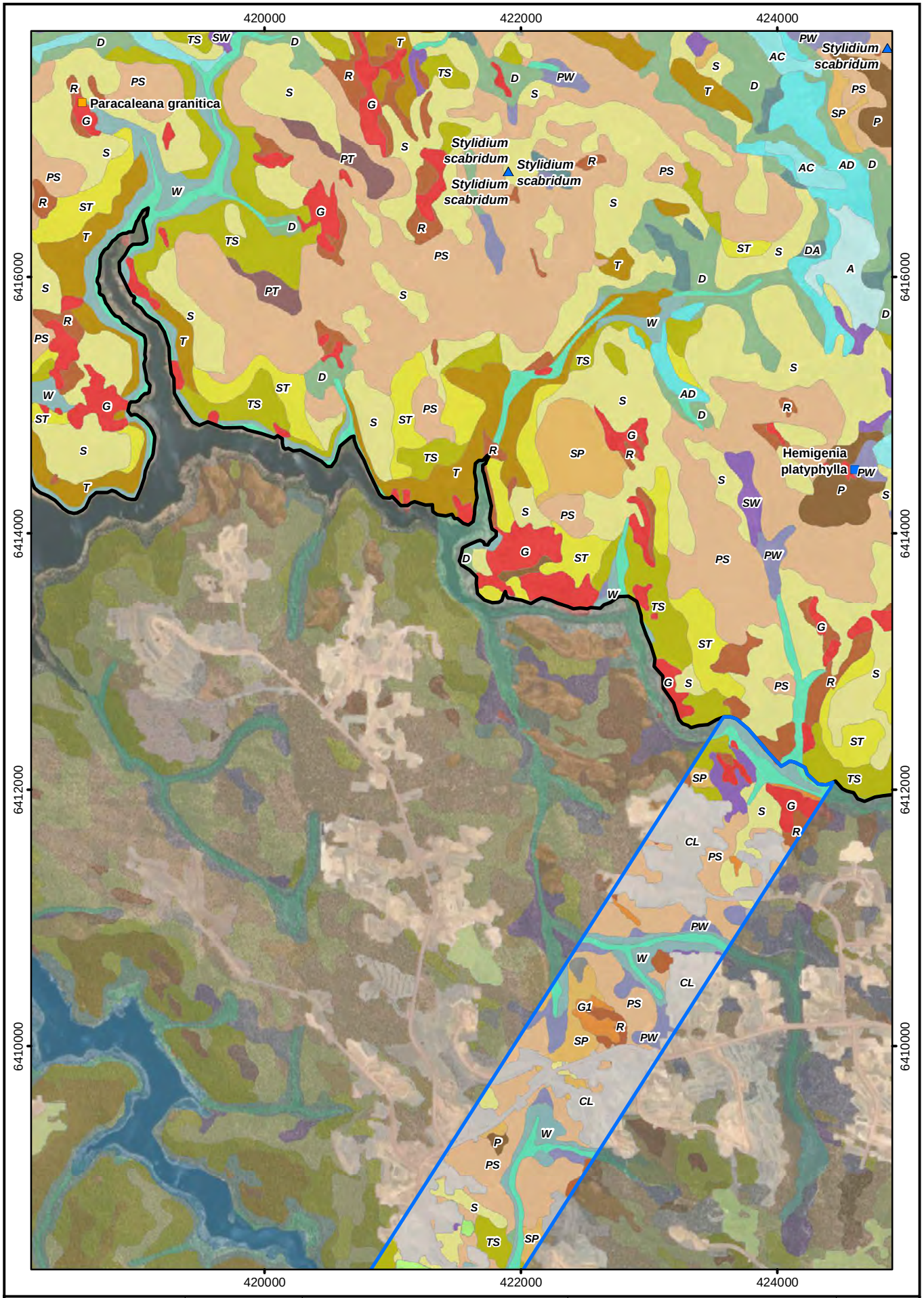
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Site-vegetation Types in North Myara Area

Sheet 7 of 10

Figure:

16.6



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

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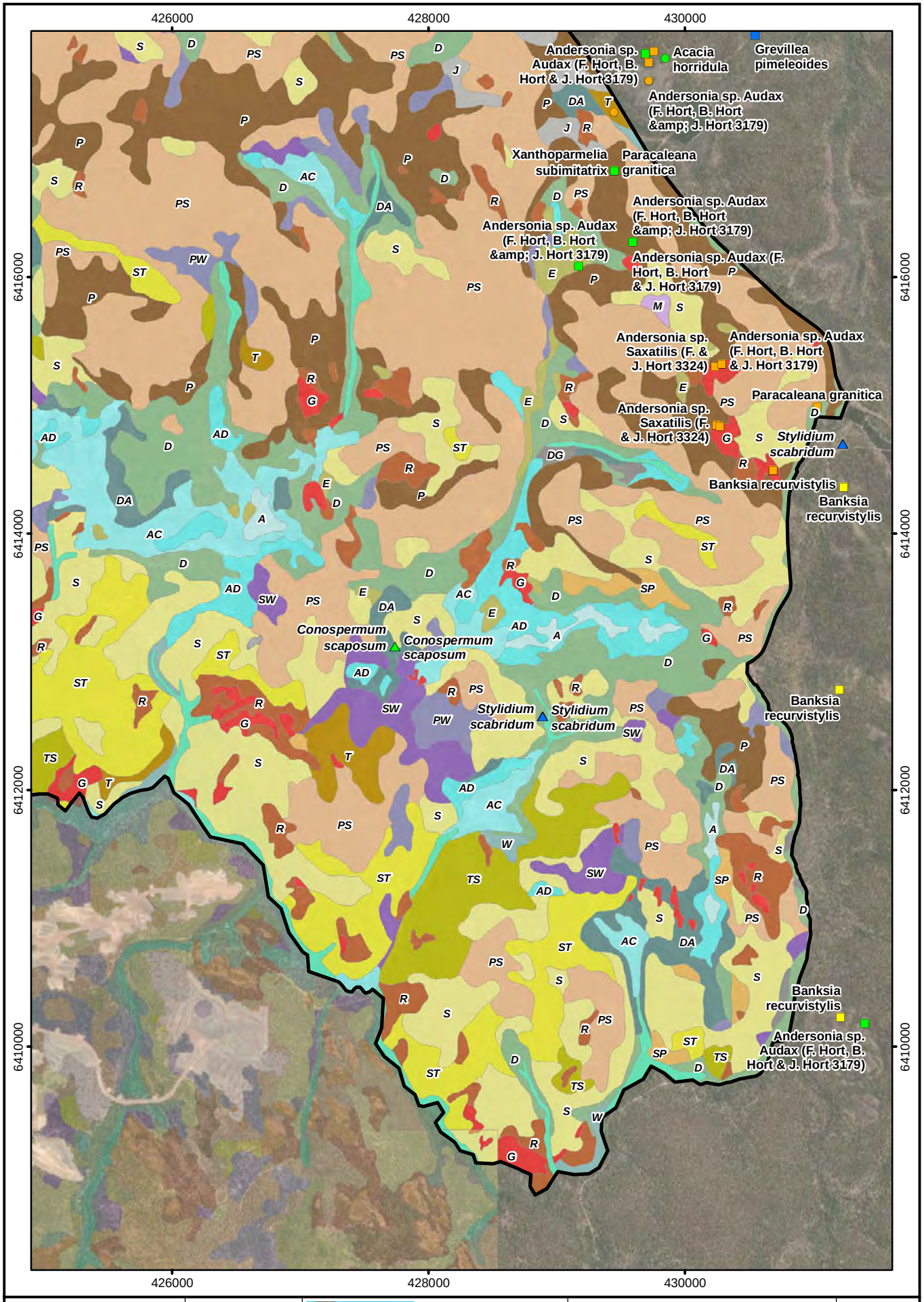
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Site-vegetation Types in North Myara Area

Sheet 8 of 10

Figure:

16.7



N

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Scale: 1:40,000
MGA94 (Zone 50)

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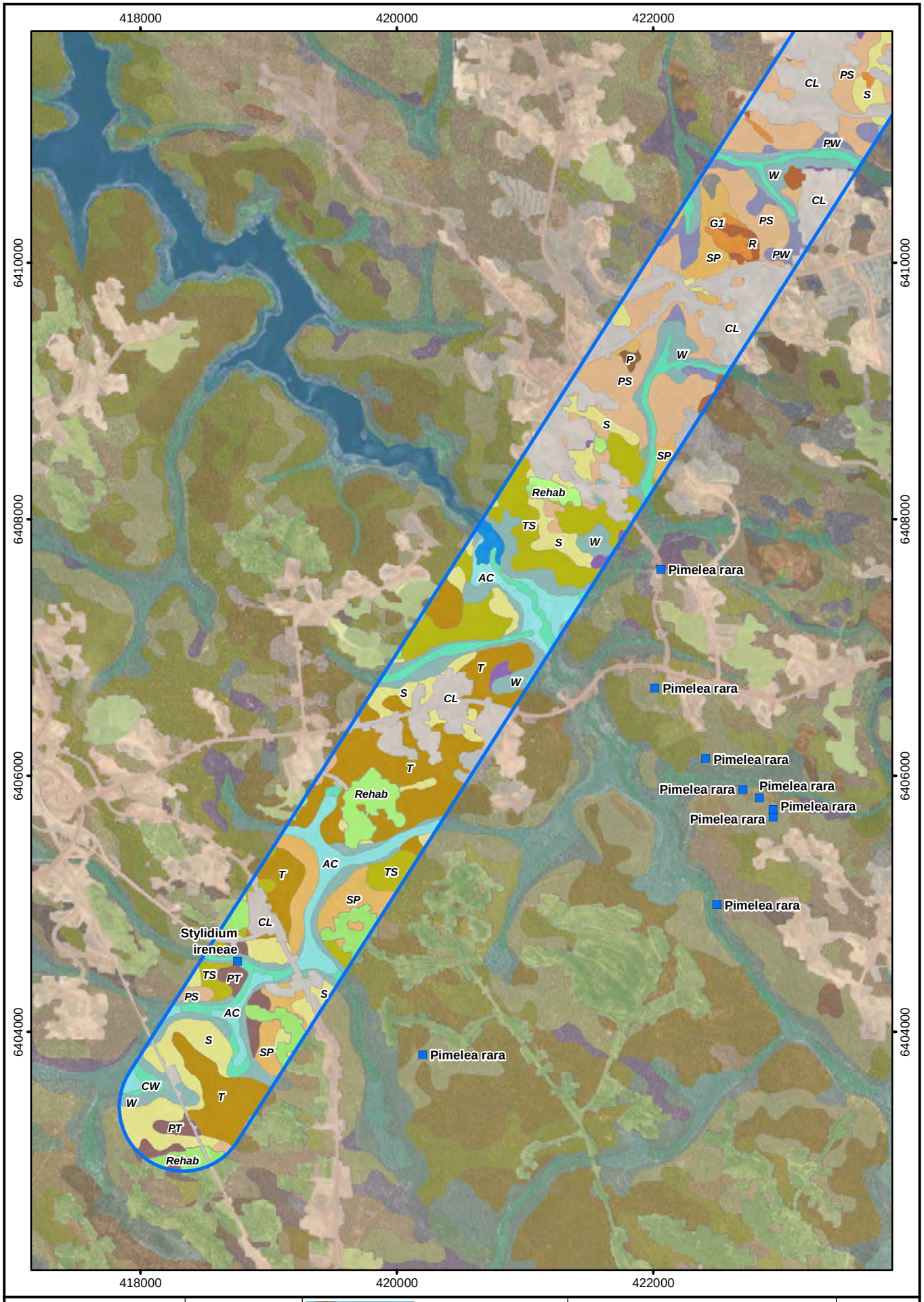
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Site-vegetation Types in North Myara Area

Sheet 9 of 10

Figure: **16.8**



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

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Site-vegetation Types in North Myara Area

Sheet 10 of 10

Figure:

16.9

5.7. Vegetation Condition

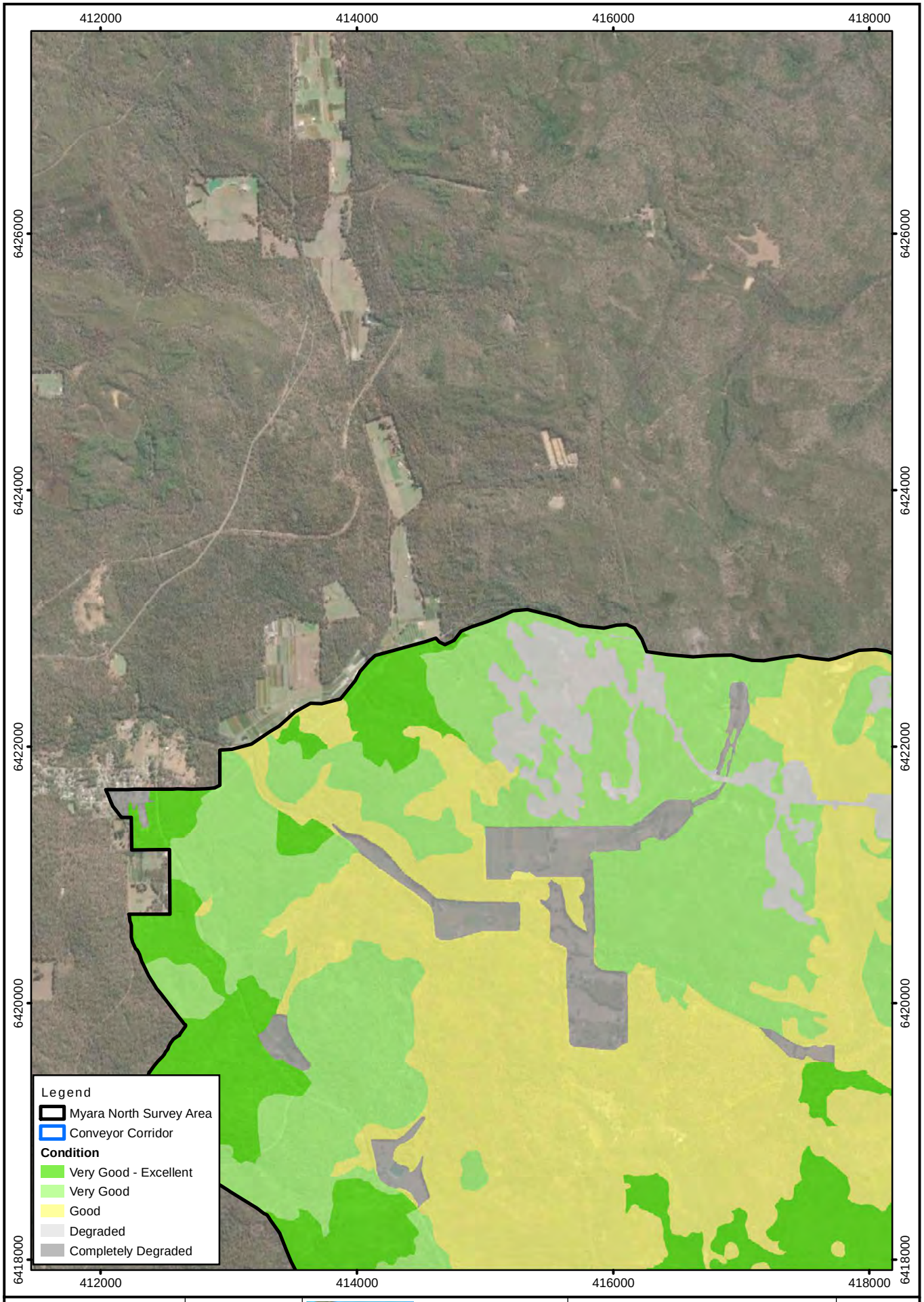
The extent of the respective condition ratings are summarised in Table 12. The extent of the respective condition ratings are summarized in Table 10. The vegetation and condition conditions rating was based on EPA Guidance Statement (2016b) which was adapted from Keighery (1994) and Trudgen (1988), Appendix A5.

The majority of the vegetation was ranked as very good and very good-excellent (50.41%) despite historical harvesting activities and local pressures from recreational activities with 15.23% being designated as Very-Good to Excellent. The biodiversity values have persisted in many areas instances. Some areas have been influence by the Jarrah Dieback disease and although the composition of the understorey has been modified as a result of the *Phytophthora cinnanomi* infections these areas still provide a range of native species towards the forest values. The degraded and completely degraded (5.57%) areas are associated with cleared, older rehabilitation areas and plantation areas, Figures 17.1 to 17.7.

Less stumps and logging activities were recorded within the swamp areas and on lower sandier soils in the broader valley types; although dieback disease from *Phytophthora cinnanomi* has influenced many of the valley systems in the MN survey area (Glevan Consulting 2020). A few areas supporting patches of larger trees were designated as potential fauna habitats. The recording sites designated on Figure 18 supported more than one tree with a diameter at breast height greater than 50cm, Figure 18.

Table 12: Summary of Condition Ratings in Myara North survey area

Condition Rating	Survey Area	Area (ha)	% Survey Area
Very Good - Excellent	Myara North	2823.31	15.23
Very Good	Myara North	6022.67	32.48
Good	Myara North	7854.43	42.36
Degraded	Myara North	387.47	2.09
Completely Degraded	Myara North	361.06	1.95
Very Good	Conveyor Corridor	500.17	2.70
Good	Conveyor Corridor	309.23	1.67
Degraded	Conveyor Corridor	53.07	0.29
Completely Degraded	Conveyor Corridor	229.29	1.24
Total		18540.71	100.00



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F08_01

Date: May 2021 | Rev: C | A4

Sheet Layout:

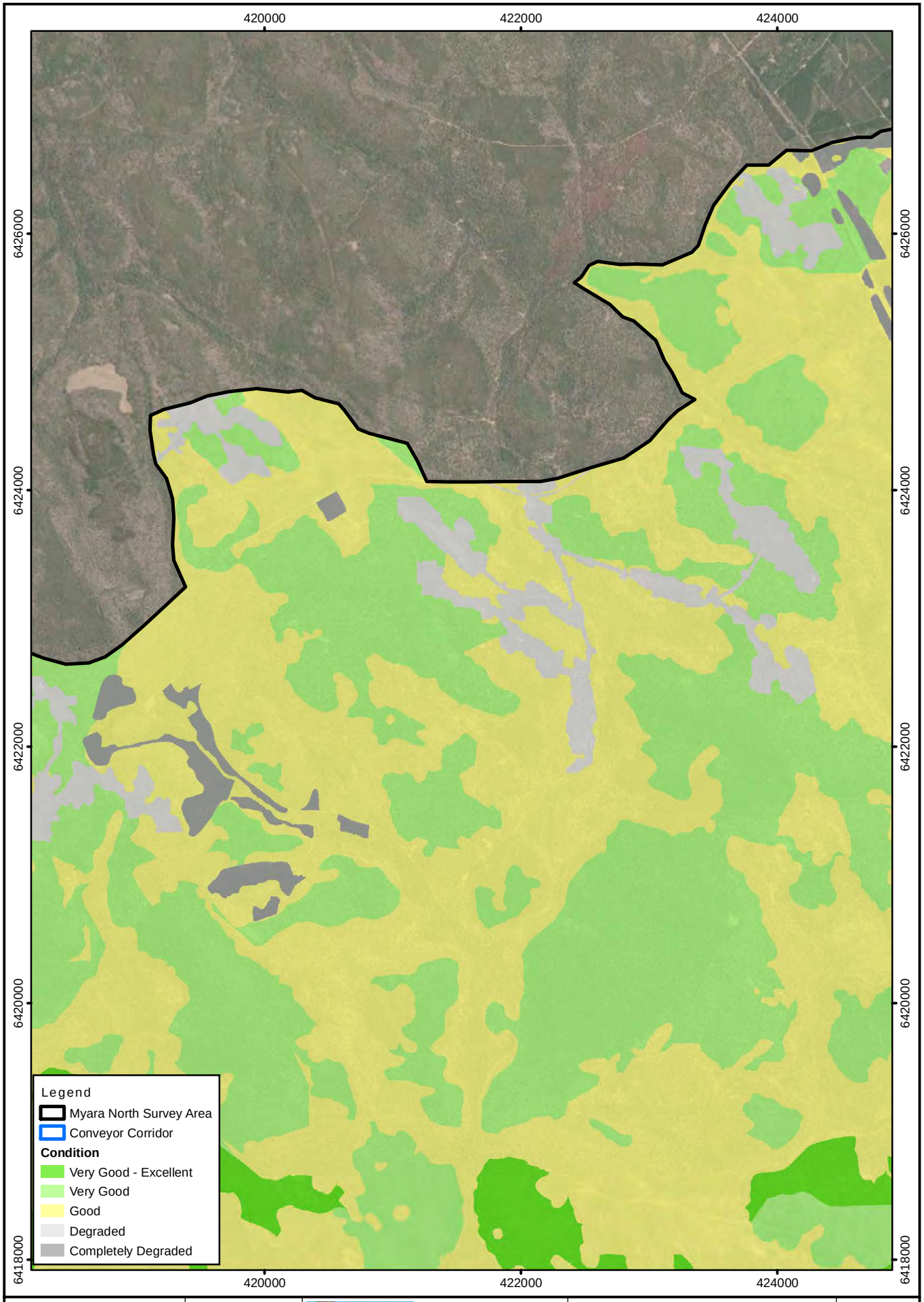
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Vegetation Condition in Myara North Area

Sheet 1 of 7

Figure:

17.1



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F08_01

Date: May 2021 | Rev: C | A4

Sheet Layout:

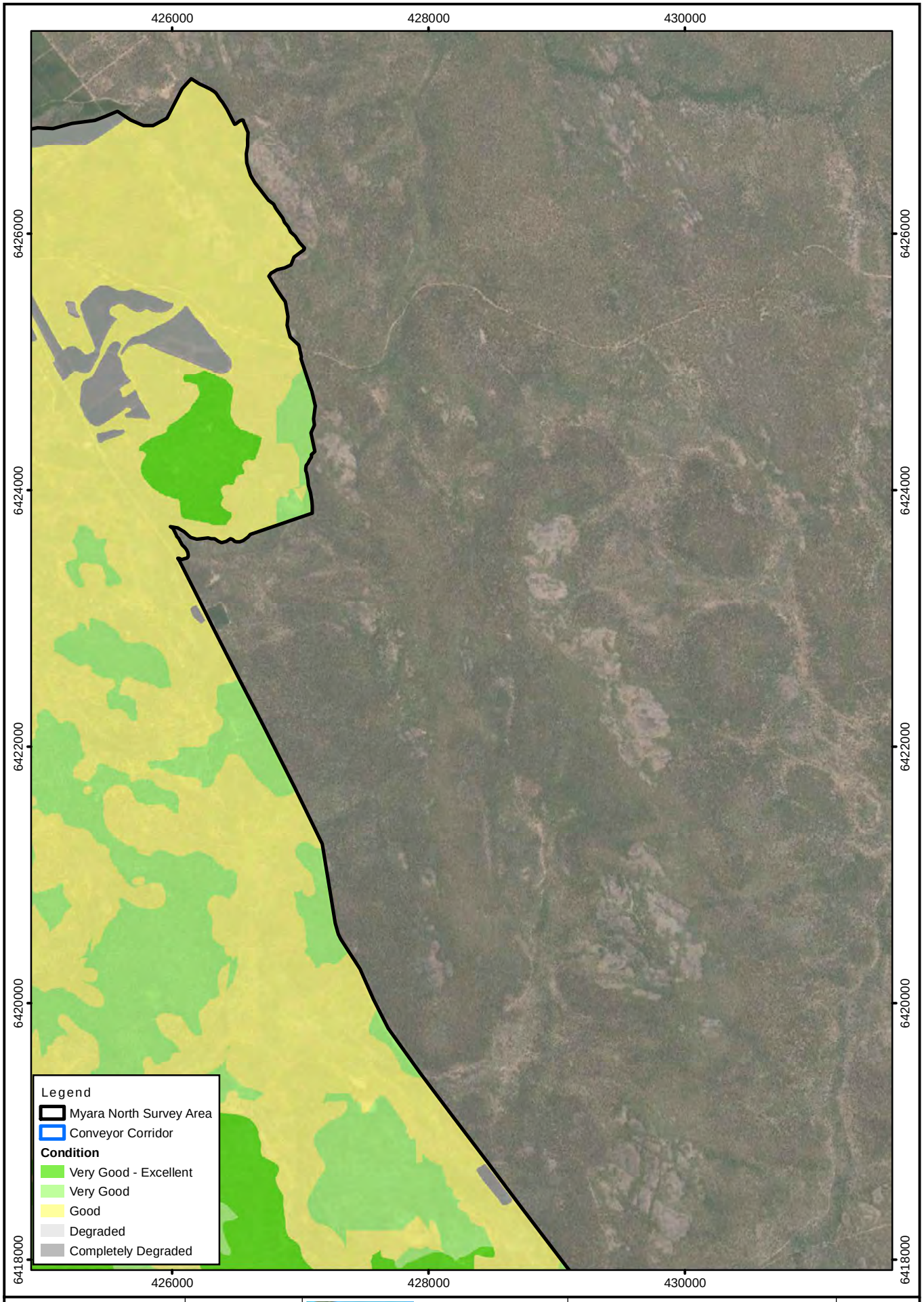
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Vegetation Condition in Myara North Area

Sheet 2 of 7

Figure:

17.2



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F08_01

Date: May 2021 | Rev: C | A4

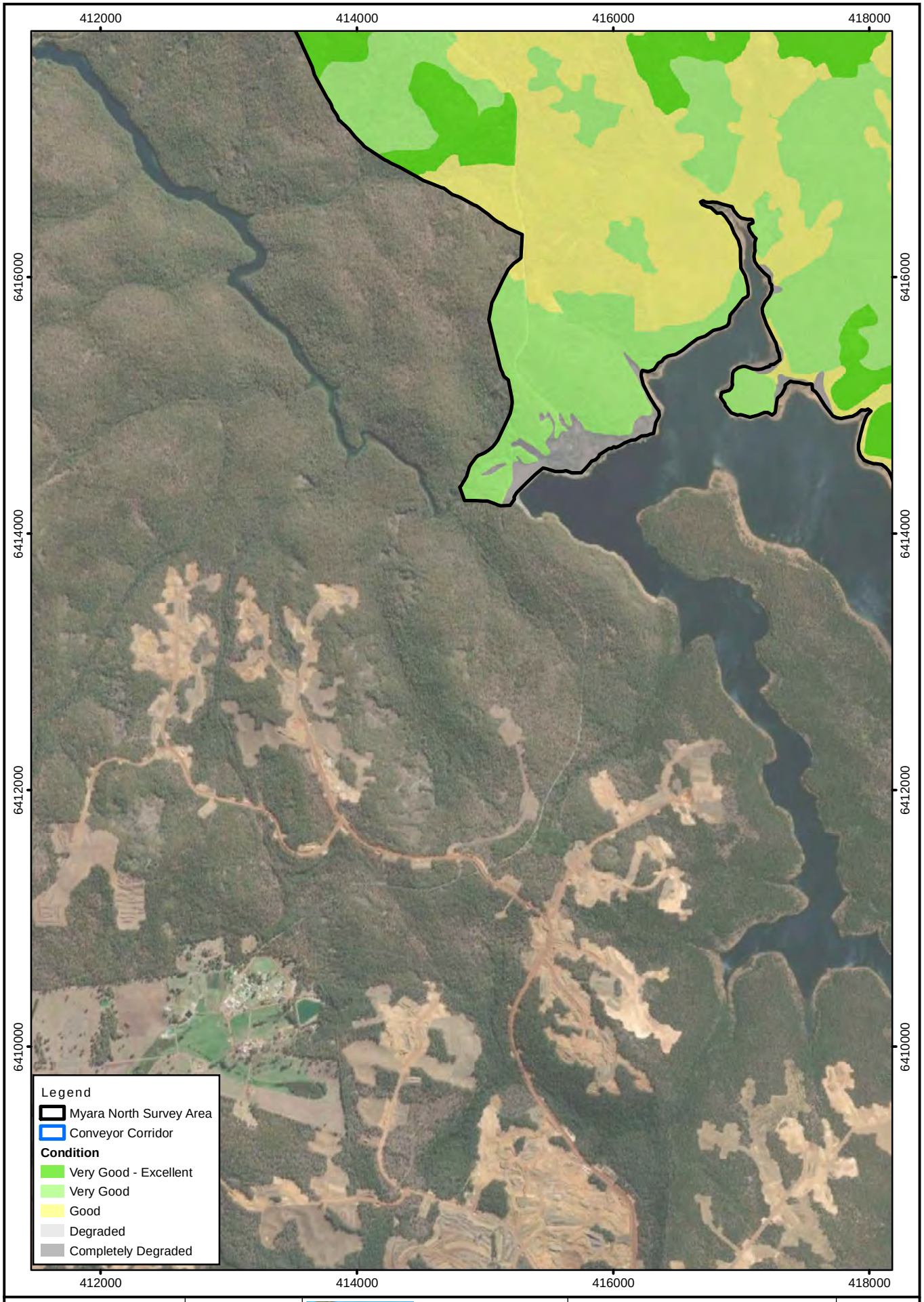
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Vegetation Condition in Myara North Area

Sheet 3 of 7

Figure: **17.3**



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F08_01

Date: May 2021 | Rev: C | A4

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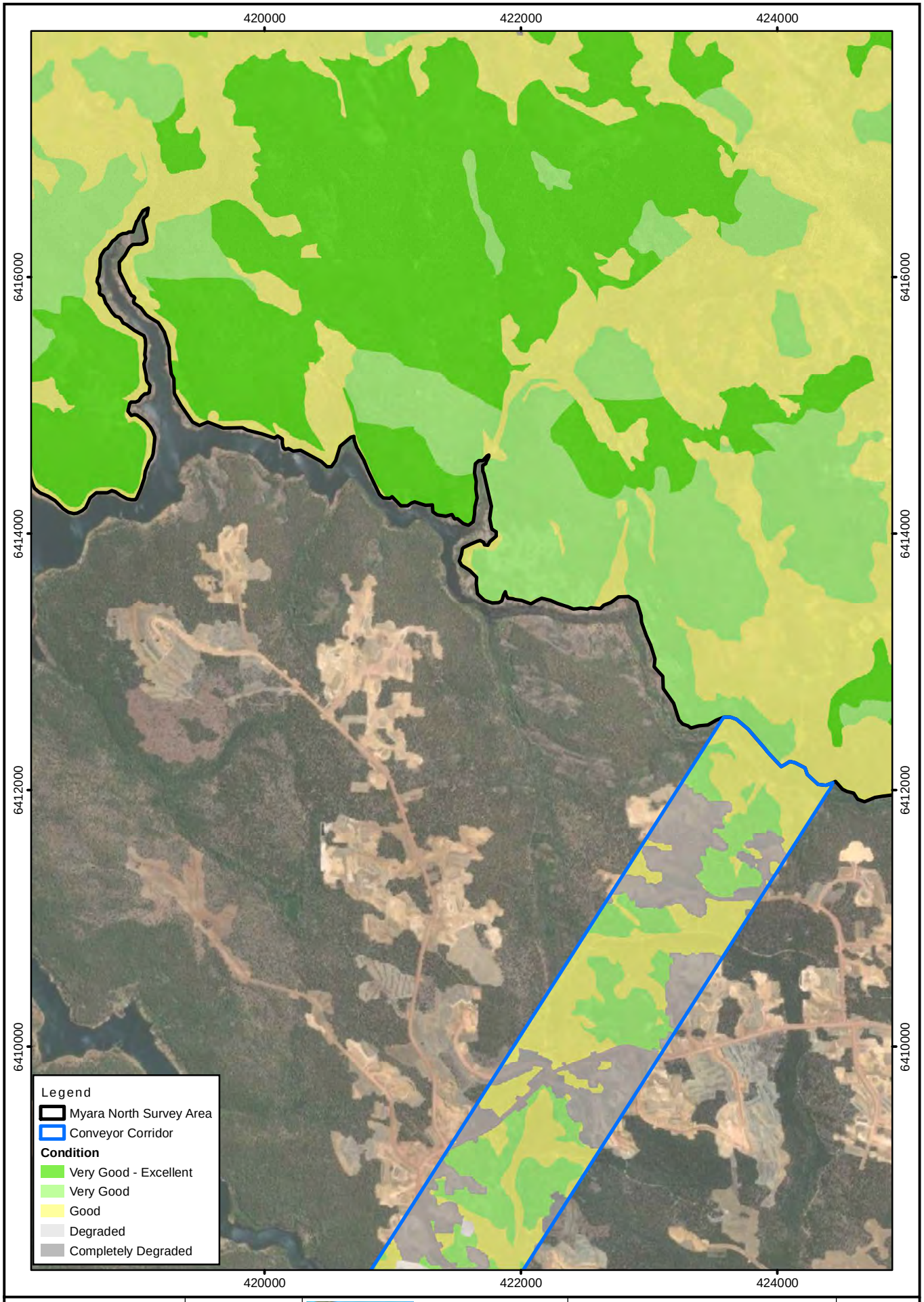
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Vegetation Condition in Myara North Area

Sheet 4 of 7

Figure:

17.4



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F08_01

Date: May 2021 | Rev: C | A4

Sheet Layout:

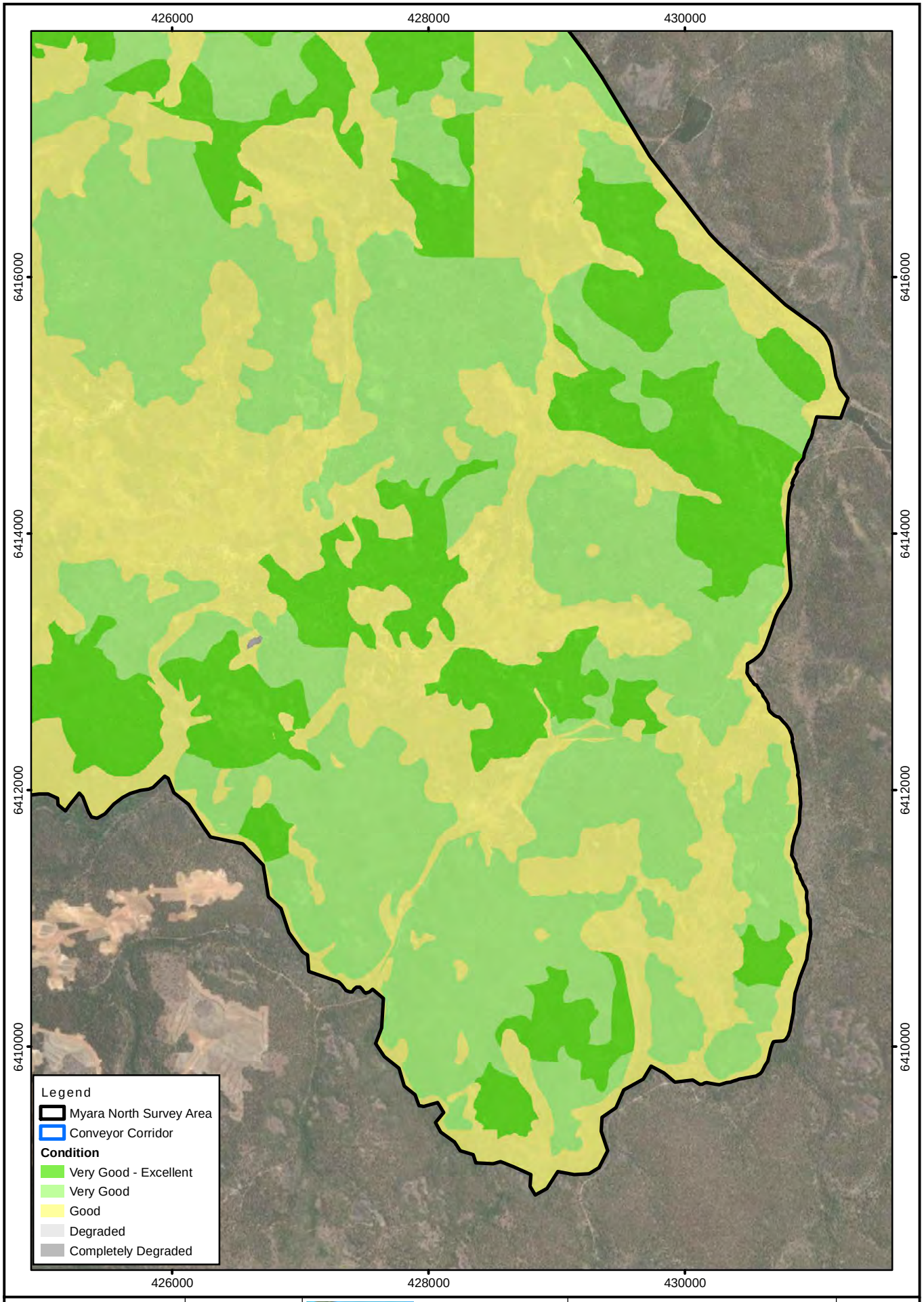
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Vegetation Condition in Myara North Area

Sheet 5 of 7

Figure:

17.5



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F08_01

Date: May 2021 | Rev: C | A4

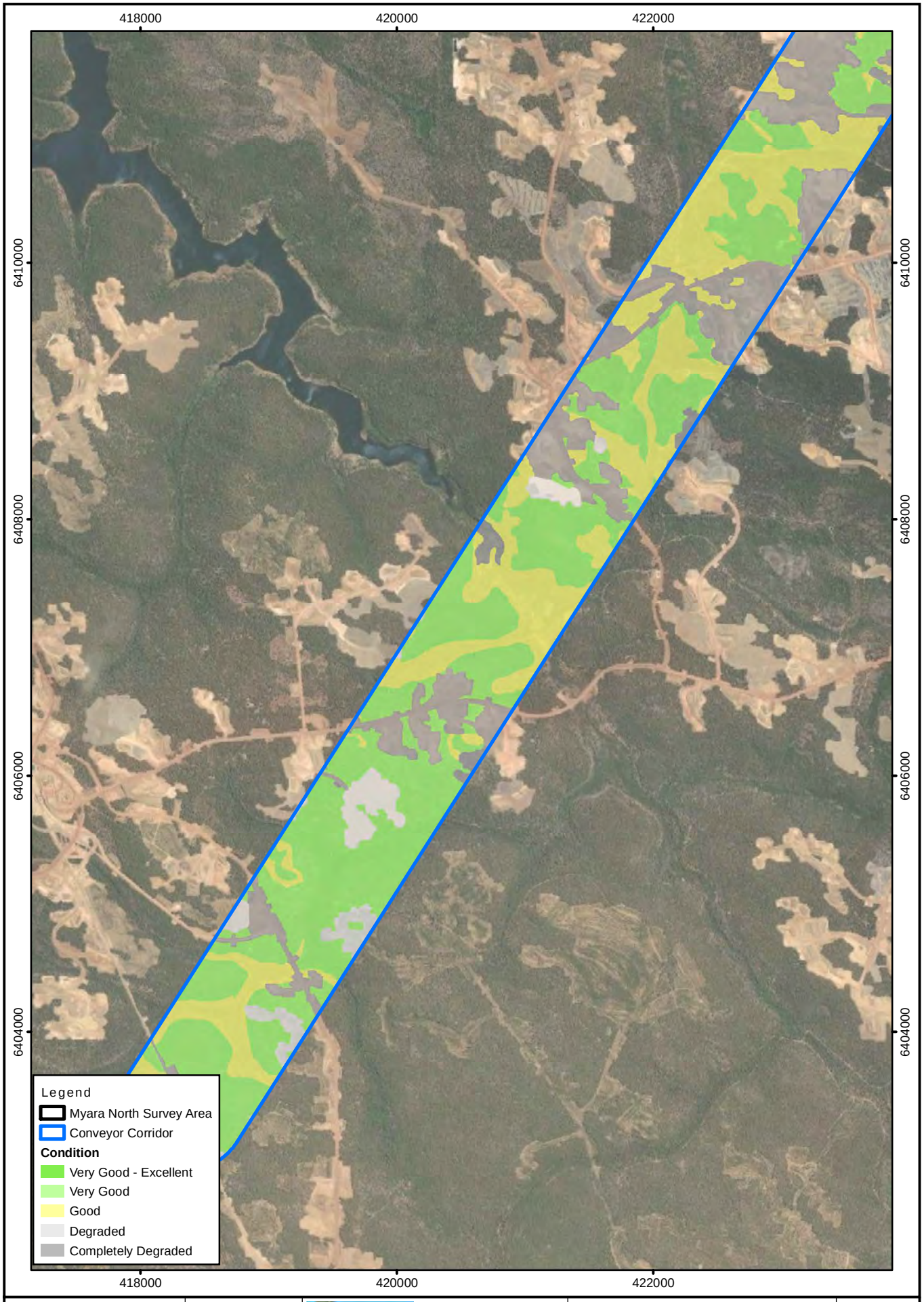
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Vegetation Condition in Myara North Area

Sheet 6 of 7

Figure: **17.6**



N

0 300 600 m

Scale: 1:40,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F08_01

Date: May 2021 | Rev: C | A4

Sheet Layout:



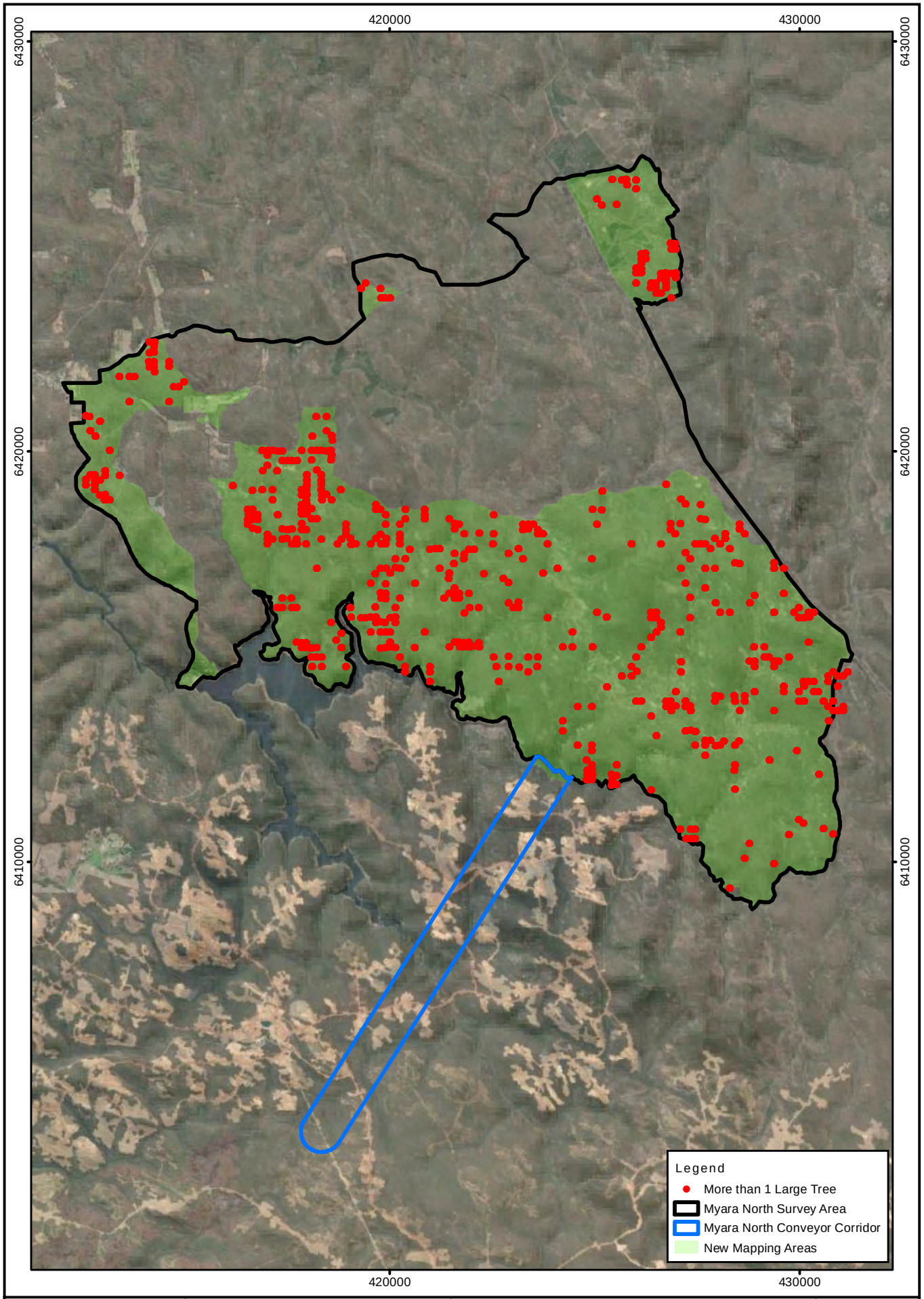
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Vegetation Condition in Myara North Area

Sheet 7 of 7

Figure:

17.7



N

0 1 2 km

Scale: 1:125,000
MGA94 (Zone 50)

CAD Ref: a1992_MyNth_F13_01

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Myara North Survey Area

Patches of Large Trees > 50cm

Figure: **18**

5.8. Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs) occur in the MN survey area. The desktop assessment highlighted several potential TECs; however these are restricted to the Swan Coastal Plain and as such do not extend into the Jarrah forest area on the Darling Ranges.

One of the priority ecological communities (PECs), as listed at State level by DBCA (2020a) occurs within the MN survey area, namely:

- Granite communities of the northern Jarrah forest (P3)
    - Jarrahdale area – Monadnocks, Blue Rock; insufficient information to distinguish discrete community type/s (DBCA 2020a).

There is one botanical PEC, listed at State level (Granite Communities of the northern Jarrah Forest), which is likely to occur in the MN survey area. This Priority Ecological Community has some affinities with the values in G and R (and variants). There is a lack of clarity on the values that determine the presence of the Priority Ecological Community other than the species that occur on granite outcrops on the Darling Scarp as defined by Markey (1997) (pers comm. J Pryde, DBCA). On a local scale the outcrop areas are locally very variable from lithic complexes to heaths to open woodlands. The species as recorded by Markey (1997), on the granite outcrops to the west on the Darling Scarp, were compared with those recorded in the site-vegetation types G and R by Mattiske Consulting team in 2020. Of these the main keystone species include *Calothamnus quadrifidus, Borya sphaerocephala, Grevillea bipinnatifida, Allocasuarina humilis* and *Babingtonia camphorosmae*. Of these species the initial four species are associated with shallow soils and granite outcrops. The *Babingtonia camphorosmae* is associated with seasonally moister soils which may occur in a range of site conditions including near run-off areas near granite outcrops. There is a lack of local data within the MN survey area to confirm the extent of the PEC other than to refer to the studies by Markey (1997) on the Darling Scarp. One limitation associated with such a comparison was relate to the degree of disturbance of the granite sampling sites on the Darling Scarp as reflected in the range of introduced species recorded in the Markey (1997) sampling areas.

The MN survey area occurs within the Regional Forest Agreement (RFA) area of the southwest forests DAWE (2020b) and as such was considered during the RFA process.

5.9. Potential Groundwater Dependent Ecosystems

The potential groundwater dependent ecosystems were determined on the basis of the site-vegetation types as mapped in Figures 16.3 to 16.9 above, see Figure 19. In view of the extensive flora and vegetation studies in the northern Jarrah Forest these vegetation complexes support species and site-vegetation types that prefer and occur on seasonally moister and wetter soils on the swamps and lower slopes of the valley systems. This approach was considered to represent a precautionary approach in the absence of detailed groundwater level data at the time of selecting the potential groundwater dependent ecosystems at this juncture.

Key site-vegetation types with the potential for groundwater dependent ecosystems included the following site-vegetation types, namely:

Swamps and Broad Valleys – A, AC, D, AD, DA and E

Valley Floors and Lower Slopes - CW and W

Slopes with localized higher seasonal soil moisture – SW and PW

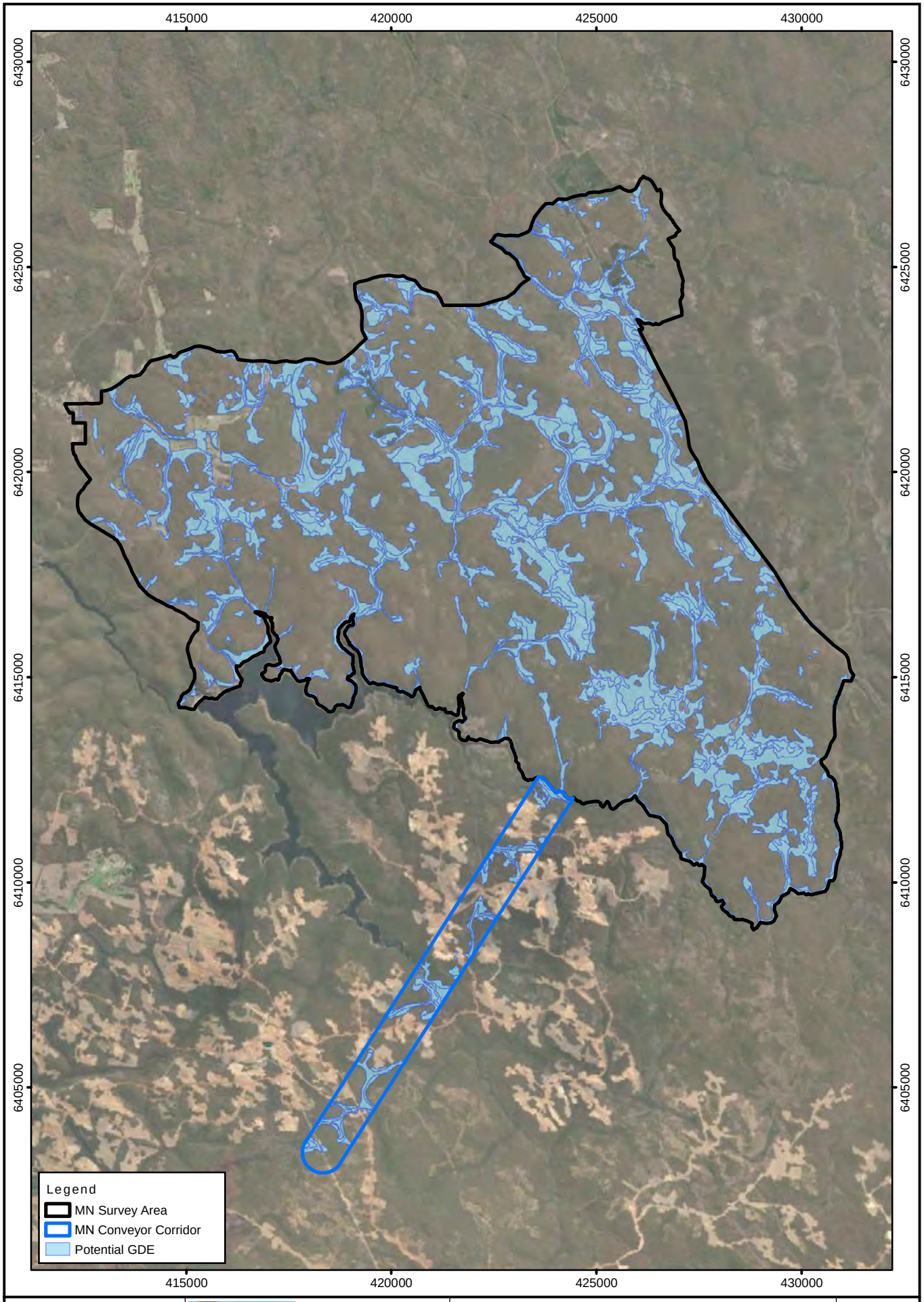
Key indicator plant species that are generally accepted as indicators of moister soils and, hence, potential groundwater dependent ecosystems include – *Banksia littoralis, Hakea varia, Acacia divergens, Pultenaea skinneri, Boronia molloyae, Thomasia paniculata, Astartea scoparia, Eucalyptus rudis, Hypocalymma cordifolium, Melaleuca preissiana, Melaleuca rhaphiophylla, Melaleuca viminea, Baumea* and *Leptocarpus* species and *Taxandria linearifolia. Babingtonia camphorosmae* and *Hypocalymma angustifolium* indicate seasonal moister soils and as such are significant in determining local conditions.

5.10. Old Growth Forests

Based on data as supplied by DBCA (2020) there are a number of patches of Old Growth Forest occurring in the area surrounding the MN survey area, with some occurring within 10 km of the survey area boundary to the north, south, east and west (see Section 4.7). A small section of Old Growth Forest intersects the survey area in the central part of the south-western boundary of the MN survey area. Due to the proximity of the MN survey area to the township of Jarrahdale and the Perth population the areas within MN have been subject to harvesting for many decades.

In reviewing the data as collected within the MN survey area it is apparent that some of the older flora and vegetation survey areas (E.M. Mattiske and Associates 1988, 1992, 1993 and Mattiske Consulting Pty Ltd 2009, 2011, 2012 and 2019) have been logged since the initial surveys were undertaken. The earlier flora and vegetation survey areas (conveyor corridor and previous survey areas within the MN survey area) were not re-assessed in 2020.

The survey did not identify any additional areas within the survey area that could potentially be un-mapped Old Growth Forest, based on Department of Parks and Wildlife criteria (DPAW 2017).



N

0 1 2 km

Scale: 1:125,000
MGA94 (Zone 50)

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Date: March 2021 | Rev: A | A4

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Potential GDE's based on Site-vegetation Types Myara North survey area

Figure: **19**

6. DISCUSSION AND CONCLUSIONS

6.1. Flora

A total of 681 vascular taxa was recorded in the MN survey area and the adjacent areas. The survey efforts were undertaken over multiple years and seasons and therefore the coverage of the flora was considered to exceed the EPA (2016a and 2016b) guidance statements expectations.

No Threatened flora species, pursuant to section 179 of the *EPBC Act* and as listed by DAWE (2020a) or pursuant to Part 2, Division 1 and Subdivision 2 of the *BC Act* and as listed by DBCA (2018a) were recorded during the detailed flora and vegetation survey of the MN survey area. The lack of threatened flora is key outcome of the survey effort and as such reinforces the desktop assessment which found a moderate to low likelihood of threatened flora occurrence on the MN survey area. The eight Threatened species that had a moderate potential to occur in the MN survey area were largely (seven of the eight) occurred in broader valleys and near granite outcrops.

Fourteen Priority flora species as listed by DBCA (2018c) have been recorded in the MN survey area. During 2020, four Priority species were recorded within the specific MN survey area, namely *Acacia drummondii* subsp. *affinis* (P3), *Acacia horridula* (P3), *Conospermum scaposum* (P3) and *Stylidium scabridum* (P4). Additional Priority flora species (*Acacia oncinophylla* subsp. *oncinophylla, Boronia tenuis, Bossiaea modesta, Banksia recurvistylis, Grevillea crowleyae, Grevillea manglesii* subsp. *dissectifolia* and *Grevillea pimeleoides*) were recorded on the fringes of the MN survey area and in nearby flora and vegetation studies in previous studies.

The Priority flora species occur on the varying landform and soil groupings, namely - 41.9% in swamps, 58.1% on or near granite outcrops and 61.3% with lateritic gravelly soils. Whilst the Priority species occur on the various landform and soil groupings, the vast majority have occurred on the eastern areas of the MN survey area in the broader valley systems and nearer the monadnock areas to the north and east.

Fiifty-eight introduced species were recorded in the MN assessment. One of the introduced species is a declared pest organism pursuant to section 22 of the BAM Act, namely:* *Gomphocarpus fruticosus* (DPIRD 2020). None of the introduced species are listed as a Weed of National Significance (WONS) (DAWE 2020d). Of the 58 introduced species, 8 have been ranked as High Ecological Impact by DPAW (2014) and 24 have been ranked as Rapid Invasiveness by DPAW (2014). **Gomphocarpus fructicosus* is associated with cleared and degraded areas, **Leptospermum laevigatum* is associated with areas near previous disturbance and tracks,**Watsonia meriana* is associated with valley floors and creek lines. The remainder are associated with degraded and completely degraded areas and fringes of road and tracks.

A key characteristic of the survey area is the shift in landforms and soils from west to east across the MN survey area and the latter is reflected in the change in the dominance of flora species that tolerate the broader valley systems, swamps and the outcrop areas. The summary of results from the plots and the recording sites as summarized by the site-vegetation types reflects this shift from species in the lateritic slopes and ridges and the broader valleys and outcrops.

6.2 Vegetation Values

The survey efforts were undertaken over multiple years and seasons and the coverage of the vegetation was considered to exceed the EPA (2016a and 2016b) guidance statements expectations. The vegetation values were recorded in vegetation plots (20m x 20m with 20 x 2m x 2m quadrats within each plot), in regular recording sites and from aerial photographic imagery interpretations. The vegetation plots were established in the spring months of 2020 and these were combined with nearby plots from Jarrahdale (JDL), Myara and Huntly areas (HU) and other forest plots (FMPs). The coverage of the survey area with

regular recording sites was undertaken over a six month period and then the data was merged with previous data sets from the earlier studies near Jarrahdale and the Myara and Huntly areas.

A total of 32 site-vegetation types were defined and mapped on the MN survey area. The delineation of the site-vegetation types was based on the interpretation of the ranking data for the flora species and the underlying landforms and soils. The interpretation of the data from recording sites was based on the previous methods adopted by Mattiske which relied on the interpretation of the keystone species as defined by Havel (1975a and 1975b) and the site parameters as recorded at each recording site. This approach provided consistency with previous approaches adopted in the site-vegetation mapping in the northern Jarrah forest by Havel (1975a and 1975b) and Mattiske on the previous areas near Jarrahdale, Dwellingup and in the eastern Jarrah forests.

A range of analyses were undertaken on the vegetation plot data and after a series of analyses there was a reliance placed on keystone species as defined by Havel (1975a and 1975b) and as modified by Mattiske for the northern Jarrah forest. The continuum nature of the vegetation was reflected in the findings for the site-vegetation types which occur on the lateritic slopes and ridges and the more distinct communities on the swamps and broader valley systems. The statistical approach adopted in other projects was less reliable in the MN survey area as many species occur on all sites or only a few sites and it also does not take into account the site parameters which are critical in the delineation of the site-vegetation types. Whilst the differentiation was evident on the more diverse and different structural and floristic communities in the sites associated with valleys and granite outcrops this was not the case for the site-vegetation types that have subtle shifts in keystone species on the gradients from sandy soils, to sandy-loams to sandy-gravels to gravels and lateritic outcropping areas.

The site-vegetation types were subdivided into six main groupings associated with site conditions which reflected landforms, soils and soil moisture levels. The site-vegetation types on the extreme sites such as granite outcrops and broad valley systems and swamps differ markedly from the forest and woodland areas on the slopes and ridges.

The G, G1, G2, RG and R site-vegetation types are associated with the outcrop areas and are in larger areas associated with the Cooke vegetation complex as defined by Heddle *et al.* (1980) and Mattiske and Havel (1998). These site-vegetation types support a range of conservation significant species. As the mining operations are mainly associated with the lateritic slopes and uplands these areas are unlikely to be impacted to the same degree.

The series of site-vegetation types associated with the broader valley systems which dominate the Yarragil 2 and Swamp vegetation complexes as defined by Mattiske and Havel (1998) provide a spatial diversity that supports a range of species. As the mining operations are mainly associated with the lateritic slopes and uplands these areas are unlikely to be directly impacted to the same degree. There is potential for some of these site-vegetation types to be groundwater dependent ecosystems with the potential for indirect impacts from some operational activities. As some of the key species in these areas are depended on seasonal increases in soil moisture availability in the valley systems there is some potential for indirect impacts.

The dominant site-vegetation types on the lateritic slopes and ridges include types P, PS, SP, S, ST, T and TS. The other areas of significance are the localised site-vegetation types that support specific and localised flora species (e.g. site-vegetation types E and J that occur in more restricted areas within the broader valleys). The remaining codes (CL, CL Other, Rehab, Dam and PL) are associated with modified environments.

No Threatened Ecological Communities (TECs) occur in the MN survey area. The only botanical Priority Ecological Community has some affinities with the values in G and R (and variants). There is a lack of clarity on the values that determine the presence of the Priority Ecological Community other than the association with the outcrops. On a local scale the outcrop areas are locally very variable from lithic

complexes to heaths to open woodlands. The species as recorded by Markey (1997), on the granite outcrops to the west on the Darling Scarp, were compared with those recorded in the site-vegetation types G and R by Mattiske Consulting team in 2020. Of these the main keystone species include *Calothamnus quadrifidus, Borya sphaerocephala, Grevillea bipinnatifida, Allocasuarina humilis* and *Babingtonia camphorosmae*. Of these species the initial four species are associated with shallow soils and granite outcrops. The *Babingtonia camphorosmae* is associated with seasonally moister soils which may occur in a range of site conditions including near run-off areas near granite outcrops. No specific sampling by DBCA was undertaken (pers comm. J Pryde, DBCA) in the areas designated as the PEC granite community within the MN survey area.

The majority of the vegetation was ranked as very good and very good-excellent (50.41%) despite historical harvesting activities and local pressures from recreational activities with 15.23% being designated as Very-Good to Excellent. The biodiversity values have persisted in many areas instances. Some areas have been influence by the Jarrah Dieback disease and although the composition of the understorey has been modified as a result of the *Phytophthora cinnanomi* infections these areas still provide a range of native species towards the forest values. The degraded and completely degraded (5.57%) areas are associated with cleared, older rehabilitation areas and plantation areas. Less stumps and logging activities were recorded within the swamp areas and on lower sandier soils in the broader valley types; although dieback disease from *Phytophthora cinnanomi* has influenced many of the valley systems in the MN survey area (Glevan Consulting 2020). A few areas supporting patches of larger trees were designated as potential fauna habitats.

The potential groundwater dependent ecosystems were determined on the basis of the vegetation complexes and when the more detailed site-vegetation type mapping was available the initial interpretations were updated. The dominant and key indicator species which occur in moister and wetter soils on the swamps and lower slopes of the valley systems underpinned the selection of the potential groundwater dependent ecosystems. Soil moisture levels reflect local site conditions, such as runoff from granite outcrops in wetter seasons and areas where the soil type can hold water for longer periods. Therefore not all areas supporting the latter species are GDEs, but may reflect other specific site conditions not related to the groundwater levels.

State Government mapping indicates that there is a number of patches of old growth forests occurring in the area surrounding the MN survey area, with some occurring within 10 km of the survey area boundary to the north, south, east and west. A small section of old growth forest intersects the survey area in the central part of the south-western boundary of the MN survey area. The survey did not identify any additional areas within the survey area that could potentially be un-mapped old growth forest, based on Department of Parks and Wildlife criteria (DPAW 2017).

7. ACKNOWLEDGEMENTS

The authors would like to thank Alcoa of Australia Ltd and the environment team at GHD for their assistance with this project.

8. PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this recent project. Thanks also go to previous staff members of the Mattiske Consulting team, the Alcoa Australia environmental team, Mike Hislop from the State Herbarium for assistance with plant identifications and the environmental team at GHD for their support during this project.

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L Rowles	Experienced Botanist	Project Leader, Field Studies, Data Collation, Assisting with Reporting	FB62000020-2
S. Ruoss	Experienced Botanist	Field Studies, Data Collation	FB62000031-2 TFL 17-1819
R. Dharmarajan	Experienced Botanist	Field Studies, Data Collation	FB62000028-2
E. Chetwin	Experienced Botanist	Field Studies, Data Collation	FB62000026-2
L. Cockram	Experience Botanist	Field Studies, Assisting with Plant Identifications, Data Collation	FB62000266
A. Barrett	Experience Botanist	Field Studies	FB62000030-2
B. Ellery	Senior Botanist	Assisting with Plant Identifications	FB62000024-2
N. Watson	Botanist	Field Studies, Assisting with Plant Identifications, Data Collation	FB62000146-2
A. Pereira	Botanist	Field Studies, Data Collation	FB62000145-2
Z. Sims	Botanist	Field Studies, Data Collation	FB62000025-2
J. Wescombe	Botanist	Data collation, reporting	FB62000032-2
R. Jones	Botanist	Data collation and Assisting with Reporting	N/A
M. Behn	Biologist	Field Studies, Data Collation and Assisting with Reporting	FB62000264
T. Gregory	Technical Support	Data Collation and Assisting with Reporting	N/A

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APPENDIX A1: THREATENED AND PRIORITY FLORA DEFINITIONS

Under section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), threatened flora are categorised as extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent (Table A1.1).

Table A1.1 Federal definition of threatened flora species

Note: Adapted from section 179 of the EPBC Act.

CODE	CATEGORY	DEFINITION
Ex	Extinct	Species which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild	Species which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	Critically Endangered	Species which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	Endangered	Species which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable	Species which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent	Species which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

The *Biodiversity Conservation Act 2016* (BC Act) provides for (amongst other things) the protection of flora that is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future in Western Australia under Part 10 (Division 2).

Threatened flora are listed in the *Wildlife Conservation (Rare Flora) Notice 2018* (under Part 2, Division 1, Subdivision 2 of the BC Act; Department of Biodiversity, Conservation and Attractions [DBCA] (2018a) and are categorised under Schedules 1-3. A flora species is defined as threatened if it is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future, pursuant to sections 20, 21 and 22 of the BC Act (DBCA 2019). Threatened species are categorised as critically endangered, endangered, and vulnerable (Table A1.2).

Table A1.2 State definition of threatened flora species

Note: Adapted from DBCA (2019).

CODE	CATEGORY	DEFINITION
CR	Critically endangered	Species considered to be facing an extremely high risk of becoming extinct in the wild (listed under Schedule 1 of the *Wildlife Conservation (Rare Flora) Notice 2018*).
EN	Endangered	Species considered to be facing a very high risk of becoming extinct in the wild (listed under Schedule 2 of the *Wildlife Conservation (Rare Flora) Notice 2018*).
VU	Vulnerable	Species considered to be facing a high risk of becoming extinct in the wild (listed under Schedule 3 of the *Wildlife Conservation (Rare Flora) Notice 2018*).

Priority flora species are defined as "possibly threatened species that do not meet the survey criteria, or are otherwise data deficient" or species that are "adequately known, are rare but not threatened, meet criteria for near threatened or have recently been removed from the threatened species list" for other than taxonomic reasons" (DBCA 2019). Priority species are not afforded the same level of protection under state or federal legislation as the listed Threatened species, however are considered significant under the Environmental Protection Authority's *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a). The Department of Biodiversity, Conservation and Attractions categorises priority flora into four categories: Priority 1; Priority 2, Priority 3 and Priority 4 (Table A1.3).

Table A1.3: State definition of priority flora species

Note: Adapted from DBCA (2019).

CODE	CATEGORY	DEFINITION
P1	Priority 1: Poorly-known species	Known from one or a few locations (< 5) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation; or are otherwise under threat of habitat destruction or degradation. In urgent need of further survey.
P2	Priority 2: Poorly-known species	Known from one or a few locations (< 5). Some occurrences are on lands managed primarily for nature conservation. In urgent need of further survey.
P3	Priority 3: Poorly-known species	Known from several locations and the species does not appear to be under imminent threat; or from few but widespread locations with either a large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. In need of further survey.
P4	Priority 4: Rare, Near Threatened, and other species in need of monitoring	a) Rare - Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. b) Near Threatened - Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c) Other - Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX A2: THREATENED AND PRIORITY ECOLOGICAL COMMUNITY DEFINITIONS

Under section 181 of the EPBC Act, threatened ecological communities are categorised as critically endangered, endangered and vulnerable (Table A2.1).

Table A2.1 Federal definition of threatened ecological communities

Note: Adapted from section 181 and section 182 of the EPBC Act.

CATEGORY	DEFINITION
Critically Endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Threatened ecological communities (TECs) are listed in the *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment (28 June 2018)* (under Part 2, Division 2, Subdivision 1 of the BC Act; DBCA 2018b). An ecological community is defined as threatened if it is facing an extremely high risk of collapse in the immediate, near or medium-term future, pursuant to sections 28, 29 and 30 of the BC Act. Threatened ecological communities are categorised as critically endangered, endangered, and vulnerable (Table A2.2).

Currently there is no Western Australian legislation covering the conservation of state listed threatened ecological communities (TECs), however, a non-statutory process is in place, whereby the DBCA (and former equivalent departments) have been identifying and informally listing TECs since 1994. Some of these TECs are also endorsed by the Federal Minister as threatened, and some of these are listed under the EPBC Act and therefore afforded legislative protection at the Commonwealth level.

Table A2.2 State definition of threatened ecological communities

Note: Adapted from Department of Environment and Conservation (2013).

CODE	CATEGORY	DEFINITION
CR	Critically Endangered	An ecological community will be listed as CR when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one or more of the following criteria: 1. The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; 2. The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or 3. The ecological community is highly modified with potential of being rehabilitated in the immediate future.
EN	Endangered	An ecological community will be listed as EN when it has been adequately surveyed and is not CR, but is facing a very high risk of total destruction in the near future. The ecological community must meet any one or more of the following criteria: 1. The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; 2. The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or 3. The ecological community is highly modified with potential of being rehabilitated in the short term future.
VU	Vulnerable	An ecological community will be listed as VU when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one or more of the following criteria: 1. The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; 2. The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; or 3. The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

Priority ecological communities (PECs) are defined as possible threatened ecological communities that do not meet the stringent survey criteria for the assessment of threatened ecological communities, and are listed by the DBCA (2020a) in the *Priority Ecological Communities for Western Australia – Version 29 (05 May 2020)*. Similarly to priority flora, PECs are not afforded legislative protection, however are considered significant under the Environmental Protection Authority's (2016a) *Environmental Factor Guideline: Flora and Vegetation*. The Department of Biodiversity, Conservation and Attractions categorises priority ecological communities into five categories: Priority 1; Priority 2, Priority 3, Priority 4 and Priority 5 (Table A2.3).

Table A2.3 State definition of priority ecological communities

Note: Adapted from Department of Environment and Conservation (2013).

CODE	CATEGORY	DEFINITION
P1	Priority 1 (Poorly known ecological communities)	Ecological communities that are known from very few, restricted occurrences (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Most of these occurrences are not actively managed for conservation (e.g. located within agricultural or pastoral lands, urban areas, or active mineral leases) and for which immediate threats exist.
P2	Priority 2 (Poorly known ecological communities)	Communities that are known from few small occurrences (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation.
P3	Priority 3 (Poorly known ecological communities)	1. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation; 2. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat; or 3. Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	Priority 4 (Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring)	1. Rare – Communities known from few occurrences that are considered to have been adequately surveyed, sufficient knowledge is available, and are considered not to be currently threatened. 2. Near Threatened – Communities considered to have been adequately surveyed and do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable. 3. Communities that have been removed from the list of threatened communities during the past five years.
P5	Priority 5 (Conservation Dependent ecological communities)	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX A3: CATEGORIES AND CONTROL MEASURES OF DECLARED PEST (PLANT) ORGANISMS IN WESTERN AUSTRALIA

Section 22 of Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act) makes provision for a plant taxon to be listed as a declared pest organism in respect to parts of, or the entire State. According to the BAM Act, a declared pest is defined as a prohibited organism (section 12), or an organism for which a declaration under section 22 (2) of the Act is in force.

Under the *Biosecurity and Agriculture Management Regulations 2013* (WA), declared pest plants are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Table A4.1). The current listing of declared pest organisms and their control category is through the Western Australian Organism List (Department of Primary Industries and Regional Development 2020).

Table A3.1 Categories and control measures of declared pest (plant) organisms

Note: Adapted from *Biosecurity and Agriculture Management Regulations 2013*.

CONTROL CATEGORY	CONTROL MEASURES
C1 (Exclusion) '(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented.' Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.	In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C2 (Eradication) '(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible.' Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.	In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C3 (Management) '(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to: (i) alleviate the harmful impact of the declared pest in the area; or (ii) reduce the number or distribution of the declared pest in the area; or (iii) prevent or contain the spread of the declared pest in the area.' Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.	In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to: (a) alleviate the harmful impact of the declared pest in the area for which it is declared; or (b) reduce the number or distribution of the declared pest in the area for which it is declared; or (c) prevent or contain the spread of the declared pest in the area for which it is declared.

APPENDIX A4: OTHER DEFINITIONS

Environmentally sensitive areas

Environmentally sensitive areas are declared by the State Minister under section 51B of the *Environmental Protection Act 1986* (EP Act) and are listed in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, gazetted 8 April 2005. Specific environmentally sensitive areas relevant to this report include: a defined wetland and the area within 50 metres of the wetland; the area covered by vegetation within 50 metres of rare flora; the area covered by a threatened ecological community; a Bush Forever site – further areas and information are described in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*.

Conservation significant flora

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), flora may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority species;
- locally endemic or associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- new species or anomalous features that indicate a potential new species;
- representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids; or
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Conservation significant vegetation

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), vegetation may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority ecological communities;
- restricted distribution;
- degree of historical impact from threatening processes;
- a role as a refuge; or
- providing an important function required to maintain ecological integrity of a significant ecosystem.

APPENDIX A5: VEGETATION CONDITION SCALE (adapted from Keighery 1994 and Trudgen 1988 and as summarized in EPA Guidance Statement 2016b and modified to adjust to "forest" areas)

Vegetation Condition	EPA Definition (2016b) - South West and Interzone Botanical Provinces	Comments reflecting condition **ratings for "Forest" areas** (including diversity of structural and floristic composition areas)	Clearing Agriculture Residential	Post-Mining & Rehabilitation	Tracks & Roads	Logging Harvest Records, Stumps	Dieback	Introduced Flora Species
Pristine	Pristine or nearly so, no obvious signs of disturbances caused by human activities since European settlement.	Very restricted areas as most areas been subject to some disturbance.	None	None	None	No Logging (old growth forest)	None obvious, limited / no vulnerable species	Limited / no presence
Excellent	Vegetation Structure intact, disturbance affecting individual species and weeds are non-aggressive. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional tracks.	Very little evidence of logging in past. Occasional tracks, past burning, no obvious dieback, presence of short-lived non-aggressive weed.	None	None	Occasional tracks	Predominantly mature forest (last harvest > 70 years ago)	None obvious, limited / no vulnerable species	Non aggressive weeds
Very Good	Vegetation Structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Some modification to structural components through past logging activities, repeated fires. Grazing only by native animals in forests. No obvious dieback, presence of short-lived non-aggressive weed.	None	None	Occasional tracks	Immature forest (last harvest > 20, < 70 years ago)	Limited dieback infestation on localised areas, limited vulnerable species	Non-aggressive weeds
Good	Vegetation Structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Some modification to structural and floristic components through past mining and logging activities. Occurrence of repeated fires that have impacted vegetation. Grazing mainly by native animals in forests and occasional feral animal (e.g. pigs).	Localised partial clearing near past logging activities and tracks and previous facilities	Rehabilitation areas with structural and/or floristic components developing and persisting (post 2000, Grant and Koch 2007)	Occasional tracks and informal roads	Juvenile forest (last harvest < 20 years ago)	Extensive dieback infestation, prevalent vulnerable species, some structural impact	Aggressive weeds and non-aggressive weeds reflecting disturbance
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Basic vegetation structure severely impacted by disturbance. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Partial clearing near past logging activities and tracks and previous facilities	Rehabilitation areas with lower species diversity (pre 2000, Grant and Koch 2007) and/or early phases of regrowth and establishment of tree species with potential for shift to Good	Extensive tracks, informal roads	Logged land is expected to recover to Good (juvenile forest)	Extensive dieback infestation, dominant vulnerable species, severe structure impact	High density of aggressive weeds or presence of introduced crop species or plantation species
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crops species with isolated native trees and shrubs.	Mostly cleared areas supporting only occasional native trees or planted trees, mainly small agricultural holdings or residential and highly modified areas.	Cleared agricultural and residential areas.	Recently cleared mine areas, rehabilitation not completed.	Extensive tracks and roads	Logged land is expected to recover to Good if rehabilitation undertaken	Extensive dieback infestation, dominant vulnerable species, structure no longer intact.	Plantations, understorey is predominantly introduced species.

APPENDIX B: VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR IN THE MYARA NORTH SURVEY AREA

Note: * denotes introduced species; T denotes threatened species; P1-P4 denotes priority species; SCC = State Conservation Code; FCC = Federal Conservation Code; CE = Critically Endangered, E = Endangered, V = Vulnerable.

Family	Species	SCC	FCC	Data source								
				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
AIZOACEAE	* *Aizoon pubescens*				x							
AMARANTHACEAE	*Ptilotus drummondii*							x		x		
	Ptilotus drummondii var. *drummondii*				x							
	Ptilotus esquamatus				x							
	Ptilotus manglesii				x	x	x	x		x		
	Ptilotus polystachyus				x							
	Ptilotus sp.					x		x				
ANARTHRIACEAE	*Anarthria humilis*				x							
	Lyginia barbata					x	x	x				
	Lyginia sp.						x					
APIACEAE	*Actinotus glomeratus*				x							
	Actinotus leucocephalus				x							
	Apium prostratum						x	x				
	Centella asiatica									x		
	Daucus glochidiatus				x	x				x		
	Eryngium pinnatifidum				x							
	Eryngium pinnatifidum subsp. *pinnatifidum*				x							
	Homalosciadium homalocarpum				x	x						
	Pentapeltis peltigera				x	x	x	x	x	x		
	Platysace compressa				x		x	x	x	x		
	Platysace filiformis				x		x	x	x	x		
	Platysace juncea				x							
	Platysace tenuissima						x	x	x	x		
	Schoenolaena juncea				x							
	Xanthosia atkinsoniana				x	x	x	x	x	x		
	Xanthosia candida				x	x	x	x	x	x		
	Xanthosia ciliata				x					x		
	Xanthosia fruticulosa				x							
	Xanthosia huegelii				x	x	x	x	x	x		
	Xanthosia singuliflora				x		x	x		x		
	Xanthosia tasmanica					x						
	Xanthosia sp.					x						
	Apiaceae sp.						x					
APOCYNACEAE	* *Asclepias curassavica*				x							
	* *Gomphocarpus fruticosus*				x							
	Parsonsia diaphanophleba	P4			x							
	* *Vinca major*				x							
ARACEAE	* *Zantedeschia aethiopica*				x							
ARALIACEAE	*Hydrocotyle alata*				x							
	Hydrocotyle callicarpa				x	x				x		
	Hydrocotyle diantha					x						
	Trachymene coerulea subsp. *coerulea*				x							
	Trachymene pilosa				x	x	x	x		x		

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Family	Species	SCC	FCC	Data source								
				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
ARECACEAE	* *Washingtonia filifera*				x							
ASPARAGACEAE	*Acanthocarpus canaliculatus*				x							
	Acanthocarpus preissii				x							
	* *Asparagus asparagoides*			x								
	Dichopogon capillipes				x	x				x		
	Dichopogon preissii								x			
	* *Lachenalia aloides*				x							
	Laxmannia grandiflora								x			
	Laxmannia minor				x							
	Laxmannia squarrosa				x	x	x	x				
	Lomandra brittanii				x	x	x	x		x		
	Lomandra caespitosa				x	x	x	x		x		
	Lomandra drummondii				x		x	x	x	x		
	Lomandra hermaphrodita				x	x	x	x	x	x		
	Lomandra integra				x		x			x		
	Lomandra micrantha				x		x	x	x	x		
	Lomandra micrantha subsp. *micrantha*				x	x	x	x				
	Lomandra nigricans				x	x	x	x		x		
	Lomandra odora				x	x				x		
	Lomandra pauciflora						x					
	Lomandra preissii				x	x	x	x	x	x		
	Lomandra purpurea				x		x	x	x	x		
	Lomandra sericea				x		x	x	x	x		
	Lomandra sonderi				x	x	x	x	x	x		
	Lomandra spartea				x	x	x	x	x	x		
	Lomandra suaveolens				x	x						
	Lomandra sp.				x	x	x	x	x	x		
	Sowerbaea laxiflora				x	x				x		
	Thysanotus anceps	P3			x					x		
	Thysanotus arbuscula				x							
	Thysanotus asper				x							
	Thysanotus dichotomus				x	x	x	x	x	x		
	Thysanotus fastigiatus				x		x	x	x	x		
	Thysanotus gracilis									x		
	Thysanotus manglesianus				x	x	x	x		x		
	Thysanotus multiflorus				x	x	x	x	x	x		
	Thysanotus patersonii				x					x		
	Thysanotus sparteus				x		x	x		x		
	Thysanotus tenellus				x	x	x			x		
	Thysanotus thyrsoideus				x	x	x			x		
	Thysanotus triandrus				x			x				
	Thysanotus sp.					x	x	x		x		
	Asparagaceae sp.					x						
ASPHODELACEAE	*Bulbine semibarbata*				x					x		
ASTERACEAE	* *Arctotheca calendula*				x		x					
	Asteridea pulverulenta				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
ASTERACEAE (continued)	*Blennospora drummondii*				x							
	Brachyscome ciliaris				x							
	Brachyscome iberidifolia				x	x	x					
	Brachyscome perpusilla				x							
	* *Chrysanthemoides monilifera*			x								
	* *Chrysanthemoides monilifera* subsp. *monilifera*			x								
	* *Cichorium intybus*				x							
	* *Conyza sumatrensis*									x		
	* *Conyza* sp.								x			
	Cotula australis				x							
	* *Cotula coronopifolia*				x							
	* *Cotula turbinata*				x							
	Craspedia variabilis				x	x	x	x				
	* *Crepis foetida*				x							
	* *Crepis foetida* subsp. *foetida*				x							
	* *Dittrichia graveolens*								x			
	Euchiton sphaericus				x					x		
	Gnephosis tenuissima					x						
	Hyalosperma cotula				x	x	x	x				
	Hyalosperma demissum				x	x						
	* *Hypochaeris glabra*				x	x	x	x		x		
	* *Hypochaeris radicata*				x			x				
	* *Hypochaeris* sp.							x				
	Lagenophora huegelii				x	x	x	x		x		
	* *Logfia gallica*				x							
	Millotia tenuifolia				x					x		
	Millotia tenuifolia var. *laevis*	P2			x							
	Millotia tenuifolia var. *tenuifolia*				x	x						
	Olearia cassiniae				x							
	Olearia lehmanniana				x							
	Olearia paucidentata				x	x						
	Olearia rudis				x							
	Pithocarpa corymbulosa	P3			x							
	Pithocarpa pulchella				x							
	Pithocarpa pulchella var. *pulchella*				x							
	Podolepis gracilis				x	x	x					
	Podolepis lessonii				x		x					
	Podolepis sp.					x						
	Podotheca angustifolia				x	x						
	Podotheca gnaphalioides						x					
	Pseudognaphalium luteoalbum					x	x			x		
	Pterochaeta paniculata				x	x	x	x	x	x		
	Quinetia urvillei				x							
	Rhodanthe citrina				x	x	x					
	Rhodanthe corymbosa				x							
	Rhodanthe manglesii				x							
	Senecio diaschides				x	x	x	x	x	x		
	Senecio gilbertii	P1			x							
	Senecio glossanthus				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
ASTERACEAE (continued)	*Senecio hispidulus*					x	x	x		x		
	Senecio leucoglossus	P4			x		x	x	x			
	Senecio multicaulis subsp. *multicaulis*				x							
	Senecio pinnatifolius					x	x					
	Senecio pinnatifolius var. *latilobus*				x							
	Senecio quadridentatus				x	x	x	x	x	x		
	* *Senecio vulgaris*						x	x				
	* *Senecio* sp.							x				
	Senecio sp.					x	x	x	x			
	Siloxerus filifolius				x	x						
	Siloxerus humifusus				x	x	x					
	Siloxerus multiflorus				x							
	* *Sonchus asper*				x							
	* *Sonchus oleraceus*				x	x	x			x		
	* *Sphaeromorphaea australis*				x							
	* *Symphyotrichum squamatum*				x							
	* *Tagetes erecta*				x							
	* *Tolpis barbata*				x							
	Trichocline spathulata				x	x	x	x	x	x		
	* *Ursinia anthemoides*				x		x					
	* *Ursinia anthemoides* subsp. *anthemoides*				x							
	* *Vellereophyton dealbatum*				x	x						
	Waitzia suaveolens var. *suaveolens*					x		x				
	Waitzia sp.						x					
	Xerochrysum macranthum				x							
	* Asteraceae sp.						x					
	Asteraceae sp.					x	x		x			
BERBERIDACEAE	* *Nandina domestica*				x							
BORAGINACEAE	*Halgania corymbosa*	P3			x							
BORYACEAE	*Borya constricta*				x							
	Borya scirpoidea				x			x				
	Borya sphaerocephala				x	x		x	x			
BRASSICACEAE	* *Brassica tournefortii*						x					
	* *Raphanus raphanistrum*				x							
BYBLIDACEAE	*Byblis gigantea*	P3			x							
CAMPANULACEAE	*Isotoma hypocrateriformis*				x	x	x	x		x		
	Lobelia anceps				x							
	Lobelia gibbosa				x		x	x		x		
	Lobelia heterophylla				x		x					
	Lobelia rarifolia				x							
	Lobelia rhombifolia				x		x					
	Lobelia rhytidosperma				x							
	Lobelia tenuior					x						

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
CAMPANULACEAE	*Lobelia* sp.							x	x			
(continued)	* *Monopsis debilis* var. *depressa*				x							
	Wahlenbergia gracilenta				x							
	Wahlenbergia multicaulis				x							
	Wahlenbergia preissii				x					x		
	Wahlenbergia stricta subsp. *stricta*				x							
	Wahlenbergia sp.					x						
CAPRIFOLIACEAE	* *Lonicera japonica*				x							
CARYOPHYLLACEAE	* *Petrorhagia dubia*				x							
	* *Silene gallica*				x							
	* *Silene gallica* var. *quinquevulnera*				x							
	* *Stellaria media*				x							
CASUARINACEAE	*Allocasuarina fraseriana*				x		x	x	x	x		
	Allocasuarina huegeliana				x			x				
	Allocasuarina humilis				x	x	x	x	x			
	Allocasuarina sp.							x	x			
CELASTRACEAE	*Stackhousia monogyna*				x		x	x		x		
	Stackhousia pubescens				x							
	Stackhousia scoparia				x							
	Stackhousia sp. Red-blotched corolla (A. Markey 911)	P3			x							x
	Stackhousia sp.					x		x				
	Tripterococcus brunonis				x	x	x	x		x		
CENTROLEPIDACEAE	*Aphelia brizula*				x							
	Aphelia cyperoides				x	x				x		
	Aphelia sp. Albany (B.G. Briggs 596)				x							
	Centrolepis aristata				x	x				x		
	Centrolepis caespitosa				x							
	Centrolepis drummondiana				x					x		
	Centrolepis glabra				x							
	Centrolepis inconspicua				x							
	Centrolepis pilosa				x	x						
	Centrolepis polygyna				x							
	Centrolepis sp.					x			x			
COLCHICACEAE	*Burchardia congesta*				x	x	x	x	x	x		
	Burchardia multiflora				x							
	Wurmbea dioica				x					x		
	Wurmbea dioica subsp. *alba*				x	x						
	Wurmbea sp.					x						
CONVOLVULACEAE	* *Cuscuta epithymum*				x							
CRASSULACEAE	*Crassula colorata* var. *colorata*				x							
	Crassula decumbens var. *decumbens*				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
CRASSULACEAE (continued)	*Crassula exserta*				x							
	Crassula extrorsa				x							
	* *Crassula natans* var. *minus*				x							
CUPRESSACEAE	*Callitris pyramidalis*				x							
CYATHEACEAE	* *Sphaeropteris cooperi*				x							
CYPERACEAE	*Baumea acuta*				x							
	Baumea articulata					x		x		x		
	Baumea juncea				x	x						
	Baumea laxa				x							
	Baumea preissii				x							
	Baumea riparia				x							
	Baumea rubiginosa				x							
	Baumea vaginalis				x		x					
	Chorizandra enodis				x	x						
	Cyathochaeta avenacea				x	x	x	x	x	x		
	Cyathochaeta teretifolia	P3			x							
	* *Cyperus brevifolius*				x							
	* *Cyperus rotundus*									x		
	* *Cyperus tenellus*				x							
	Cyperus vaginatus				x							
	Eleocharis keigheryi	T	V	x								
	Gahnia aristata				x				x			
	Gahnia decomposita				x	x	x	x	x	x		
	Gahnia trifida				x	x	x					
	Isolepis cernua var. *cernua*				x							
	Isolepis cernua var. *setiformis*				x	x						
	Isolepis congrua				x							
	Isolepis cyperoides				x							
	Isolepis marginata				x	x	x					
	Isolepis oldfieldiana				x							
	Isolepis sp.					x						
	Lepidosperma apricola				x							
	Lepidosperma asperatum				x							
	Lepidosperma carphoides				x							
	Lepidosperma costale							x				
	Lepidosperma effusum							x				
	Lepidosperma gracile						x	x		x		
	Lepidosperma leptostachyum				x		x	x		x		
	Lepidosperma longitudinale				x	x						
	Lepidosperma pruinosum				x							
	Lepidosperma pubisquameum				x	x	x	x				
	Lepidosperma pubisquameum sens. lat.								x			
	Lepidosperma scabrum				x							
	Lepidosperma squamatum				x	x	x	x	x	x		
	Lepidosperma striatum				x							
	Lepidosperma tenue					x	x	x	x	x		

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CYPERACEAE (continued)	*Lepidosperma tetraquetrum*				x	x	x	x	x	x		
	Lepidosperma tuberculatum				x			x	x			
	Lepidosperma sp. Gosnells (A. Markey 1145)				x							
	Lepidosperma sp. Margaret River (B.J. Lepschi 1841)				x							
	Lepidosperma sp.				x	x	x	x	x			
	Mesomelaena graciliceps				x					x		
	Mesomelaena pseudostygia				x							
	Mesomelaena stygia subsp. *stygia*				x							
	Mesomelaena tetragona				x	x	x	x	x	x		
	Schoenus armeria				x							
	Schoenus asperocarpus				x							
	Schoenus bifidus				x	x						
	Schoenus brevisetis				x							
	Schoenus caespititius				x							
	Schoenus clandestinus				x	x						
	Schoenus discifer				x							
	Schoenus efoliatus				x							
	Schoenus grammatophyllus				x							
	Schoenus laevigatus				x							
	Schoenus nanus				x	x						
	Schoenus odontocarpus				x	x						
	Schoenus plumosus				x							
	Schoenus rigens				x							
	Schoenus sculptus				x							
	Schoenus subbulbosus				x							
	Schoenus ?subfascicularis					x						
	Schoenus subflavus				x							
	Schoenus tenellus				x							
	Schoenus unispiculatus				x	x						
	Schoenus variicellae				x							
	Schoenus sp. smooth culms (K.R. Newbey 7823)				x							
	Schoenus sp.					x	x					
	Tetraria australiensis	T	V	x	x							
	Tetraria capillaris				x	x	x	x	x	x		
	Tetraria octandra				x	x	x	x	x	x		
	Tetraria sp. Jarrah Forest (R. Davis 7391)				x				x			
	Tetraria sp.											
	Tricostularia neesii				x							
	Cyperaceae sp.					x						
DASYPOGONACEAE	*Calectasia grandiflora*				x							
	Calectasia narragara				x							
	Dasypogon bromeliifolius				x		x					
	Kingia australis				x			x	x			

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DENNSTAEDTIACEAE	*Pteridium esculentum*				x	x	x	x	x	x		
	Pteridium esculentum subsp. *esculentum*				x							
	Pteridium sp.									x		
DILLENIACEAE	*Hibbertia acerosa*				x	x	x	x	x	x		
	Hibbertia amplexicaulis				x	x	x	x	x	x		
	Hibbertia aurea				x							
	Hibbertia commutata				x	x	x	x	x	x		
	Hibbertia commutata (hairy form)						x					
	Hibbertia diamesogenos				x	x	x	x		x		
	Hibbertia glomerata subsp. *darlingensis*				x							
	Hibbertia huegelii				x		x	x		x		
	Hibbertia hypericoides				x	x	x	x		x		
	Hibbertia hypericoides subsp. *hypericoides*				x							
	Hibbertia lasiopus				x		x	x		x		
	Hibbertia montana				x							
	Hibbertia mylnei				x							
	Hibbertia nymphaea				x							
	Hibbertia ovata				x	x	x	x	x	x		
	Hibbertia perfoliata				x		x	x	x	x		
	Hibbertia pilosa				x		x					
	Hibbertia polyancistra	P1			x							
	Hibbertia quadricolor				x	x	x			x		
	Hibbertia racemosa									x		
	Hibbertia serrata				x							
	Hibbertia silvestris							x	x			
	Hibbertia spicata				x							
	Hibbertia stellaris				x							
	Hibbertia striata				x							
	Hibbertia subvaginata				x	x						
	Hibbertia vaginata				x		x					
	Hibbertia sp.				x			x	x			
DIOSCOREACEAE	*Dioscorea hastifolia*				x							
DROSERACEAE	*Drosera bulbosa*					x				x		
	Drosera callistos				x							
	Drosera collina				x							
	Drosera drummondii				x							
	Drosera erythrorhiza				x	x		x		x		
	Drosera gigantea				x	x	x	x				
	Drosera glanduligera				x							
	Drosera hyperostigma				x		x					
	Drosera intricata				x							
	Drosera leucoblasta					x						
	Drosera macrantha				x	x		x		x		
	Drosera mannii				x							
	Drosera marchantii				x							
	Drosera menziesii				x	x		x				

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DROSERACEAE (continued)	*Drosera micrantha*				x							
	Drosera microphylla				x					x		
	Drosera myriantha				x							
	Drosera nitidula				x							
	Drosera occidentalis	P4			x							
	Drosera oreopodion				x							
	Drosera paleacea	P1				x						
	Drosera pallida				x	x				x		
	Drosera platystigma				x	x	x			x		
	Drosera porrecta				x							
	Drosera pulchella				x	x				x		
	Drosera purpurascens				x							
	Drosera rosulata				x	x						
	Drosera scorpioides				x							
	Drosera silvicola				x			x				
	Drosera spilos				x							
	Drosera squamosa				x							
	Drosera stolonifera				x	x				x		
	Drosera stricticaulis				x							
	Drosera subhirtella				x							
	Drosera sp. Branched styles (S.C. Coffey 193)				x							
	Drosera sp. (climbing)						x					
	Drosera sp.					x	x	x	x	x		
ELAEOCARPACEAE	*Tetratheca affinis*				x							
	Tetratheca hirsuta				x	x	x	x	x	x		
	Tetratheca hirsuta subsp. *hirsuta*				x							
	Tetratheca hirsuta subsp. *viminea*				x							
	Tetratheca hispidissima				x		x	x				
	Tetratheca nuda				x	x						
	Tetratheca phoenix	P2			x							
	Tetratheca setigera						x					
	Tremandra diffusa							x				
ERICACEAE	*Andersonia aristata*				x			x				
	Andersonia involucrata				x							
	Andersonia latiflora									x		
	Andersonia lehmanniana				x			x				
	Andersonia lehmanniana subsp. *lehmanniana*				x			x				
	Andersonia sp. Audax (F. Hort, B. Hort & J. Hort 3179)	P3			x						x	x
	Andersonia sp. Saxatilis (F. & J. Hort 3324)	P1			x						x	x
	Andersonia sp.							x	x			
	Astroloma sp.					x						
	Conostephium pendulum				x		x					
	Conostephium preissii				x							
	Leucopogon australis						x					
	Leucopogon capitellatus				x	x	x	x	x	x		
	Leucopogon darlingensis subsp. *darlingensis*				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
ERICACEAE (continued)	*Leucopogon glabellus*				x		x	x				
	Leucopogon gracillimus				x							
	Leucopogon hirsutus						x			x		
	Leucopogon propinquus							x				
	Leucopogon pulchellus				x		x	x				
	Leucopogon sprengelioides				x	x						
	Leucopogon tenuis				x							
	Leucopogon verticillatus				x		x	x	x	x		
	Leucopogon sp. Parkerville (A. Meebold 11654)				x							
	Leucopogon sp.					x	x	x	x	x		
	Lysinema ciliatum				x							
	Styphelia compacta				x							
	Styphelia discolor				x	x	x	x	x	x		
	Styphelia nitens				x	x	x	x	x	x		
	Styphelia pallida				x	x	x	x	x	x		
	Styphelia propinqua					x	x		x	x		
	Styphelia prostata					x						
	Styphelia stricta					x		x				
	Styphelia tenuiflora				x	x	x	x	x	x		
	Styphelia tortifolia				x							
	Styphelia propinqua				x							
	Styphelia stricta				x							
	Styphelia sp.							x	x			
	Ericaceae sp.					x						
EUPHORBIACEAE	*Amperea simulans*				x		x					
	Beyeria lechenaultii				x							
	* *Euphorbia helioscopia*				x							
	* *Euphorbia terracina*				x							
	Monotaxis grandiflora				x		x			x		
	Monotaxis grandiflora var. *grandiflora*				x	x						
	Monotaxis occidentalis					x	x	x	x	x		
	Ricinocarpos graniticus				x							
	Stachystemon vermicularis				x			x		x		
FABACEAE	*Acacia alata*				x		x	x	x	x		
	Acacia alata var. *alata*				x	x	x	x				
	Acacia applanata				x			x				
	Acacia barbinervis				x	x	x		x	x		
	Acacia barbinervis subsp. *barbinervis*				x		x					
	Acacia browniana				x		x	x		x		
	Acacia browniana var. *endlicheri*							x				
	Acacia celastrifolia				x		x	x		x		
	Acacia cuneifolia	P4			x							
	* *Acacia dealbata* subsp. *dealbata*								x			
	* *Acacia decurrens*				x							
	Acacia dentifera				x		x	x				
	Acacia divergens				x	x	x	x	x	x		
	Acacia drewiana subsp. *drewiana*				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
FABACEAE (continued)	*Acacia drummondii*									x		
	Acacia drummondii subsp. *affinis*	P3			x							
	Acacia drummondii subsp. *candolleana*				x	x	x	x	x			
	Acacia drummondii subsp. *drummondii*						x	x				
	Acacia drummondii subsp. *elegans*				x							
	Acacia ephedroides				x			x	x			
	Acacia extensa				x	x	x	x	x	x		
	* *Acacia floribunda*				x							
	Acacia gemina				x							
	Acacia horridula	P3			x							
	Acacia incrassata				x					x		
	Acacia incurva				x	x						
	* *Acacia iteaphylla*				x							
	Acacia lasiocarpa				x							
	Acacia lasiocarpa var. *bracteolata*				x							
	Acacia lateriticola				x	x	x	x	x	x		
	Acacia latipes subsp. *latipes*				x							
	Acacia microbotrya				x							
	* *Acacia mollifolia*				x							
	Acacia multispicata				x			x				
	Acacia nervosa				x	x	x	x	x			
	Acacia obovata				x			x	x			
	Acacia oncinophylla subsp. *oncinophylla*	P3			x							
	* *Acacia podalyriifolia*				x							
	Acacia preissiana				x	x	x	x		x		
	Acacia pulchella				x	x	x	x	x	x		
	Acacia pulchella var. *glaberrima*				x	x	x					
	Acacia pulchella var. *goadbyi*				x							
	Acacia pulchella var. *pulchella*				x	x						
	Acacia pulchella var. *reflexa*				x							
	Acacia saligna				x	x			x	x		
	Acacia saligna subsp. *lindleyi*				x							
	Acacia saligna subsp. *saligna*				x							
	Acacia sclerophylla				x							
	Acacia sessilis				x							
	Acacia stenoptera				x	x		x				
	Acacia ?*sulcata* var. *platyphylla*							x				
	Acacia subflexuosa subsp. *subflexuosa*				x							
	Acacia teretifolia				x							
	Acacia tetragonocarpa				x							
	Acacia trigonophylla				x							
	Acacia ulicina				x							
	Acacia urophylla				x		x	x	x	x		
	Acacia varia							x		x		
	Acacia varia var. *varia*				x		x					
	Acacia willdenowiana				x	x	x	x	x	x		
	Acacia sp.				x	x	x	x	x	x		
	Aotus cordifolia				x	x						
	Bossiaea angustifolia				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
FABACEAE (continued)	*Bossiaea aquifolium*				x		x	x		x		
	Bossiaea aquifolium subsp. *aquifolium*				x	x			x			
	Bossiaea eriocarpa				x		x	x		x		
	Bossiaea modesta	P2			x							
	Bossiaea ornata				x	x	x	x	x	x		
	Bossiaea pulchella				x							
	Bossiaea rufa				x							
	Callistachys lanceolata						x	x				
	Chorizema cordatum				x		x	x	x	x		
	Chorizema dicksonii				x	x						
	Chorizema ilicifolium					x				x		
	Chorizema nanum				x							
	Chorizema rhombeum				x		x			x		
	Chorizema ulotropis	P4			x							
	Cristonia biloba subsp. *biloba*				x							
	Daviesia brachyphylla				x							
	Daviesia cordata				x		x		x			
	Daviesia costata				x							
	Daviesia decipiens				x							
	Daviesia decurrens				x		x	x	x	x		
	Daviesia decurrens subsp. *decurrens*				x							
	Daviesia horrida				x	x	x	x	x	x		
	Daviesia incrassata					x	x	x				
	Daviesia longifolia							x				
	Daviesia nudiflora subsp. *nudiflora*				x							
	Daviesia physodes				x		x	x		x		
	Daviesia preissii				x		x	x	x			
	Daviesia rhombifolia				x		x	x				
	Daviesia sp.						x		x			
	Dillwynia laxiflora				x	x						
	Dillwynia sp.						x					
	Eutaxia parvifolia				x							
	Eutaxia virgata				x			x				
	Gastrolobium asperum				x							
	Gastrolobium bilobum							x				
	Gastrolobium calycinum							x				
	Gastrolobium capitatum				x	x						
	Gastrolobium dilatatum				x							
	Gastrolobium ebracteolatum				x		x	x		x		
	Gastrolobium spathulatum				x							
	Gastrolobium spinosum				x	x		x				
	Gastrolobium villosum				x			x	x			
	* *Genista monspessulana*			x								
	* *Genista* sp. x *Genista monspessulana*			x								
	Gompholobium aristatum				x							
	Gompholobium capitatum				x					x		
	Gompholobium confertum				x	x						
	Gompholobium cyaninum				x			x		x		
	Gompholobium knightianum				x		x	x	x	x		

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
FABACEAE (continued)	*Gompholobium marginatum*				x	x	x	x	x	x		
	Gompholobium polymorphum				x	x	x	x	x	x		
	Gompholobium preissii				x	x	x	x	x	x		
	Gompholobium tomentosum				x			x	x			
	Gompholobium sp.					x				x		
	Hardenbergia comptoniana						x	x				
	Hardenbergia sp.						x					
	Hovea chorizemifolia				x	x	x	x	x	x		
	Hovea pungens				x							
	Hovea trisperma				x		x	x	x	x		
	Hovea trisperma var. *grandiflora*				x							
	Hovea trisperma var. *trisperma*					x						
	Hovea sp.					x						
	Isotropis cuneifolia subsp. *cuneifolia*					x			x			
	Jacksonia alata				x		x					
	Jacksonia furcellata				x		x					
	Jacksonia lehmannii				x							
	Jacksonia restioides				x							
	Jacksonia sternbergiana				x							
	Kennedia carinata				x							
	Kennedia coccinea				x	x	x	x	x	x		
	Kennedia microphylla				x							
	Kennedia prostrata				x	x	x	x	x	x		
	Kennedia stirlingii				x							
	Labichea lanceolata				x							
	Labichea lanceolata subsp. *lanceolata*				x							
	Labichea punctata				x	x	x	x	x	x		
	* *Lathyrus tingitanus*				x							
	Latrobea tenella					x						
	* *Lotus angustissimus*				x							
	* *Lotus subbiflorus*				x							
	* *Lotus uliginosus*				x							
	* *Lupinus cosentinii*				x							
	* *Lupinus luteus*				x							
	* *Medicago* sp.					x						
	Mirbelia dilatata				x	x	x	x	x	x		
	Mirbelia floribunda				x							
	Mirbelia spinosa				x							
	* *Ornithopus pinnatus*				x							
	Paraserianthes lophantha						x	x	x	x		
	Paraserianthes lophantha subsp. *lophantha*				x	x	x	x				
	Paraserianthes sp.							x				
	* *Podalyria sericea*				x							
	Pultenaea ochreata				x							
	* *Robinia pseudoacacia*							x				
	Sphaerolobium linophyllum				x		x			x		
	Sphaerolobium macranthum				x							
	Sphaerolobium medium				x	x	x	x	x	x		
	Sphaerolobium vimineum					x	x					

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FABACEAE (continued)	*Sphaerolobium* sp.					x						
	Templetonia drummondii				x	x						
	* *Trifolium angustifolium* var. *angustifolium*				x							
	* *Trifolium arvense*					x						
	* *Trifolium arvense* var. *arvense*				x							
	* *Trifolium campestre*				x							
	* *Trifolium cernuum*				x							
	* *Trifolium dubium*				x					x		
	* *Trifolium incarnatum* var. *incarnatum*				x							
	* *Trifolium ornithopodioides*				x							
	* *Trifolium* sp.							x				
	* *Vicia sativa*				x							
	Viminaria juncea				x	x	x	x		x		
	Fabaceae sp.					x						
GENTIANACEAE	* *Centaurium erythraea*				x	x	x	x		x		
	Centaurium sp.							x				
	* *Cicendia filiformis*				x							
GERANIACEAE	* *Erodium botrys*				x							
	Erodium sp.								x			
	Geranium retrorsum				x							
	Geranium sp.					x						
	Pelargonium littorale				x							
	* *Pelargonium* x *domesticum*				x							
GOODENIACEAE	*Anthotium junciforme*				x							
	Anthotium sp. Darling Range (F. Hort & B. Hort 2431)	P1			x							
	Dampiera alata				x	x	x			x		
	Dampiera hederacea				x	x	x	x	x	x		
	Dampiera linearis				x	x	x	x	x	x		
	Dampiera pedunculata									x		
	Goodenia claytoniacea				x							
	Goodenia coerulea				x	x						
	Goodenia drummondii subsp. *megaphylla*				x							
	Goodenia ?filiformis					x						
	Goodenia micrantha				x							
	Lechenaultia biloba				x	x	x	x	x	x		
	Lechenaultia expansa				x							
	Lechenaultia floribunda				x							
	Scaevola calliptera				x	x	x	x	x	x		
	Scaevola glandulifera				x	x						
	Scaevola pilosa				x			x		x		
	Scaevola striata				x							
	Scaevola sp.					x						
	Velleia trinervis				x							
	Verreauxia verreauxii	P4			x							
	Goodeniaceae sp.					x						

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HAEMODORACEAE	*Anigozanthos bicolor* subsp. *bicolor*				x							
	Anigozanthos manglesii				x							
	Anigozanthos manglesii subsp. *manglesii*				x							
	Anigozanthos viridis				x							
	Anigozanthos viridis subsp. *viridis*				x							
	Anigozanthos sp.				x		x					
	Conostylis aculeata				x					x		
	Conostylis aculeata subsp. *aculeata*				x		x					
	Conostylis aculeata subsp. *preissii*				x							
	Conostylis androstemma				x							
	Conostylis caricina subsp. *caricina*				x							
	Conostylis juncea				x							
	Conostylis laxiflora				x							
	Conostylis pusilla				x		x	x	x			
	Conostylis serrulata				x	x	x	x	x	x		
	Conostylis setigera				x		x	x	x	x		
	Conostylis setigera subsp. *setigera*				x	x						
	Conostylis setosa				x	x	x	x	x	x		
	Conostylis sp.				x	x	x		x			
	Haemodorum discolor				x		x					
	Haemodorum laxum				x					x		
	Haemodorum simplex				x	x						
	Haemodorum sparsiflorum				x							
	Haemodorum spicatum									x		
	Haemodorum sp.					x	x	x		x		
	Phlebocarya ciliata				x			x				
	Tribonanthes australis				x	x						
	Tribonanthes brachypetala				x							
	Tribonanthes longipetala				x	x						
	Tribonanthes violacea				x							
	Haemodoraceae sp.						x					
HALORAGACEAE	*Glischrocaryon angustifolium*				x		x					
	Glischrocaryon aureum				x			x	x	x		
	Glischrocaryon flavescens				x							
	Gonocarpus benthamii				x	x	x			x		
	Gonocarpus benthamii subsp. *benthamii* ms						x		x			
	Gonocarpus cordiger				x	x						
	Gonocarpus diffusus						x			x		
	Gonocarpus nodulosus				x							
	?*Gonocarpus* sp.							x				
	Meionectes tenuifolia	P3			x	x						
HEMEROCALLIDACEAE	*Agrostocrinum hirsutum*				x		x	x	x			
	Agrostocrinum scabrum				x	x				x		
	Agrostocrinum sp.						x					
	Caesia micrantha				x	x						
	Caesia micrantha/occidentalis					x						
	Caesia occidentalis				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
HEMEROCALLIDACEAE	*Caesia* sp.					x						
	Corynotheca micrantha						x	x				
	Dianella revoluta				x	x	x	x	x	x		
	Dianella revoluta var. *divaricata*				x			x				
	Hensmania turbinata				x							
	Johnsonia pubescens subsp. *cygnorum*	P2			x							
	Johnsonia pubescens subsp. *pubescens*				x							
	Stypandra glauca				x			x				
	Tricoryne elatior				x	x	x			x		
	Tricoryne humilis				x	x	x	x		x		
	Tricoryne sp.					x			x			
HYDROCHARITACEAE	*Ottelia ovalifolia*				x							
HYPERICACEAE	* *Hypericum perforatum*						x					
HYPOXIDACEAE	*Hypoxis* sp.					x						
	Pauridia gardneri				x							
	Pauridia glabella					x						
	Pauridia occidentalis				x							
	Pauridia occidentalis ?var. *occidentalis*					x						
	Pauridia occidentalis var. *quadriloba*					x						
	Pauridia vaginata var. *vaginata*				x							
IRIDACEAE	* *Babiana angustifolia*				x							
	* *Freesia alba* x *leichtlinii*				x							
	* *Gladiolus caryophyllaceus*				x							
	* *Gladiolus undulatus*				x							
	* *Ixia maculata*				x							
	* *Ixia polystachya*				x							
	* *Moraea flaccida*				x							
	Orthrosanthus laxus var. *laxus*				x							
	Patersonia babianoides				x	x	x	x		x		
	Patersonia juncea				x	x						
	Patersonia maxwellii				x							
	Patersonia occidentalis				x	x	x	x	x	x		
	Patersonia occidentalis var. *latifolia*				x							
	Patersonia occidentalis var. *occidentalis*				x							
	Patersonia pygmaea				x	x	x	x	x	x		
	Patersonia rudis				x		x	x	x	x		
	Patersonia rudis subsp. *rudis*				x	x		x				
	Patersonia umbrosa							x				
	Patersonia umbrosa var. *xanthina*				x							
	Patersonia sp.							x				
	* *Romulea rosea*				x	x						
	* *Sparaxis bulbifera*				x							
	* *Tritonia crocata*				x							
	* *Watsonia borbonica*				x							
	* *Watsonia meriana*				x							

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IRIDACEAE	* *Watsonia meriana* var. *bulbillifera*				x							
(continued)	* *Watsonia meriana* var. *meriana*				x							
	Iridaceae sp.											
JUNCACEAE	* *Juncus articulatus*				x							
	* *Juncus bufonius*				x					x		
	* *Juncus capitatus*				x							
	Juncus holoschoenus				x							
	Juncus kraussii subsp. *australiensis*				x							
	* *Juncus microcephalus*				x							
	Juncus pallidus				x	x						
	Juncus planifolius				x					x		
	Juncus subsecundus				x					x		
	* *Juncus usitatus*				x							
	Juncus sp.							x				
JUNCAGINACEAE	*Triglochin nana*				x							
LAMIACEAE	*Hemiandra pungens*				x			x				
	Hemigenia argentea				x							
	Hemigenia humilis				x							
	Hemigenia incana				x			x	x			
	Hemigenia parviflora				x							
	Hemigenia platyphylla	P4			x							x
	Hemigenia pritzelii				x		x	x	x	x		
	Hemigenia rigida	P1				x				x		
	Hemigenia viscida				x							
	Hemiphora bartlingii				x			x	x			
	Lachnostachys verbascifolia				x							
	* *Lavandula stoechas* subsp. *stoechas*				x							
	* *Salvia verbenaca*				x							
	Cassytha glabella				x	x	x			x		
	Cassytha glabella forma *casuarinae*				x							
	Cassytha glabella forma *glabella*						x					
	Cassytha pomiformis				x			x				
	Cassytha racemosa				x	x	x			x		
	Cassytha racemosa forma *pilosa*						x					
	Cassytha racemosa forma *racemosa*				x		x					
	Cassytha sp.					x	x	x	x			
LENTIBULARIACEAE	*Utricularia inaequalis*				x	x						
	Utricularia multifida				x	x	x			x		
	Utricularia petertaylorii				x							
	Utricularia tenella				x	x						
	Utricularia violacea				x							
	Utricularia sp.					x						
LILIACEAE	* Liliaceae sp.					x						

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Family	Species	SCC	FCC	Data source								
				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
LINACEAE	*Linum marginale*				x							
	* *Linum trigynum*				x							
LINDSAEACEAE	*Lindsaea linearis*				x	x	x	x	x	x		
LOGANIACEAE	*Orianthera campanulata*				x			x				
	Orianthera serpyllifolia						x	x		x		
	Orianthera serpyllifolia subsp. *angustifolia*				x	x	x					
	Orianthera serpyllifolia subsp. *serpyllifolia*				x		x					
	Phyllangium divergens				x							
	Phyllangium paradoxum				x	x	x			x		
LORANTHACEAE	*Amyema miquelii*				x							
	Amyema sp.							x				
	Nuytsia floribunda				x		x					
MACARTHURIACEAE	*Macarthuria australis*				x							
MALVACEAE	* *Brachychiton populneus*				x							
	Commersonia corniculata				x							
	Lasiopetalum cardiophyllum	P4							x			
	Lasiopetalum floribundum				x	x	x	x	x	x		
	Lasiopetalum glabratum				x	x	x	x	x	x		
	Lasiopetalum glutinosum									x		
	Lasiopetalum glutinosum subsp. *glutinosum*	P3			x							
	Lasiopetalum glutinosum subsp. *latifolium*				x							
	Lasiopetalum pterocarpum	T	E	x	x							
	Lasiopetalum sp.							x				
	Thomasia foliosa				x							
	Thomasia grandiflora				x							
	Thomasia ?macrocalyx								x			
	Thomasia macrocarpa				x							
	Thomasia paniculata				x	x	x	x		x		
	Thomasia pauciflora				x					x		
	?*Thomasia* sp.								x			
	Malvaceae sp.								x			
MENYANTHACEAE	*Liparophyllum capitatum*									x		
	Ornduffia parnassifolia					x	x					
MONTIACEAE	*Calandrinia calyptrata*				x							
	Calandrinia sp.					x						
MORACEAE	* *Ficus carica*				x							
MYRTACEAE	*Agonis flexuosa*						x					
	Astartea affinis				x							
	Astartea leptophylla				x			x				
	Astartea scoparia				x	x	x	x	x	x		

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
MYRTACEAE (continued)	*Astartea zephyra*				x							
	Babingtonia camphorosmae				x	x	x	x	x			
	Beaufortia macrostemon				x			x				
	Callistemon glaucus				x		x					
	Callistemon phoeniceus				x							
	Calothamnus lateralis				x							
	Calothamnus planifolius					x						
	Calothamnus quadrifidus				x		x		x	x		
	Calothamnus quadrifidus subsp. *homalophyllus*				x							
	Calothamnus quadrifidus subsp. *quadrifidus*				x							
	Calothamnus rupestris				x		x					
	Calothamnus sanguineus				x				x			
	Calothamnus torulosus				x							
	Calothamnus sp.							x				
	Calytrix acutifolia				x							
	Calytrix angulata				x							
	Calytrix aurea				x							
	Calytrix depressa				x			x	x			
	Calytrix flavescens				x		x					
	Calytrix fraseri				x							
	Calytrix glutinosa							x				
	Calytrix simplex subsp. *simplex*	P1			x							
	Calytrix simplex subsp. *suboppositifolia*				x							
	Calytrix variabilis				x							
	Calytrix sp.								x			
	Chamelaucium uncinatum				x							
	Corymbia calophylla				x	x	x	x	x	x		
	Corymbia haematoxylon				x							
	Darwinia citriodora				x		x	x	x			
	Darwinia hortiorum	P1			x							
	Darwinia thymoides				x							
	Darwinia thymoides subsp. *thymoides*				x							
	Eremaea asterocarpa subsp. *asterocarpa*				x							
	Eremaea pauciflora var. *pauciflora*				x							
	Ericomyrtus serpyllifolia				x							
	Eucalyptus x *balanites*	T	E	x								
	Eucalyptus decurva				x							
	Eucalyptus drummondii				x			x				
	Eucalyptus laeliae				x							
	Eucalyptus lane-poolei				x							
	Eucalyptus marginata				x		x	x	x	x		
	Eucalyptus marginata subsp. *marginata*				x	x						
	Eucalyptus marginata subsp. *thalassica*				x							
	Eucalyptus megacarpa				x		x	x	x	x		
	Eucalyptus patens				x	x	x	x	x	x		
	Eucalyptus rudis				x		x	x	x	x		
	Eucalyptus rudis subsp. *rudis*				x	x	x					
	Eucalyptus wandoo				x		x					
	Eucalyptus wandoo subsp. *wandoo*				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
MYRTACEAE (continued)	*Eucalyptus* sp.					x				x		
	Hypocalymma angustifolium				x	x	x	x	x	x		
	Hypocalymma angustifolium subsp. Dandaragan plateau (S. Patrick 702A)				x							
	Hypocalymma cordifolium				x		x	x	x	x		
	Hypocalymma cordifolium subsp. *cordifolium*						x	x				
	Hypocalymma robustum				x		x	x	x			
	Kunzea ericifolia					x	x					
	Kunzea glabrescens				x		x	x	x			
	Kunzea micrantha				x	x						
	Kunzea micrantha subsp. *micrantha*				x							
	Kunzea micrantha subsp. *petiolata*				x							
	Kunzea recurva				x	x						
	Leptospermum erubescens				x		x	x	x			
	* *Leptospermum laevigatum*				x				x			
	Melaleuca holosericea				x							
	Melaleuca incana							x		x		
	Melaleuca incana subsp. *incana*				x	x	x	x				
	Melaleuca lateritia					x	x	x				
	Melaleuca parviceps				x		x	x	x			
	Melaleuca pauciflora					x	x					
	Melaleuca preissiana				x	x	x	x		x		
	Melaleuca pungens				x							
	Melaleuca radula				x	x						
	Melaleuca rhaphiophylla				x		x					
	Melaleuca scabra					x						
	Melaleuca seriata				x							
	Melaleuca subtrigona				x							
	Melaleuca trichophylla				x			x	x			
	Melaleuca viminea						x	x	x			
	Melaleuca viminea subsp. *viminea*				x	x						
	Melaleuca sp.					x						
	Paragonis grandiflora				x							
	Pericalymma ellipticum				x		x	x	x	x		
	Pericalymma ellipticum var. *ellipticum*				x	x						
	Pericalymma ellipticum var. *floridum*				x							
	Regelia ciliata				x	x						
	Taxandria linearifolia				x	x	x	x	x	x		
	Thryptomene australis subsp. *australis*				x							
	Verticordia acerosa var. *acerosa*				x							
	Verticordia acerosa var. *preissii*				x							
	Verticordia bifimbriata				x							
	Verticordia chrysantha				x							
	Verticordia densiflora							x				
	Verticordia densiflora var. *cespitosa*				x							
	Verticordia densiflora var. *densiflora*				x			x				
	Verticordia endlicheriana var. *endlicheriana*				x							
	Verticordia fimbrilepis subsp. *fimbrilepis*	T	E	x	x							
	Verticordia ?huegelii							x				

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
MYRTACEAE (continued)	*Verticordia huegelii* var. *decumbens*				x							
	Verticordia huegelii var. *huegelii*				x		x					
	Verticordia insignis subsp. *insignis*				x							
	Verticordia pennigera				x			x				
	Verticordia plumosa				x			x				
	Verticordia plumosa var. *ananeotes*	T	E		x							
	Verticordia plumosa var. *brachyphylla*				x			x				
	Verticordia plumosa var. *plumosa*				x		x	x	x			
	Verticordia sp.							x				
	Myrtaceae sp.						x					
OLACACEAE	*Olax benthamiana*				x	x	x	x		x		
OLEACEAE	* *Olea europaea*			x								
ONAGRACEAE	* *Oenothera lindheimeri*				x							
ORCHIDACEAE	*Caladenia denticulata*				x							
	Caladenia discoidea				x							
	Caladenia ferruginea				x							
	Caladenia flava				x					x		
	Caladenia flava subsp. *flava*				x	x						
	Caladenia hirta subsp. *hirta*				x							
	Caladenia latifolia				x							
	Caladenia longicauda subsp. *longicauda*				x							
	Caladenia macrostylis									x		
	Caladenia marginata				x							
	Caladenia reptans									x		
	Caladenia reptans subsp. *reptans*				x	x						
	Caladenia speciosa	P4			x							
	Caladenia splendens				x							
	Caladenia sp.				x	x	x	x		x		
	Corybas recurvus				x							
	Cryptostylis ovata									x		
	Cyanicula gemmata					x						
	Cyanicula sericea				x					x		
	Cyrtostylis huegelii				x							
	Cyrtostylis robusta					x				x		
	Cyrtostylis sp.					x		x				
	* *Disa bracteata*				x	x				x		
	Diuris brumalis				x							
	Diuris corymbosa				x							
	Diuris longifolia				x					x		
	Diuris micrantha	T	V	x								
	Diuris ostrina				x							
	Diuris porrifolia				x							
	Diuris purdiei	T	E	x	x							
	Diuris setacea				x							
	Diuris sp.											

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
ORCHIDACEAE (continued)	*Drakaea elastica*	T	E	x	x							
	Drakaea glyptodon				x							
	Drakaea livida				x							
	Drakaea micrantha	T	V	x								
	Elythranthera brunonis				x		x			x		
	Elythranthera emarginata				x							
	Eriochilus dilatatus					x				x		
	Eriochilus dilatatus subsp. *multiflorus*				x							
	Eriochilus helonomos				x							
	Eriochilus scaber									x		
	Eriochilus tenuis									x		
	Leporella fimbriata				x					x		
	Leptoceras menziesii					x						
	Lyperanthus serratus									x		
	Microtis alba				x							
	Microtis media				x	x				x		
	Microtis media subsp. *media*				x							
	Microtis sp.					x						
	Paracaleana gracilicordata	P1			x						x	x
	Paracaleana granitica	P1			x						x	x
	Paracaleana hortiorum				x							
	Paracaleana nigrita				x							
	Pheladenia deformis					x				x		
	Praecoxanthus aphyllus				x							
	Prasophyllum brownii				x					x		
	Prasophyllum elatum				x					x		
	Prasophyllum fimbria				x							
	Prasophyllum macrostachyum				x							
	Prasophyllum parvifolium				x							
	Prasophyllum plumiforme				x							
	Prasophyllum sp.					x						
	Pterostylis angulata				x							
	Pterostylis aspera				x							
	Pterostylis atrosanguinea				x							
	Pterostylis barbata				x	x				x		
	Pterostylis dilatata				x							
	Pterostylis glebosa				x							
	Pterostylis pyramidalis									x		
	Pterostylis recurva				x	x				x		
	Pterostylis sanguinea				x							
	Pterostylis vittata				x	x				x		
	Pterostylis sp. Bloated snail orchid (W. Jackson BJ 486)				x							
	Pterostylis sp.					x	x	x				
	Pyrorchis nigricans				x	x				x		
	Pyrorchis sp.						x	x				
	Spiculaea ciliata				x							
	Thelymitra antennifera				x					x		
	Thelymitra benthamiana				x							

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ORCHIDACEAE	*Thelymitra cornicina*					x						
(continued)	*Thelymitra crinita*				x	x				x		
	Thelymitra dedmaniarum	T	E	x								
	Thelymitra flexuosa				x							
	Thelymitra frenchii				x							
	Thelymitra graminea				x							
	Thelymitra macrophylla				x	x	x			x		
	Thelymitra mucida				x							
	Thelymitra spiralis				x							
	Thelymitra stellata	T	E	x								
	Thelymitra uliginosa				x							
	Thelymitra vulgaris				x							
	Thelymitra sp.				x	x	x	x		x		
	Orchidaceae sp.					x	x	x				
OROBANCHACEAE	* *Bellardia trixago*				x	x						
	* *Bellardia viscosa*				x							
	* *Orobanche minor*				x		x					
	* *Parentucellia latifolia*				x	x						
OXALIDACEAE	* *Oxalis compressa*									x		
	* *Oxalis corniculata*				x					x		
	Oxalis exilis				x							
	* *Oxalis glabra*				x							
	* *Oxalis incarnata*				x							
	Oxalis perennans				x	x						
	* *Oxalis pes-caprae*					x		x				
	Oxalis sp.					x		x				
PAPAVERACEAE	* *Fumaria capreolata*				x							
PHILYDRACEAE	*Philydrella drummondii*					x	x					
	Philydrella pygmaea				x					x		
	Philydrella pygmaea subsp. *pygmaea*				x	x						
PHRYMACEAE	*Glossostigma diandrum*				x							
PHYLLANTHACEAE	*Phyllanthus calycinus*				x	x	x	x	x	x		
	Poranthera huegelii				x							
	Poranthera microphylla				x	x	x			x		
PHYTOLACCACEAE	* *Phytolacca octandra*							x				
PINACEAE	* *Pinus pinaster*											
	* *Pinus radiata*			x								
PITTOSPORACEAE	*Billardiera floribunda*				x		x	x		x		
	Billardiera fraseri				x	x				x		
	Billardiera fusiformis				x	x	x	x	x	x		

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PITTOSPORACEAE (continued)	*Billardiera heterophylla*						x					
	Billardiera variifolia				x		x	x	x	x		
	Billardiera sp.					x	x	x	x			
	Cheiranthera preissiana				x							
	Marianthus coeruleopunctatus				x							
	Marianthus drummondianus				x	x	x	x	x	x		
	Marianthus tenuis				x			x	x			
	* *Pittosporum undulatum*				x							
PLANTAGINACEAE	* *Callitriche stagnalis*				x							
	* *Misopates orontium*				x							
	Plantago hispida				x							
	* *Plantago lanceolata*									x		
	?*Veronica* sp.					x						
POACEAE	* *Aira caryophyllea*				x	x	x	x		x		
	* *Aira cupaniana*				x		x					
	* *Aira praecox*				x							
	Amphibromus nervosus				x							
	Amphipogon amphipogonoides				x	x	x	x	x	x		
	Amphipogon debilis				x	x						
	Amphipogon laguroides				x	x				x		
	Amphipogon laguroides subsp. *havelii*				x							
	Amphipogon laguroides subsp. *laguroides*				x			x				
	Amphipogon strictus				x							
	Amphipogon turbinatus				x		x					
	Amphipogon sp.					x	x					
	Aristida contorta				x							
	* *Aristida ramosa*				x							
	Austrostipa campylachne				x	x						
	Austrostipa compressa				x							
	Austrostipa flavescens				x		x					
	Austrostipa hemipogon				x							
	Austrostipa mollis				x							
	Austrostipa semibarbata				x							
	Austrostipa tenuifolia				x							
	Austrostipa trichophylla				x							
	Austrostipa variabilis				x							
	Austrostipa sp.				x	x	x		x			
	* *Avellinia michelii*				x							
	* *Avena barbata*				x							
	* *Avena fatua*									x		
	* *Brachypodium distachyon*				x							
	* *Briza maxima*				x			x				
	* *Briza minor*				x	x				x		
	* *Bromus diandrus*				x							
	* *Bromus hordeaceus*				x							
	Bromus sp.					x						
	* *Cenchrus ciliaris*			x								

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POACEAE (continued)	* *Chloris gayana*				x							
	* ?*Cynodon dactylon*					x						
	Dichelachne crinita				x		x					
	* *Ehrharta calycina*				x							
	* *Ehrharta longiflora*				x							
	* *Ehrharta* sp.				x							
	* *Eleusine indica*				x							
	Eragrostis brownii				x							
	Eragrostis elongata				x							
	* *Glyceria declinata*				x							
	Hemarthria uncinata				x							
	Lachnagrostis filiformis									x		
	Lachnagrostis plebeia				x							
	* *Lagurus ovatus*				x							
	* *Lolium rigidum*				x							
	Lolium sp.					x						
	* *Melinis repens*				x							
	Microlaena stipoides				x							
	Microlaena stipoides var. *stipoides*				x	x						
	Neurachne alopecuroidea				x	x	x	x	x	x		
	Neurachne sp.						x					
	* *Panicum miliaceum*				x							
	* *Paspalum dilatatum*				x							
	* *Pentameris airoides*				x	x						
	* *Pentameris airoides* subsp. *airoides*				x							
	* *Poa annua*				x							
	Poa drummondiana				x							
	Poa porphyroclados				x							
	Rytidosperma caespitosum				x	x	x	x	x	x		
	Rytidosperma occidentale				x			x				
	Rytidosperma pilosum				x							
	Rytidosperma setaceum				x					x		
	Rytidosperma sp.					x	x					
	* *Setaria italica*				x							
	* *Setaria verticillata*				x							
	* *Sorghum halepense*				x							
	Spartochloa scirpoidea							x				
	Tetrarrhena laevis				x	x	x	x	x	x		
	* *Urochloa mutica*			x								
	* *Vulpia bromoides*				x							
	* *Vulpia muralis*				x							
	* *Vulpia myuros*				x	x				x		
	* *Vulpia myuros* forma *myuros*				x							
	* *Vulpia* sp.					x						
	Poaceae sp.					x	x	x				
PODOCARPACEAE	*Podocarpus drouynianus*							x				

APPENDIX B: VASCULAR PLANT SPECIES WITH THE POTENTIAL TO OCCUR IN THE MYARA NORTH SURVEY AREA

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Family	Species	SCC	FCC	Data source								
				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
POLYGALACEAE	*Comesperma calymega*				x	x	x	x	x	x		
	Comesperma ciliatum				x	x	x					
	Comesperma confertum							x				
	Comesperma flavum				x							
	Comesperma polygaloides					x	x					
	Comesperma scoparium				x							
	Comesperma virgatum				x	x	x	x	x	x		
	Comesperma volubile					x						
	Comesperma sp.							x				
POLYGONACEAE	*Muehlenbeckia adpressa*				x							
	* *Polygonum aviculare*				x							
	* *Rumex acetosella*				x							
	* *Rumex crispus*				x							
POTAMOGETONACEAE	*Potamogeton ochreatus*				x							
PRIMULACEAE	* *Lysimachia arvensis*				x	x	x	x		x		
	Samolus junceus					x		x				
PROTEACEAE	*Adenanthos barbiger*				x		x	x	x	x		
	Adenanthos meisneri				x							
	Adenanthos obovatus				x		x	x	x			
	Banksia armata				x			x	x			
	Banksia armata var. *armata*				x			x				
	Banksia attenuata				x	x						
	Banksia bipinnatifida							x				
	Banksia bipinnatifida subsp. *bipinnatifida*				x			x				
	Banksia dallanneyi				x			x		x		
	Banksia dallanneyi subsp. *dallanneyi* var. *dallanneyi*				x	x	x	x	x			
	Banksia dallanneyi subsp. *dallanneyi* var. *mellicula*				x							
	Banksia dallanneyi subsp. *sylvestris*				x			x				
	Banksia grandis				x	x	x	x	x	x		
	Banksia kippistiana				x							
	Banksia littoralis				x	x	x	x	x	x		
	Banksia nivea				x					x		
	Banksia polycephala				x							
	Banksia recurvistylis	P2			x							
	Banksia seminuda						x	x				
	Banksia sessilis						x	x	x	x		
	Banksia sessilis var. *sessilis*				x		x					
	Banksia sphaerocarpa				x			x	x			
	Banksia sphaerocarpa var. *sphaerocarpa*				x							
	Banksia squarrosa subsp. *squarrosa*				x		x	x				
	Banksia telmatiaea				x							
	Banksia undata				x			x	x			
	Banksia undata var. *splendens*				x							

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Family	Species	SCC	FCC	Data source								
				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
PROTEACEAE (continued)	*Banksia undata* var. *undata*				x							
	Banksia sp.					x			x			
	Conospermum canaliculatum				x							
	Conospermum canaliculatum subsp. *canaliculatum*				x							
	Conospermum capitatum						x	x		x		
	Conospermum capitatum subsp. *glabratum*				x		x	x				
	Conospermum huegelii				x							
	Conospermum stoechadis				x							
	Conospermum stoechadis subsp. *sclerophyllum*				x							
	Conospermum stoechadis subsp. *stoechadis*				x							
	Grevillea bipinnatifida				x		x	x	x			
	Grevillea bipinnatifida subsp. *bipinnatifida*				x	x		x				
	Grevillea centristigma				x							
	Grevillea crowleyae	P2			x							
	Grevillea diversifolia				x		x	x				
	Grevillea diversifolia subsp. *diversifolia*				x	x	x	x				
	Grevillea endlicheriana				x							
	Grevillea flexuosa	T	V	x	x							
	Grevillea leptobotrys				x							
	Grevillea manglesii subsp. *dissectifolia*	P3			x							
	Grevillea manglesii subsp. *manglesii*				x			x	x			
	Grevillea manglesii subsp. *ornithopoda*	P2			x							x
	Grevillea pilulifera				x							
	Grevillea pimeleoides	P4			x				x			
	Grevillea preissii							x				
	Grevillea pulchella				x		x	x	x			
	Grevillea pulchella subsp. *ascendens*				x			x				
	Grevillea quercifolia				x		x	x		x		
	Grevillea synapheae									x		
	Grevillea synapheae subsp. *synapheae*				x							
	Grevillea ?trifida						x					
	Grevillea wilsonii				x		x	x	x	x		
	Hakea amplexicaulis				x		x	x	x	x		
	Hakea candolleana				x							
	Hakea ceratophylla				x							
	Hakea cyclocarpa				x		x	x	x	x		
	Hakea erinacea				x			x				
	Hakea gilbertii				x							
	Hakea incrassata				x	x	x	x	x			
	Hakea lasianthoides				x							
	Hakea lissocarpha				x	x	x	x	x	x		
	Hakea marginata				x	x						
	Hakea neospathulata				x							
	Hakea petiolaris							x	x			
	Hakea petiolaris subsp. *petiolaris*				x			x				
	Hakea prostrata				x	x	x	x		x		
	Hakea ruscifolia				x	x	x	x	x	x		
	Hakea stenocarpa				x		x	x				

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
PROTEACEAE (continued)	*Hakea sulcata*				x							
	Hakea trifurcata				x		x	x				
	Hakea undulata				x		x	x	x			
	Hakea varia				x	x	x	x	x	x		
	Isopogon asper				x							
	Isopogon autumnalis	P3			x							
	Isopogon crithmifolius				x							
	Isopogon dubius				x			x	x			
	Isopogon sphaerocephalus				x			x	x			
	Isopogon sp. Darling Range (F. Hort 1662)				x			x	x			
	Lambertia multiflora var. *darlingensis*				x							
	Persoonia angustiflora				x	x			x			
	Persoonia elliptica				x		x	x	x	x		
	Persoonia longifolia				x	x	x	x	x	x		
	Persoonia quinquenervis				x							
	Persoonia saccata				x							
	Petrophile biloba				x			x				
	Petrophile brevifolia				x							
	Petrophile filifolia subsp. *laxa*	P3			x							
	Petrophile heterophylla						x					
	Petrophile linearis				x			x				
	Petrophile macrostachya				x							
	Petrophile seminuda				x							
	Petrophile serruriae				x			x	x			
	Petrophile squamata				x							
	Petrophile squamata subsp. northern (J. Monks 40)				x							
	Petrophile striata				x	x		x	x			
	Petrophile sp.								x			
	Stirlingia latifolia				x			x				
	Stirlingia simplex				x				x			
	Synaphea acutiloba				x							
	Synaphea cuneata				x							
	Synaphea damopsis				x			x				
	Synaphea decorticans				x							
	Synaphea gracillima				x	x		x				
	Synaphea odocoileops	P1			x							
	Synaphea pandurata	P3			x							
	Synaphea petiolaris				x		x	x				
	Synaphea petiolaris subsp. *petiolaris*				x			x				
	Synaphea pinnata				x							
	Synaphea spinulosa											
	Synaphea sp. Fairbridge Farm (D. Papenfus 696)	T	CE	x	x							
	Synaphea sp. Pinjarra Plain (A.S. George 17182)	T	E		x							
	Synaphea sp. Serpentine (G.R. Brand 103)	T	CE	x	x							
	Synaphea sp.								x			
	Xylomelum occidentale				x		x	x				

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Family	Species	SCC	FCC	Data source								
				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
PTERIDACEAE	*Cheilanthes austrotenuifolia*				x			x				
	Cheilanthes distans				x							
	Cheilanthes sieberi subsp. *sieberi*				x			x				
	Cheilanthes sp.							x				
RANUNCULACEAE	*Clematis pubescens*				x	x	x	x	x	x		
	Ranunculus colonorum				x	x	x		x	x		
	* *Ranunculus muricatus*									x		
RESTIONACEAE	*Alexgeorgea nitens*						x					
	Chaetanthus aristatus				x							
	Cytogonidium leptocarpoides				x							
	Desmocladus asper				x							
	Desmocladus castaneus				x							
	Desmocladus fasciculatus				x	x	x	x	x	x		
	Desmocladus flexuosus				x	x	x	x	x	x		
	Desmocladus lateriflorus				x							
	Desmocladus sp.								x			
	Dielsia stenostachya				x							
	Empodisma gracillimum									x		
	Hypolaena exsulca				x	x	x	x		x		
	Lepidobolus preissianus				x	x						
	Lepidobolus preissianus subsp. *preissianus*				x							
	Leptocarpus canus					x						
	Leptocarpus coangustatus					x	x			x		
	Leptocarpus decipiens				x	x						
	Leptocarpus kraussii				x							
	Leptocarpus scariosus					x	x					
	Leptocarpus sp.					x						
	Lepyrodia glauca				x	x						
	Lepyrodia heleocharoides	P3			x							
	Lepyrodia macra				x							
	Lepyrodia muirii				x							
	Lepyrodia riparia				x							
	Loxocarya cinerea				x	x	x	x	x	x		
	Loxocarya striata							x	x			
	Sporadanthus rivularis						x					
	Tremulina tremula				x							
	Restionaceae sp.					x	x					
RHAMNACEAE	*Cryptandra arbutiflora*				x							
	Cryptandra arbutiflora var. *arbutiflora*				x	x		x				
	Cryptandra nutans				x							
	Cryptandra sp.					x						
	Stenanthemum coronatum				x							
	Stenanthemum emarginatum				x							
	Stenanthemum nanum				x							
	Trymalium ledifolium				x		x	x	x	x		
	Trymalium ledifolium var. *ledifolium*				x	x						

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
RHAMNACEAE (continued)	*Trymalium ledifolium* var. *rosmarinifolium*				x							
	Trymalium odoratissimum						x	x		x		
	Trymalium odoratissimum subsp. *odoratissimum*				x	x	x	x	x	x		
ROSACEAE	*Acaena echinata*				x							
	* *Prunus cerasifera*				x							
	* *Rubus anglocandicans*				x							
	* *Rubus fruticosus* aggregate			x								
	* *Rubus laudatus*				x							
	* *Rubus loganobaccus*				x							
	* *Rubus ulmifolius*				x							
	* *Rubus ulmifolius* var. *ulmifolius*				x							
RUBIACEAE	* *Galium divaricatum*				x							
	* *Galium murale*				x							
	Opercularia apiciflora				x	x	x			x		
	Opercularia echinocephala				x	x	x	x	x	x		
	Opercularia hispidula				x	x	x	x		x		
	Opercularia vaginata				x	x		x		x		
	Opercularia sp.					x						
RUPPIACEAE	*Ruppia polycarpa*				x							
RUTACEAE	*Asterolasia pallida*				x			x	x			
	Boronia crenulata				x		x	x	x			
	Boronia crenulata subsp. *crenulata* var. *crenulata*				x		x					
	Boronia crenulata subsp. *viminea*				x	x	x	x				
	Boronia fastigiata				x	x	x	x	x	x		
	Boronia molloyae				x		x	x	x	x		
	Boronia ramosa				x							
	Boronia ramosa subsp. *ramosa*				x							
	Boronia scabra subsp. *scabra*				x							
	Boronia spathulata						x					
	Boronia tenuis	P4			x							x
	Boronia sp.					x	x					
	Diplolaena microcephala							x				
	Philotheca nodiflora subsp. *latericola*				x							
	Philotheca spicata				x	x	x	x	x	x		
	Rutaceae sp.								x			
SALICACEAE	* *Salix* spp. except *S.babylonica, S.* x *calodendron* & *S.* x *reichardtii*			x								
SALVINIACEAE	* *Salvinia molesta*			x								
SANTALACEAE	*Exocarpos sparteus*							x				
	Leptomeria cunninghamii				x	x	x	x	x	x		

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
SAPINDACEAE	*Diplopeltis huegelii* subsp. *huegelii*				x							
	Diplopeltis huegelii subsp. *lehmannii*				x							
	Dodonaea ceratocarpa				x			x	x			
	Dodonaea pinifolia				x							
	Dodonaea viscosa subsp. *angustissima*							x				
SCROPHULARIACEAE	* *Phyllopodium cordatum*				x							
	* *Verbascum virgatum*				x			x				
SOLANACEAE	*Anthocercis gracilis*	T	V	x	x							
	* *Datura ferox*				x							
	* *Lycium ferocissimum*			x								
	* *Solanum elaeagnifolium*			x								
STYLIDIACEAE	*Levenhookia dubia*					x						
	Levenhookia preissii	P1										
	Levenhookia pusilla				x	x	x	x		x		
	Levenhookia stipitata				x	x		x				
	Stylidium adpressum				x							
	Stylidium amoenum				x	x	x	x	x	x		
	Stylidium amoenum var. *amoenum*				x							
	Stylidium amoenum var. *caulescens*				x							
	Stylidium androsaceum				x		x			x		
	Stylidium brunonianum				x	x	x	x				
	Stylidium bulbiferum				x		x	x		x		
	Stylidium calcaratum				x	x	x			x		
	Stylidium carnosum				x							
	Stylidium ciliatum				x	x		x	x			
	Stylidium crassifolium				x	x	x			x		
	Stylidium despectum				x							
	Stylidium dichotomum				x		x		x			
	Stylidium diuroides				x							
	Stylidium diuroides subsp. *diuroides*				x			x				
	Stylidium divaricatum				x							
	Stylidium diversifolium				x							
	Stylidium ecorne				x							
	Stylidium emarginatum				x	x						
	Stylidium eriopodum				x							
	Stylidium guttatum				x	x						
	Stylidium hispidum				x					x		
	Stylidium ireneae	P4			x	x	x					
	Stylidium junceum				x		x	x		x		
	Stylidium lateriticola				x			x		x		
	Stylidium lineatum				x		x					
	Stylidium longitubum	P4				x	x					
	Stylidium paulineae				x							
	Stylidium perpusillum				x							
	Stylidium petiolare				x	x						
	Stylidium piliferum				x		x	x	x	x		

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
STYLIDIACEAE (continued)	*Stylidium pulchellum*				x	x						
	Stylidium pycnostachyum				x	x						
	Stylidium recurvum				x							
	Stylidium repens				x		x	x	x			
	Stylidium scariosum				x							
	Stylidium schoenoides				x					x		
	Stylidium spathulatum					x				x		
	Stylidium tenue subsp. *majusculum*				x							
	Stylidium tenue subsp. *tenue*				x							
	Stylidium thesioides				x	x				x		
	Stylidium utricularioides				x	x						
	Stylidium xanthellum				x							
	Stylidium sp. Boulder Rock (A.H. Burbidge 2536)				x							
	Stylidium sp.				x	x	x		x			
TAMARICACEAE	* *Tamarix aphylla*			x								
THYMELAEACEAE	*Pimelea argentea*				x							
	Pimelea brevistyla subsp. *brevistyla*				x							
	Pimelea ciliata						x	x	x	x		
	Pimelea ciliata subsp. *ciliata*				x	x	x	x				
	Pimelea imbricata				x							
	Pimelea imbricata var. *piligera*				x	x						
	Pimelea lanata						x					
	Pimelea lehmanniana							x		x		
	Pimelea lehmanniana subsp. *nervosa*				x							
	Pimelea preissii				x							
	Pimelea rara	P4			x						x	
	Pimelea spectabilis				x		x					
	Pimelea suaveolens					x	x	x		x		
	Pimelea suaveolens subsp. *suaveolens*				x		x	x				
	Pimelea sylvestris				x							
	Pimelea sp.					x	x		x			
TYPHACEAE	*Typha* sp.							x				
VERBENACEAE	* *Lantana camara*			x								
	Verbenaceae sp.					x						
VIOLACEAE	*Hybanthus calycinus*				x		x			x		
	Hybanthus debilissimus				x	x	x			x		
	Hybanthus floribundus				x		x	x		x		
	Hybanthus floribundus subsp. *floribundus*				x	x		x				
XANTHORRHOEACEAE	*Chamaescilla corymbosa*				x		x	x		x		
	Chamaescilla corymbosa var. *corymbosa*				x	x	x					
	Chamaescilla sp.							x				
	Xanthorrhoea acanthostachya				x							

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				EPBC	Naturemap	MCPL 2006	MCPL 2011	MCPL 2012	MCPL 2019	Permanent Plots Myara North	DBCA TPFL Sites	DBCA WAH records
XANTHORRHOEACEAE	*Xanthorrhoea gracilis*				x	x	x	x	x	x		
(continued(	*Xanthorrhoea preissii*				x	x	x	x	x	x		
ZAMIACEAE	*Macrozamia riedlei*				x	x	x	x	x	x		
ZYGOPHYLLACEAE	* *Tribulus terrestris*				x							

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Anthocercis gracilis	Solanaceae	T	Vulnerable	Habit: Erect, spindly shrub, to 0.6 (-1) m high. Flower colour: yellow-green Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Sandy or loamy soils. Granite outcrops. IBRA Distribution: AVW, JAF Florabase records: 29	Moderate			
Caladenia huegelii	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, 0.25-0.6 m high. Flower colour: green & cream & red Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Grey or brown sand, clay loam. IBRA Distribution: JAF, SCP Florabase records: 41	Low			
Diuris drummondii	Orchidaceae	T	Vulnerable	Habit: Tuberous, perennial, herb, 0.5-1.05 m high. Flower colour: yellow Flowering period (indicated in green): **J** F M A M J J A S O **N** **D** Soils: Low-lying depressions, swamps IBRA Distribution: AVW, JAF, SWA, WAR Florabase records: 51	Moderate			

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Diuris micrantha	Orchidaceae	T	Vulnerable	Habit: Tuberous, perennial, herb, 0.3-0.6 m high. Flower colour: yellow & brown Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Brown loamy clay. Winter-wet swamps, in shallow water. IBRA Distribution: JAF, SWA Florabase records: 7	Moderate			
Diuris purdiei	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, 0.15-0.35 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Grey-black sand, moist. Winter-wet swamps. IBRA Distribution: JAF, SWA Florabase records: 24	Low			
Drakaea elastica	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, 0.12-0.3 m high. Flower colour: red & green & yellow Flowering period (indicated in green): J F M A M J J A S **O** **N** D Soils: White or grey sand. Low-lying situations adjoining winter-wet swamps. IBRA Distribution: SWA Florabase records: 19	Low			

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Drakaea micrantha	Orchidaceae	T	Vulnerable	Habit: Tuberous, perennial, herb, 0.15-0.3 m high. Flower colour: red & yellow Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: White-grey sand. IBRA Distribution: JAF, SWA, WAR Florabase records: 49	Low			
Eleocharis keigheryi	Cyperaceae	T	Vulnerable	Habit: Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Flower colour: green Flowering period (indicated in green): J F M A M J J **A** **S** **O** **N** D Soils: Clay, sandy loam. Emergent in freshwater: creeks, claypans. IBRA Distribution: AVW, GES, JAF, SWA Florabase records: 56	Moderate			
Eucalyptus x *balanites*	Myrtaceae	T	Endangered	Habit: Mallee to 5 m high, bark rough, flaky. Flower colour: white Flowering period (indicated in green): **J** **F** M A M J J A S **O** **N** **D** Soils: Sandy soils with lateritic gravel. IBRA Distribution: GES, SWA Florabase records: 11	Low			

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Grevillea flexuosa	Proteaceae	T	Vulnerable	Habit: Irregular, few-branched, non-lignotuberous shrub, to 2 m high. Flower colour: creamy-yellow Flowering period (indicated in green): J F M A M J **J A S O** N D Soils: Red-brown sand with laterite & gravel, sand over granite. Ridgetop plateau & associated breakaways. IBRA Distribution: JAF Florabase records: 43	Moderate			
Lasiopetalum pterocarpum	Malvaceae	T	Endangered	Habit: Open, multi-stemmed shrub (with distinctly winged fruit), to 1.2 m high. Flower colour: pink Flowering period (indicated in green): J F M A M J J **A S O N D** Soils: Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines. IBRA Distribution: JAF Florabase records: 11	Moderate	Darling Scarp, DS2		
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Proteaceae	T	Critically Endangered	Habit: Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A S **O** N D Soils: Sandy with lateritic pebbles. Near winter-wet flats. IBRA Distribution: JAF, SWA Florabase records: 31	Low			

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Synaphea sp. Pinjarra Plain (A.S. George 17182)	Proteaceae	T	Endangered	Habit: Erect, clumped shrub (sub-shrub), to 0.8 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S O N** D Soils: Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains. IBRA Distribution: SWA Florabase records: 63	Low			
Synaphea sp. Serpentine (G.R. Brand 103)	Proteaceae	T	Critically Endangered	Habit: Erect shrub 0.3-0.6 m high and to 0.5 m wide. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S O** N D Soils: Sand, loamy sand, clay-loam, clay soil. Flats, gentle slope to wetland, seasonally wet areas. IBRA Distribution: SWA Florabase records: 36	Low			

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Tetraria australiensis	Cyperaceae	T	Vulnerable	Habit: Rhizomatous, tufted perennial, grass-like or herb (sedge), to 1 m high. Flower colour: brown Flowering period (indicated in green): J F M A M J J A S O **N** **D** Soils: Sand, sandy loam. Flats, well-drained areas. IBRA Distribution: JAF, SWA Florabase records: 37	Low			
Thelymitra dedmaniarum	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, to 0.8 m high. Flower colour: yellow Flowering period (indicated in green): **J** F M A M J J A S O **N** **D** Soils: Granite IBRA Distribution: JAF Florabase records: 4	Low			
Thelymitra stellata	Orchidaceae	T	Endangered	Habit: Tuberous, perennial, herb, 0.15-0.25 m high. Flower colour: yellow & brown Flowering period (indicated in green): J F M A M J J A S **O** **N** D Soils: Sand, gravel, lateritic loam. IBRA Distribution: GES, JAF, SWA Florabase records: 20	Low			

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Verticordia fimbrilepis subsp. *fimbrilepis*	Myrtaceae	T	Endangered	Habit: Shrub, 0.3-0.7 m high. Flower colour: pink-white Flowering period (indicated in green): **J** F M A M J **J** A S **O** **N** **D** Soils: Gravelly or clayey soils. Flats, road verges. IBRA Distribution: AVW, JAF Florabase records: 39	Moderate			
Verticordia plumosa var. *ananeotes*	Myrtaceae	T	Endangered	Habit: Erect, sparsely branched shrub, 0.3-0.5 m high. Flower colour: pink-purple/white Flowering period (indicated in green): J F M A M J J A S O **N** **D** Soils: Sandy loam. Seasonally inundated plains. IBRA Distribution: JAF, SWA Florabase records: 23	Moderate			
Andersonia sp. Saxatilis (F. & J. Hort 3324)	Ericaceae	P1	-	Habit: Single-stemmed shrub to 0.6 m high. Flower colour: white-pink Flowering period (indicated in green): **J** F M A M J J A **S** **O** N D Soils: Dry, brown loam, clay over granite. Slope, outcrops, granite and laterite. IBRA Distribution: JAF Florabase records: 6	High	Dwellingup, D2 Cooke, Ce	Dwellingup, D2 Cooke, Ce	G

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Anthotium sp. Darling Range (F. Hort & B. Hort 2431)	Goodeniaceae	P1	-	Habit: Prostrate, spreading perennial, herb, to 0.05 m high. Flower colour: pink/mauve/purple/blue Flowering period (indicated in green): J F M A M J J A S O **N** **D** Soils: Yellow, grey or brown clayey sand, loam. Slopes, low plains, drainage lines of swamp flats. IBRA Distribution: JAF Florabase records: 16	Low			
Calytrix simplex subsp. *simplex*	Myrtaceae	P1	-	Habit: Shrub, ca 0.2 m high. Flower colour: purple Flowering period (indicated in green): J F M A M J J A S **O** **N** D Soils: Grey clay loam soil, red-brown gravelly loam. Flats and slopes on laterite, swamp. IBRA Distribution: JAF, SWA Florabase records: 5	Moderate			
Darwinia hortiorum	Myrtaceae	P1	-	Habit: Erect to spreading, densely branched shrub to 0.7 m high and 0.8 m wide. Flower colour: reddish-brown & green & yellow-red Flowering period (indicated in green): J F M A M J J A **S** **O** **N** **D** Soils: Shallow granitic soils, loam or loam/clay associated with laterite. Granite outcrops and drainage lines to granite outcrops. IBRA Distribution: JAF Florabase records: 8	Low	Cooke, Ce		

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Hemigenia rigida	Lamiaceae	P1	-	Habit: Upright or spreading shrub, 0.1-0.6 (-1) m high. Flower colour: blue-purple/violet Flowering period (indicated in green): **J** F M A M J J **A S O N D** Soils: Sandy soils, lateritic gravelly soils. Hillslopes, granite outcrops IBRA Distribution: AVW Florabase records: 4	Low			
Hibbertia polyancistra	Dilleniaceae	P1	-	Habit: Erect shrub 0.3-0.45 (-0.6) m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A S O **N D** Soils: Shallow soil over granite. IBRA Distribution: JAF Florabase records: 8	Low			
Levenhookia preissii	Stylidiaceae	P1	-	Habit: Annual (ephemeral), herb, 0.03-0.17 m high. Flower colour: pink-red Flowering period (indicated in green): **J** F M A M J J A **S O N D** Soils: Grey or black, peaty sand. Swamps. IBRA Distribution: SWA Florabase records: 14	Low			

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Paracaleana gracilicordata	Orchidaceae	P1	-	Habit: Perennial, herb, to 0.07 m high. Flower colour: green-yellow-purple Flowering period (indicated in green): J F M A M J J A S **O N** D Soils: Growing on moss mats, granite. Outcrops. IBRA Distribution: JAF Florabase records: 8	High		Dwellingup, D2	G S
Paracaleana granitica	Orchidaceae	P1	-	Habit: Perennial, herb, to 0.07 m high. Flower colour: green-purple Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Growing on moss mats, granite. Outcrops. IBRA Distribution: JAF Florabase records: 7	High		Dwellingup, D2 Pindalup, Pn Murray 1, My1	G T D P
Senecio gilbertii	Asteraceae	P1	-	Habit: Erect, slender perennial, herb, to 1.5 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S O N** D Soils: Peaty sand. Swamps, slopes IBRA Distribution: AVW, JAF Florabase records: 10	Low			

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Synaphea odocoileops	Proteaceae	P1	-	Habit: Tufted, compact shrub, 0.2-0.5 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A S O N D Soils: Brown-orange loam & sandy clay, granite. Swamps, winter-wet areas. IBRA Distribution: SWA Florabase records: 22	Low			
Banksia recurvistylis	Proteaceae	P2	-	Habit: Non-lignotuberous shrub to c. 2 m high and 3 m wide. Flower colour: pale yellow Flowering period (indicated in green): J F M A M J J A S O **N D** Soils: Shallow, lateritic soils associated with granite outcrops. IBRA Distribution: JAF Florabase records: 7	High			
Bossiaea modesta	Fabaceae	P2	-	Habit: Slender, trailing & twining shrub. Flower colour: yellow & red Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Soils derived from granite. Damp areas close to stream. IBRA Distribution: JAF, SWA Florabase records: 22	Low	Yarragil 2, Yg2		

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Grevillea crowleyae	Proteaceae	P2	-	Habit: Dense & spreading shrub, 0.5-1.5 m high. Flower colour: - Flowering period (indicated in green): J F M A M J J **A S O N** D Soils: Loam. IBRA Distribution: JAF Florabase records: 9	High			
Grevillea manglesii subsp. *ornithopoda*	Proteaceae	P2	-	Habit: Spreading, virgate shrub, 1-3 (-5) m high, up to 3 m wide. Flower colour: - Flowering period (indicated in green): J F M A M J J A **S O N** D Soils: Loam, loam over clay, sand, clay. Edge of river bank and creek, dunes IBRA Distribution: JAF, SWA Florabase records: 17	High		Dwellingup, D1	G
Johnsonia pubescens subsp. *cygnorum*	Hemerocallidaceae	P2	-	Habit: Tufted, perennial, herb, 0.15-0.25 m high. Flower colour: white-green Flowering period (indicated in green): J F M A M J J A **S** O N D Soils: Grey-white-yellow sand. Flats, seasonally-wet sites. IBRA Distribution: SWA Florabase records: 12	Low			

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Millotia tenuifolia var. *laevis*	Asteraceae	P2	-	Habit: Ascending to erect annual, herb, 0.02-0.1 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Granite or laterite soils. IBRA Distribution: AVW, JAF, SWA Florabase records: 13	Moderate	Dwellingup, D2		
Tetratheca phoenix	Elaeocarpaceae	P2	-	Habit: Few-branched shrub (subshrub), to 0.25 m high. Flower colour: dark pink-magenta Flowering period (indicated in green): J F M A M J J A **S** **O** N D Soils: Brown gravelly loam over granite. Mid to Upper slopes, near granite outcrops. IBRA Distribution: JAF Florabase records: 10	Moderate			
Acacia drummondii subsp. *affinis*	Fabaceae	P3	-	Habit: Erect shrub, 0.3-1 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J **J** **A** S O N D Soils: Lateritic gravelly soils. IBRA Distribution: AVW, JAF, SWA Florabase records: 37	Moderate			

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Acacia horridula	Fabaceae	P3	-	Habit: Harsh, slender, single-stemmed shrub, 0.3-0.6 (-1) m high. Flower colour: yellow Flowering period (indicated in green): J F M A **M J J A** S O N D Soils: Gravelly soils over granite, sand. Rocky hillslopes. IBRA Distribution: JAF, SWA Florabase records: 33	Moderate	Darling Scarp, DS2 Dwellingup, D2		
Acacia oncinophylla subsp. *oncinophylla*	Fabaceae	P3	-	Habit: Shrub, 0.9-2.5 m high, 'minni-ritchi' bark, phyllodes mostly 8-13 cm long, 1-2 mm wide. Flower colour: yellow Flowering period (indicated in green): J F M A M J J **A S O** N D Soils: Granitic soils IBRA Distribution: AVW, JAF, SWA Florabase records: 42	High			
Andersonia sp. Audax (F. Hort, B. Hort & J. Hort 3179)	Ericaceae	P3	-	Habit: Shrub, to 1.1 m high and 1.1 m wide. Flower colour: white-cream/mauve-pink Flowering period (indicated in green): J F M A M J J A S **O N** D Soils: Loam, clay, sand, gravel. Granite, slopes and drainage lines. IBRA Distribution: JAF Florabase records: 22	High	Dwellingup, D2 Yarragil 2, Yg2 Cooke, Ce	Cooke, Ce Dwellingup, D2 Swamp, S	G E P PL

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Byblis gigantea	Byblidaceae	P3	-	Habit: Small, branched perennial, herb (or sub shrub), to 0.45 m high. Flower colour: pink-purple/white Flowering period (indicated in green): **J** F M A M J **J** A **S** **O** **N** **D** Soils: Sandy-peat swamps. Seasonally wet areas. IBRA Distribution: JAF, SWA Florabase records: 40	Low	Yarragil 2, Yg2		
Cyathochaeta teretifolia	Cyperaceae	P3	-	Habit: Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2.0 m high, to 1.0 m wide. Flower colour: brown Flowering period (indicated in green): **J** F M A M J **J** A **S** **O** **N** D Soils: Grey sand, sandy clay. Swamps, creek edges. IBRA Distribution: JAF, SWA, WAR Florabase records: 39	Low			
Grevillea manglesii subsp. *dissectifolia*	Proteaceae	P3	-	Habit: Spreading, virgate shrub, 1.5-3 (-5) m high, up to 33 m wide. Flower colour: white & red & brown Flowering period (indicated in green): J F M A M **J** J A **S** **O** **N** D Soils: Gravelly loam, moist. Roadsides. IBRA Distribution: JAF Florabase records: 27	Moderate	Dwellingup, D1 Murray 1, My1 Pindalup, Pn		

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Halgania corymbosa	Boraginaceae	P3	-	Habit: Erect shrub, 0.35-1 m high. Flower colour: blue-purple Flowering period (indicated in green): J F M A M J J **A S O N** D Soils: Gravelly soils, soils over granite. IBRA Distribution: JAF, SWA Florabase records: 18	Moderate			
Isopogon autumnalis	Proteaceae	P3	-	Habit: Shrub 0.3-1 m high, commonly 0.5-1 m wide. Flower colour: pale yellow Flowering period (indicated in green): J **F M A M** J J A S O N D Soils: Sandy soils. IBRA Distribution: GES, JAF, SWA Florabase records: 59	Low			
Lasiopetalum glutinosum subsp. *glutinosum*	Malvaceae	P3	-	Habit: Shrub to 0.8 m high. Flower colour: pink-purple Flowering period (indicated in green): J F M A M J J A **S O** N D Soils: Lateritic gravel and clay, clay loam, sandy clay over granite. Slopes, granite outcrops. IBRA Distribution: AVW, JAF, SWA Florabase records: 48	Moderate			

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

Note: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; ESP – Esperance Plains; GES – Geraldton Sandplains; JAF – Jarrah Forest; MAL – Mallee; SWA – Swan Coastal Plain; WAR – Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Lepyrodia heleocharoides	Restionaceae	P3	-	Habit: Rhizomatous, slender, tufted perennial, herb (sedge-like), 0.15-0.25 m high. Flower colour: - Flowering period (indicated in green): J F M A M J J A S O N D Soils: Moist peaty sand. Dry or seasonally inundated heath or woodland, swamps. IBRA Distribution: JAF, SWA Florabase records: 20	Low			
Meionectes tenuifolia	Haloragaceae	P3	-	Habit: Annual semi-aquatic herb, to 0.35 m high. Flower colour: orange-red-brown, green Flowering period (indicated in green): J F M A M J J A S O N D Soils: Grey sand or grey-brown clay, shallow soils. Seasonally inundated flat, edge of swamp. IBRA Distribution: JAF, SWA Florabase records: 24	Low	Yarragil 1, Yg1		

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Petrophile filifolia subsp. *laxa*	Proteaceae	P3	-	Habit: Erect, spreading shrub, to 0.75 m high. Flower colour: cream Flowering period (indicated in green): **J** F M A M J **J** A S O **N** **D** Soils: White gritty sand, brown, red, yellow, white or grey sand, brown-yellow sandy clay. Winter-wet sites, flats, slopes, swamps, drainage lines. IBRA Distribution: JAF Florabase records: 18	Moderate	Yarragil 2, Yg2 Swamp, S		
Pithocarpa corymbulosa	Asteraceae	P3	-	Habit: Erect to scrambling perennial, herb, 00.5-1 m high. Flower colour: white Flowering period (indicated in green): **J** **F** **M** **A** M J J A S O N D Soils: Gravelly or sandy loam. Amongst granite outcrops. IBRA Distribution: GES, JAF, SWA Florabase records: 22	Moderate	Murray 1, My1		
Stackhousia sp. Red-blotched corolla (A. Markey 911)	Celastraceae	P3	-	Habit: Erect herb or shrub, approximately 0.2 m high. Flower colour: cream-yellow Flowering period (indicated in green): J F M A M J J A **S** **O** **N** D Soils: Brown loamy sand, clayey sand over laterite, white sandy clay over granite, grey clay. Slopes. IBRA Distribution: AVW, GES, JAF Florabase records: 9	Moderate			

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Synaphea pandurata	Proteaceae	P3	-	Habit: Clumped shrub (subshrub), 0.2-0.55 m high. Flower colour: yellow Flowering period (indicated in green): J F M **A** M **J** J A **S** **O** N **D** Soils: Yellow-grey, yellow-brown, yellow-red sands and sandy loams, dark brown loam, laterite gravel, granite. In undulating areas. IBRA Distribution: JAF Florabase records: 23	Moderate			
Thysanotus anceps	Asparagaceae	P3	-	Habit: Rhizomatous, leafless perennial, herb, to 0.4 m high. Flower colour: purple Flowering period (indicated in green): J F M A M J J A S **O** **N** **D** Soils: White or grey sand, lateritic gravel, laterite. IBRA Distribution: GES, JAF, SWA Florabase records: 17	Moderate	Dwellingup, D1		
Acacia cuneifolia	Fabaceae	P4	-	Habit: Erect or straggly shrub, 1-3 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J **J** **A** **S** **O** N D Soils: Sand, clay or loam over granite. Granite outcrops & hills, rocky watercourses. IBRA Distribution: AVW, JAF Florabase records: 41	Low	Cooke, Ce		

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Boronia tenuis	Rutaceae	P4	-	Habit: Procumbent or erect & slender shrub, 0.1-0.5 m high. Flower colour: blue/pink-white Flowering period (indicated in green): J F M A M J J **A S O N** D Soils: Laterite, stony soils, granite. IBRA Distribution: JAF, SWA Florabase records: 45	High	Yarragil 1, Yg1 Murray 1, My1	Dwellingup, D2	PL
Caladenia speciosa	Orchidaceae	P4	-	Habit: Tuberous, perennial, herb, 0.35-0.6 m high. Flower colour: white-pink Flowering period (indicated in green): J F M A M J J A **S O** N D Soils: White, grey or black sand. IBRA Distribution: JAF, SWA Florabase records: 59	Low	Cooke, Ce		
Chorizema ulotropis	Fabaceae	P4	-	Habit: Sprawling, open, semi-prostrate shrub, to 0.45 m high. Flower colour: orange-yellow Flowering period (indicated in green): J F M A M J **J A S** O N D Soils: Moist to dry soils, white sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats. IBRA Distribution: ESP, JAF, MAL Florabase records: 24	Moderate			

APPENDIX C: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Drosera occidentalis	Droseraceae	P4	-	Habit: Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Flower colour: pink/white Flowering period (indicated in green): **J** F M A M J **J** A S **O** **N** **D** Soils: White/black sand over yellow clay, yellow sand, moist brown/grey clay/sand, peaty sand, sandy clay. Damp flats, flood plain. IBRA Distribution: JAF, SWA Florabase records: 18	Low	Pindalup, Pn Dwellingup, D2		
Grevillea pimeleoides	Proteaceae	P4	-	Habit: Non-lignotuberous shrub, 0.4-2.4 m high. Flower colour: yellow-orange Flowering period (indicated in green): J F M A **M** **J** **J** **A** **S** **O** **N** D Soils: Gravelly soils over granite. Rocky hillsides. IBRA Distribution: JAF Florabase records: 36	High	Murray 1, My1 Dwellingup, D1 Dwellingup, D2		
Hemigenia platyphylla	Lamiaceae	P4	-	Habit: Spreading shrub, 0.2-1.5 m high. Flower colour: blue-purple Flowering period (indicated in green): J F M A M J J A **S** **O** **N** D Soils: Sandy & loamy soils. Granite rocks, slopes. IBRA Distribution: AVW, ESP, JAF, MAL Florabase records: 21	High		Dwellingup, D1	PW

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Lasiopetalum cardiophyllum	Malvaceae	P4	-	Habit: Erect, multi-stemmed shrub, 0.2-0.5 m high. Flower colour: pink Flowering period (indicated in green): **J** F M A M J J **A** **S** **O** **N** **D** Soils: Lateritic gravelly soils, sandy clay. Flats, hillslopes. IBRA Distribution: AVW, JAF Florabase records: 34	Moderate			
Parsonsia diaphanophleba	Apocynaceae	P4	-	Habit: Woody climber, to 10 m high. Flower colour: white/cream & pink Flowering period (indicated in green): **J** **F** M **A** **M** **J** J A **S** O N D Soils: Alluvial soils. Along rivers. IBRA Distribution: JAF, SWA Florabase records: 28	Moderate	Murray 1, My1		
Pimelea rara	Thymelaeaceae	P4	-	Habit: Shrub, 0.2-0.35 m high. Flower colour: white Flowering period (indicated in green): **J** F M A M J J A S O N **D** Soils: Lateritic soils. IBRA Distribution: JAF Florabase records: 52	High	Dwellingup, D1 Yarragil 1, Yg1 Yarragil 2, Yg2 Dwellingup, D2	Yarragil 1, Yg1 Dwellingup, D2 Yarragil 2, Yg2	D ST S

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Senecio leucoglossus	Asteraceae	P4	-	Habit: Erect annual, herb, to 1.3 m high. Flower colour: white Flowering period (indicated in green): J F M A M J J **A S O N D** Soils: Gravelly lateritic or granitic soils. Granite outcrops, slopes. IBRA Distribution: JAF, SWA, WAR Florabase records: 44	Moderate			
Stylidium ireneae	Stylidiaceae	P4	-	Habit: Lax perennial, herb, (0.06-) 0.1-0.28 m high. Flower colour: pink Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Sandy loam. Valleys near creek lines. IBRA Distribution: JAF, SWA, WAR Florabase records: 25	Moderate			
Stylidium longitubum	Stylidiaceae	P4	-	Habit: Erect annual (ephemeral), herb, 0.05-0.12 m high. Flower colour: pink Flowering period (indicated in green): J F M A M J J A S **O N D** Soils: Sandy clay, clay. Seasonal wetlands. IBRA Distribution: GES, JAF, SWA Florabase records: 46	Low			

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Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence	Vegetation complex outside Occurrence	Vegetation complex Occurrence	SVT Code
Verreauxia verreauxii	Goodeniaceae	P4	-	Habit: Perennial, herb, to 0.5 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M J J A S O N D Soils: White/grey or yellow sand. Flats. IBRA Distribution: AVW, JAF Florabase records: 44	Low			

APPENDIX D: ASSESSMENT OF INTRODUCED (WEED) FLORA POTENTIALLY PRESENT IN THE MYARA NORTH SURVEY AREA

Note: WONS = Weeds of National Significance (Department of Agriculture, Water and the Environment 2020e); WAOL = Western Australian Organism List (Department of Primary Industries and Regional Development 2020). IBRA Distribution: AVW – Avon Wheatbelt; CAR – Carnarvon; CEK – Central Kimberley; COO – Coolgardie; DAL – Dampierland; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; HAM – Hampton; JAF – Jarrah Forest; MAL – Mallee; NUL – Nullarbor; PIL – Pilbara; SWA – Swan Coastal Plain; VIB – Victoria Bonaparte; WAR - Warren. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking.

Species	WONS	WAOL legal status	WAOL Control Category	WAOL Control Category	Declared areas	Description and Habitat	Likelihood of Occurrence
* *Asparagus asparagoides*	Yes	Declared Pest - s22(2)	-	Exempt	No Control Category, Whole of State	Habit: Rhizomatous and tuberous, perennial, herb and climber, 1-5 m high. Flower colour: white Flowering period (indicated in green): J F M A M J J **A** **S** O N D Soils: Sand, loam, clay, granite. IBRA Distribution: AVW, COO, ESP, GES, JAF, MAL, SWA, WAR Florabase records: 78	Moderate
* *Chrysanthemoides monilifera*	No	Declared Pest, Prohibited - s12	C1 Exclusion	Prohibited	Whole of State	Habit: Shrub, 0.8-3 m high. Flower colour: yellow Flowering period (indicated in green): J F M A M **J** **J** **A** **S** **O** N D Soils: Swampy loam, lateritic sandy clay. Coastal areas, roadsides, waste areas. IBRA Distribution: JAF Florabase records: 50	Moderate
* *Chrysanthemoides monilifera* subsp. *monilifera*	Yes	Declared Pest, Prohibited - s12	C2 Eradication	Prohibited	Whole of State	Habit: Erect shrub, 0.8-3m high. Flower colour: yellow Flowering period (indicated in green): J F M A M **J** **J** **A** **S** **O** N D Soils: Red-brown loam, limestone rubble. Sandplains, coastal areas, roadsides & waste areas. IBRA Distribution: AVW, GES, JAF, SWA Florabase records: 47	Moderate

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Species	WONS	WAOL legal status	WAOL Control Category	WAOL Control Category	Declared areas	Description and Habitat	Likelihood of Occurrence
** Genista monspessulana*	Yes	Permitted - s11	-	-	-	Habit: Erect shrub, 1-5 m high, leaves trifoliate, petiolate, standard more or less glabrous. Flower colour: yellow Flowering period (indicated in green): **J** F M A M J J **A** S O **N** D Soils: Loam, lateritic sand, black peaty sand. Edging rivers and roadsides. IBRA Distribution: AVW. JAF, SWA, WAR Florabase records: 38	Moderate
** Gomphocarpus fruticosus*	No	Declared Pest - s22(2)	C3 Management	-	Shire of Serpentine-Jarrahdale, Shire of Wandering	Habit: Erect perennial, herb or shrub, 0.5-1.5 m high. Flower colour: white/cream Flowering period (indicated in green): J **F M A M J J** A S O N D Soils: Disturbed sites. IBRA Distribution: AVW, ESP, JAF, MAL, NUL, SWA Florabase records: 44	Moderate
** Lantana camara*	Yes	Declared Pest, Prohibited - s12	C1 Exclusion	Prohibited	Whole of State	Habit: Scrambling, prickly shrub or climber, to 3(-8) m high. Flower colour: cream-yellow/pink-purple/orange-red Flowering period (indicated in green): **J F M** A M **J J A S** O N D Soils: Sandy soils. Moist areas. IBRA Distribution: CAR, COO, DAL, GES, JAF, PIL, SWA, Florabase records: 35	Low

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Species	WONS	WAOL legal status	WAOL Control Category	WAOL Control Category	Declared areas	Description and Habitat	Likelihood of Occurrence
**Lycium ferocissimum*	Yes	Permitted - s11	-	-	-	Habit: Intricately branched, spiny shrub, 0.5-2.5(-4) m high. Flower colour: white-purple-blue Flowering period (indicated in green): J F M **A** **M** J J **A** **S** **O** **N** **D** Soils: Waste grounds. IBRA Distribution: AVW, CAR, COO, ESP, GAS, GES, HAM, MAL, NUL, SWA Florabase records: 50	Low
**Moraea flaccida*	No	Declared Pest - s22(2)	-	Exempt	No Control Category, Whole of State	Habit: Cormous, perennial, herb, to 0.75 m high. Flower colour: yellow & orange/yellow Flowering period (indicated in green): J F M A M J J A **S** **O** **N** D Soils: White sand, grey sandy loam over limestone, laterite clay, gravel. Seasonally wet sites, along creeklines, hilltops, pasture and disturbed land. IBRA Distribution: AVW, ESP, JAF, MAL, SWA, WAR Florabase records: 84	Moderate
**Rubus anglocandicans*	No	Declared Pest - s22(2)	C3 Management	Exempt	Whole of State	Habit: Scrambling, rampant, sprawling shrub, to 4 m high. Flower colour: pink/white Flowering period (indicated in green): **J** **F** M A M J J A S O **N** **D** Soils: Grey sand, red-brown gravelly loam, red clay loam, granite, limestone. Hillsides, along river banks and watercourses, in roadside drains. IBRA Distribution: JAF, SWA, WAR Florabase records: 98	Moderate

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Species	WONS	WAOL legal status	WAOL Control Category	WAOL Control Category	Declared areas	Description and Habitat	Likelihood of Occurrence
**Rubus fruticosus* aggregate	Yes	-	-	-	-	Habit: Perennial, semi-deciduous shrub. Flower colour: white-pink Flowering period (indicated in green): J F M A M J J A S O N D Soils: - IBRA Distribution: - Florabase records: -	Moderate
**Rubus laudatus*	No	Declared Pest - s22(2)	C3 Management	Exempt	Whole of State	Habit: Decumbent shrub, to 3 m high. Flower colour: white Flowering period (indicated in green): J F M A M J J A S O N D Soils: Grey to black-grey sand, red-brown gravelly loam, granite. Low flats, along watercourses and streams, near swamps, roadsides. IBRA Distribution: ESP, JAF, SWA, WAR Florabase records: 62	Moderate
**Rubus ulmifolius*	No	Declared Pest - s22(2)	C3 Management	Exempt	Whole of State	Habit: Straggling perennial, herb or shrub, to 4 m high. Flower colour: pink/white/blue/purple Flowering period (indicated in green): J F M A M J J A S O N D Soils: Along creeks & drains. IBRA Distribution: JAF, SWA, WAR Florabase records: 45	Moderate

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Species	WONS	WAOL legal status	WAOL Control Category	WAOL Control Category	Declared areas	Description and Habitat	Likelihood of Occurrence
* *Rubus ulmifolius* var. *ulmifolius*	No	Declared Pest - s22(2)	C3 Management	Exempt	Whole of State	Habit: Prickly perennial, herb or shrub, to 4 m high. Flower colour: pink, pale blue/mauve Flowering period (indicated in green): **J** F M A M J J A S O **N** D Soils: Slopes adjacent to drainage lines, around dams, near towns. IBRA Distribution: JAF, SWA, WAR Florabase records: 20	Moderate
**Salix* spp. except *S. babylonica, S.* x *calodendron & S.* x *reichardtii*	Yes	-	-	-	-	Habit: Deciduous shrub or tree Flower colour: cream/yellow Flowering period (indicated in green): J F M A M J J A S **O** **N** D Soils: - IBRA Distribution: - Florabase records: -	Low
* *Salvinia molesta*	Yes	Declared Pest, Prohibited - s12	C2 Eradication	Prohibited	Whole of State	Habit: Rhizomatous, herb or (fern), 0.05-0.2 m high, floating aquatic; leaves in whorls of 3: 2 floating leaves and 1 submerged root-like water-leaf. Flower colour: - Flowering period (indicated in green): J F M A M J J A S O N D Soils: Still or slow-flowing fresh water ponds and streams. IBRA Distribution: GES, JAF, PIL, SWA, VIB, WAR Florabase records: 17	Moderate

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Species	WONS	WAOL legal status	WAOL Control Category	WAOL Control Category	Declared areas	Description and Habitat	Likelihood of Occurrence
* *Solanum elaeagnifolium*	Yes	Declared Pest - s22(2)	-	Exempt	No Control Category, Whole of State	Habit: Erect perennial, herb, to 1 m high. Flower colour: blue/purple/pink/white Flowering period (indicated in green): **J F M** A M J J A S O **N D** Soils: Gravelly, red-brown clay-loam. Roadside. IBRA Distribution: AVW, MAL, SWA Florabase records: 27	Low
* *Tamarix aphylla*	Yes	Declared Pest - s22(2)	-	Exempt	No Control Category, Whole of State	Habit: Tree, to 12 m high. Flower colour: pink-white Flowering period (indicated in green): J **F** M A **M** J J A S O N D Soils: Along river banks. IBRA Distribution: AVW, CAR, CEK, GES, MAL, SWA Florabase records: 16	Low
* *Zantedeschia aethiopica*	No	Declared Pest - s22(2)	-	Exempt	No Control Category, Whole of State	Habit: Rhizomatous (tuber-like), perennial, herb, to 1 m high. Flower colour: white Flowering period (indicated in green): J F M A M J **J A S O N** D Soils: Loam, sand. Swamps, rarely uplands. IBRA Distribution: AVW, GES, JAF, SWA, Florabase records: 49	Moderate

APPENDIX E: SUMMARY OF SITE-VEGETATION TYPES DEFINED PREVIOUSLY IN AND NEAR THE MYARA NORTH SURVEY AREA

The site-vegetation types were initially defined and mapped by Havel (1975a, 297b) and have since been refined and expanded on extensive studies by Mattiske for various clients in the Northern Jarrah forest.

SVT Code	Description
A -	Open Woodland of *Melaleuca preissiana* with dense understorey of Myrtaceae species, *Hakea varia* and sedge species on swamp areas.
A/C -	Mosaic of A and C site-vegetation types.
AC -	Open Woodland of *Melaleuca preissiana - Banksia littoralis* with dense understorey of Myrtaceae species on swamps and creeklines.
AW -	Open woodland of *Eucalyptus patens - Corymbia calophylla – Eucalyptus marginata – Banksia littoralis* with low mixed understorey on sandy to loam soils on valley floors.
AW/AX -	Mosaic of AW and AX site-vegetation types.
AW/CW -	Mosaic of AW and CW site-vegetation types.
AX -	Open Woodland *of Eucalyptus rudis – Melaleuca preissiana* with dense understorey of mixed *Melaleuca* species on clay soils in swamps.
C -	Woodland of *Melaleuca* species - *Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines.
CW -	Woodland to Open Forest of *Eucalyptus patens - Corymbia calophylla - Banksia littoralis* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses.
D -	Open Forest of *Eucalyptus marginata - Corymbia calophylla* on lower slopes with mixed low understorey species, including *Babingtonia camphorosmae* and *Acacia extensa* on clay loams to gravelly clay-loams.
E -	Open Forest to Woodland of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Kingia australis, Mesomelaena tetragona* and *Babingtonia camphorosmae* on sandy gravels on lower slopes.
G -	Mosaic of Open Woodland of *Eucalyptus marginata – Corymbia calophylla*, mixed Proteaceae – Myrtaceae heath and Lithic Complex associated with granite outcrops.
J -	Open Woodland of *Eucalyptus marginata - Corymbia calophylla - Eucalyptus patens* over low mixed understorey, including *Lyginia barbata* and *Patersonia* species on sandy soils on lower slopes.
P -	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii* and *Adenanthos barbiger* and low shrubs, herbs and sedges on sandy gravels.
PS -	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla - Banksia grandis* with scattered understorey, including *Adenanthos barbiger* and *Grevillea wilsonii* on sandy gravel soils.
PW -	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii, Adenanthos barbiger, Babingtonia camphorosmae* and *Hypocalymma angustifolium* on moister sandy gravels.

APPENDIX E: SUMMARY OF SITE VEGETATION TYPES DEFINED PREVIOUSLY IN AND NEAR THE MYARA NORTH SURVEY AREA

SVT Code	Description
Q -	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Eucalyptus patens* on lower slopes with mixed understorey species, including *Trymalium odoratissimum* subsp. *odoratissimum, Acacia extensa* and *Phyllanthus calycinus* on seasonally moister loamy soils.
R -	Open Woodland of *Eucalyptus marginata - Corymbia calophylla* on fringes of granite outcrops or shallow soils.
RG -	Open Woodland of *Eucalyptus marginata - Corymbia calophylla* with patches of Heath of Proteaceae – Myrtaceae species on fringes of granite outcrops or shallow soils.
S -	Open Forest of *Eucalyptus marginata - Banksia grandis – Allocasuarina fraseriana* with scattered understorey, including *Adenanthos barbiger, Leucopogon capitellatus* and *Styphelia tenuiflora* on gravels and sandy-gravels.
SP -	Open Forest of *Allocasuarina fraseriana - Eucalyptus marginata - Banksia grandis* with scattered understorey, including *Adenanthos barbiger* and *Leucopogon capitellatus* on sandy-gravels to gravelly soils.
ST -	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon capitellatus, Leucopogon verticillatus, Lasiopetalum floribundum* and *Styphelia tenuiflora* on sandy-gravelly soils.
SW -	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Adenanthos barbiger, Hypocalymma angustifolium* and *Styphelia tenuiflora* on seasonally moister sandy-gravelly soils.
T -	Open Forest of *Eucalyptus marginata - Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly soils.
TS -	Open Forest of *Eucalyptus marginata - Corymbia calophylla – Banksia grandis* with scattered understorey, including *Leucopogon verticillatus, Pteridium esculentum, Clematis pubescens* and *Bossiaea aquifolium* subsp. *aquifolium* on sandy-loam gravelly to gravelly soils.
W -	Open Forest of *Eucalyptus marginata - Eucalyptus patens – Corymbia calophylla* on lower slopes with mixed low understorey species, including *Acacia extensa* and *Hypocalymma angustifolium* on seasonally moister sandy-loam gravelly soils.
WA -	Open woodland of *Eucalyptus patens - Corymbia calophylla – Eucalyptus marginata – Banksia littoralis* including *Hypocalymma angustifolium* and range of *Myrtaceae* species on sandy loam lower slopes.

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY		SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
ADIANTACEAE		*Adiantum aethiopicum*	1				
		Cheilanthes austrotenuifolia	1				
		Cheilanthes sieberi	1				
AMARANTHACEAE		*Ptilotus drummondii*	1		1		
		Ptilotus drummondii var. *drummondii*		1			
		Ptilotus manglesii	1	1		1	1
ANARTHRIACEAE		*Lyginia barbata*	1				
		Lyginia imberbis	1				
APIACEAE		*Centella asiatica*	1		1		
		Daucus glochidiatus			1	1	
		Hydrocotyle callicarpa	1		1	1	
		Pentapeltis peltigera	1	1	1	1	1
		Platysace compressa	1	1	1	1	1
		Platysace filiformis			1		
		Platysace tenuissima	1		1		
		Trachymene pilosa	1	1	1	1	1
		Xanthosia atkinsoniana	1	1	1	1	1
		Xanthosia candida	1	1	1	1	1
		Xanthosia ciliata	1			1	
		Xanthosia huegelii	1	1	1	1	1
		Xanthosia singuliflora	1		1		
		Xanthosia tasmanica	1				
		Xanthosia sp.	1				
APOCYNACEAE	*	*Gomphocarpus fruticosus*	1				
ASPARAGACEAE		*Chamaescilla corymbosa*	1	1	1	1	1
		Dichopogon capillipes	1			1	
		Laxmannia sessiliflora	1				
		Laxmannia sessiliflora subsp. australis	1				
		Laxmannia squarrosa	1				
		Laxmannia sp.	1				
		Lomandra brittanii	1			1	1
		Lomandra caespitosa	1		1	1	1
		Lomandra drummondii	1	1	1	1	1
		Lomandra effusa	1				
		Lomandra hermaphrodita	1	1	1	1	1
		Lomandra integra	1			1	1
		Lomandra micrantha	1	1		1	1
		Lomandra micrantha subsp. *micrantha*	1				
		Lomandra nigricans	1	1		1	1
		Lomandra odora	1			1	1
		Lomandra preissii	1	1		1	1
		Lomandra purpurea	1		1	1	1
		Lomandra sericea	1			1	
		Lomandra sonderi	1	1	1	1	1
		Lomandra spartea	1	1	1	1	1
		Lomandra suaveolens	1				
		Lomandra sp.	1	1	1	1	
		Sowerbaea laxiflora	1			1	
	P3	*Thysanotus anceps*				1	
		Thysanotus dichotomus	1	1	1	1	1
		Thysanotus fastigiatus	1	1	1	1	
		Thysanotus gracilis				1	
		Thysanotus manglesianus	1	1		1	
		Thysanotus multiflorus	1	1	1	1	1
		Thysanotus patersonii	1				1
		Thysanotus scaber	1				
		Thysanotus sparteus					1

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY	SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
ASPARAGACEAE	*Thysanotus tenellus*				1	
(continued)	*Thysanotus thyrsoideus*	1	1	1	1	1
	Thysanotus sp.	1		1	1	
	Asparagaceae sp.	1				
ASPHODELACEAE	*Bulbine semibarbata*				1	
ASTERACEAE	*Asterolasia pallida*	1				
	Craspedia variabilis	1	1			
	* *Erigeron* sp.	1		1		
	* *Erigeron sumatrensis*				1	1
	Euchiton sphaericus				1	1
	Hyalosperma cotula	1				
	* *Hypochaeris glabra*	1		1	1	1
	Lagenophora huegelii	1	1	1	1	1
	Millotia tenuifolia	1			1	1
	Olearia paucidentata	1				
	Podolepis gracilis			1		
	Panaetia lessonii	1		1		
	Podolepis sp.	1		1		
	Podotheca angustifolia	1				
	Podotheca gnaphalioides	1				
	Podotheca sp.	1				
	Pseudognaphalium luteoalbum	1			1	1
	Pterochaeta paniculata	1			1	
	Quinetia urvillei	1		1		
	Senecio diaschides	1		1	1	1
	Senecio hispidulus	1		1	1	1
	Senecio leucoglossus (P4)		1	1	1	1
	Senecio quadridentatus	1		1	1	1
	Senecio sp.	1		1		
	Siloxerus humifusus	1		1		
	Siloxerus multiflorus	1				
	* *Sonchus oleraceus*				1	1
	Trichocline spathulata	1	1	1	1	1
	* *Ursinia anthemoides*	1				
	* Asteraceae sp.	1	1			
BORYACEAE	*Borya sphaerocephala*	1				
CAMPANULACEAE	*Isotoma hypocrateriformis*	1			1	1
	Lobelia gibbosa			1	1	
	Wahlenbergia preissii					1
CASUARINACEAE	*Allocasuarina fraseriana*	1	1	1	1	1
	Allocasuarina humilis	1				
	Allocasuarina microstachya	1				
CELASTRACEAE	*Stackhousia monogyna*	1	1	1		1
	Tripterococcus brunonis	1	1	1		1
CENTROLEPIDACEAE	*Aphelia cyperoides*			1		1
	Centrolepis aristata	1		1	1	1
	Centrolepis drummondiana			1		
COLCHICACEAE	*Burchardia congesta*	1	1		1	1
	Burchardia multiflora	1				
	Burchardia sp.	1				
	Wurmbea dioica	1			1	
	Wurmbea sp.	1				
CUPRESSACEAE	*Callitris pyramidalis*	1				

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY	SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
CYPERACEAE	*Baumea juncea*			1		
	Baumea vaginalis	1				
	Caustis dioica	1				1
	Chorizandra enodis	1				
	Cyathochaeta avenacea	1	1	1	1	1
	* *Cyperus rotundus*			1		
	Gahnia aristata	1				
	Gahnia decomposita	1		1		1
	Isolepis cernua	1				
	Isolepis marginata	1				1
	Lepidosperma asperatum	1				
	Lepidosperma gracile	1		1		
	Lepidosperma leptostachyum	1		1	1	
	Lepidosperma longitudinale	1				1
	Lepidosperma pubisquameum	1				1
	Lepidosperma squamatum	1		1	1	1
	Lepidosperma tenue	1		1	1	1
	Lepidosperma tetraquetrum	1		1		
	Lepidosperma sp.	1	1			1
	Lepidosperma sp. (flat)	1				
	Lepidospema sp. (terete)	1				
	Lepidosperma sp.1					1
	Mesomelaena graciliceps	1			1	1
	Mesomelaena stygia					1
	Mesomelaena tetragona	1		1	1	1
	Schoenus clandestinus	1				
	Schoenus discifer	1				
	Schoenus sp.	1				
	Tetraria capillaris			1	1	1
	Tetraria octandra	1		1	1	1
	Tetraria sp. Jarrah Forest (R. Davis 7391)	1	1			1
	Cyperaceae sp.	1	1			
DASYPOGONACEAE	*Dasypogon bromeliifolius*	1				
	Kingia australis	1				
DENNSTAEDTIACEAE	*Pteridium esculentum*	1	1	1	1	1
DILLENIACEAE	*Hibbertia acerosa*	1	1	1		1
	Hibbertia amplexicaulis	1	1	1	1	1
	Hibbertia commutata	1	1	1	1	1
	Hibbertia commutata (seedling)					1
	Hibbertia diamesogenos			1		
	Hibbertia huegelii	1	1	1	1	1
	Hibbertia hypericoides	1	1	1		1
	Hibbertia lasiopus	1		1		
	Hibbertia lineata					1
	Hibbertia ovata	1		1		
	Hibbertia perfoliata	1	1	1		1
	Hibbertia pilosa	1				
	Hibbertia quadricolor	1		1		1
	Hibbertia racemosa			1		
	Hibbertia silvestris	1				
	Hibbertia stellaris	1				
	Hibbertia striata					1
	Hibbertia sp.	1	1		1	1
DROSERACEAE	*Drosera bulbosa*				1	
	Drosera erythrorhiza	1		1	1	1
	Drosera glanduligera	1				
	Drosera macrantha	1		1	1	
	Drosera microphylla				1	
	Drosera pallida			1	1	

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY	SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
DROSERACEAE	*Drosera platystigma*			1	1	
(continued)	*Drosera pulchella*			1		1
	Drosera stolonifera	1		1	1	1
	Drosera sp.	1	1	1		1
	Drosera sp. (climbing)	1				1
	Drosera sp. 1	1				1
	Drosera sp. 2	1				1
ELAEOCARPACEAE	*Platytheca galioides*	1				
	Tetratheca hirsuta	1	1	1	1	1
	Tetratheca sp.	1				
ERICACEAE	*Andersonia aristata*	1				
	Andersonia latiflora			1		
	Andersonia lehmanniana	1				1
	Andersonia lehmanniana subsp. *lehmanniana*	1				
	Leucopogon australis	1	1			
	Leucopogon capitellatus	1	1	1	1	1
	Leucopogon glabellus	1				
	Leucopogon hirsutus			1		
	Leucopogon parviflorus					1
	Leucopogon sprengelioides					1
	Leucopogon tenuis	1				
	Leucopogon verticillatus	1	1	1	1	1
	Leucopogon sp.	1				
	Lysinema ciliatum	1				
	Lysinema elegans	1				
	Lysinema pentapetalum	1				
	Styphelia discolor	1	1	1	1	1
	Styphelia epacridis	1				
	Styphelia erectifolia	1				
	Styphelia erubescens				1	
	Styphelia nitens	1	1	1	1	1
	Styphelia pallida	1		1	1	1
	Styphelia propinqua	1	1	1	1	1
	Styphelia stricta	1				
	Styphelia tenuiflora	1	1	1	1	1
	Styphelia sp.	1				
	Ericaceae sp.	1				
EUPHORBIACEAE	*Amperea simulans*	1				
	Monotaxis grandiflora			1	1	
	Monotaxis grandiflora var. *grandiflora*					1
	Monotaxis occidentalis	1		1	1	
	Stachystemon vermicularis			1		
	Stachystemon virgatus	1				
FABACEAE	*Acacia alata*	1		1	1	1
	Acacia alata var. *alata*	1				
	Acacia applanata	1				1
	Acacia barbinervis	1	1	1	1	1
	Acacia barbinervis subsp. *barbinervis*	1				
	Acacia browniana	1		1		
	Acacia browniana var. *endlicheri*	1				
	Acacia browniana var. *intermedia*	1				
	Acacia browniana var. *obscura*	1				
	Acacia celastrifolia	1			1	
	Acacia divergens	1		1		1
	Acacia drummondii		1	1	1	1
	Acacia drummondii subsp. *candolleana*	1				1
	Acacia ephedroides	1				
	Acacia extensa	1	1	1		1
	Acacia gemina	1				

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY	SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
FABACEAE	*Acacia horridula* (P3)	1				
(continued)	*Acacia incrassata*			1		
	Acacia incurva	1				
	Acacia lateriticola	1	1	1	1	1
	* *Acacia longifolia*	1				
	* *Acacia longifolia* subsp. *longifolia*	1				
	Acacia multispicata	1				
	Acacia nervosa	1	1			
	Acacia obovata	1				
	Acacia oncinophylla	1				
	Acacia preissiana	1		1		
	Acacia pulchella	1	1	1	1	1
	Acacia pulchella var. glaberrima	1				
	Acacia pulchella var. pulchella	1				
	Acacia saligna	1		1		1
	Acacia stenoptera	1				1
	Acacia trigonophylla	1				
	Acacia urophylla	1	1	1	1	1
	Acacia varia			1	1	
	Acacia willdenowiana	1		1	1	
	Acacia sp.	1	1	1		
	Aotus cordifolia					1
	Aotus gracillima	1				
	Bossiaea aquifolium	1	1	1	1	1
	Bossiaea eriocarpa	1		1		
	Bossiaea ornata	1	1	1	1	1
	Bossiaea pulchella	1				
	Bossiaea spinescens					1
	Callistachys lanceolata	1				
	Chorizema cordatum	1	1	1		1
	Chorizema dicksonii	1				
	Chorizema ilicifolium			1		
	Chorizema rhombeum			1		
	Daviesia cordata	1				
	Daviesia decurrens	1	1	1	1	1
	Daviesia horrida	1		1		1
	Daviesia incrassata	1				
	Daviesia physodes			1		
	Daviesia preissii	1	1			
	Daviesia rhombifolia	1	1			
	Daviesia sp.	1				
	Dillwynia laxiflora	1				
	Gastrolobium bilobum	1				
	Gastrolobium calycinum	1				
	Gastrolobium ebracteolatum			1		
	Gastrolobium retusum	1				
	Gastrolobium spinosum	1				1
	Gastrolobium villosum	1	1			1
	Gastrolobium sp.	1				
	Gompholobium capitatum	1		1		
	Gompholobium cyaninum	1	1	1		
	Gompholobium knightianum	1	1	1	1	1
	Gompholobium marginatum		1	1	1	1
	Gompholobium polymorphum	1	1	1	1	1
	Gompholobium preissii	1	1	1	1	1
	Gompholobium scabrum	1				
	Gompholobium tomentosum	1				1
	Gompholobium sp.	1		1		
	Gompholobium sp.1					1
	Hardenbergia comptoniana	1				
	Hovea chorizemifolia	1	1	1	1	1
	Hovea pungens	1				

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY		SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
FABACEAE		*Hovea trisperma*	1		1	1	1
(continued)		*Hovea trisperma var. grandiflora*	1				
		Hovea sp.	1				
		Isotropis cuneifolia					1
		Isotropis cuneifolia subsp. *cuneifolia*	1				
		Jacksonia alata					1
		Jacksonia furcellata	1				
		Kennedia coccinea	1	1	1	1	1
		Kennedia prostrata	1	1	1		1
		Labichea punctata	1	1	1	1	1
		Mirbelia dilatata	1		1	1	1
		Paraserianthes lophantha	1		1		
		Sphaerolobium linophyllum				1	
		Sphaerolobium macranthum					1
		Sphaerolobium medium	1		1	1	1
		Sphaerolobium sp.					1
	*	*Trifolium dubium*			1	1	
		Viminaria juncea	1		1		
		Fabaceae sp.	1				
GENTIANACEAE	*	*Centaurium erythraea*			1	1	
GERANIACEAE		*Pelargonium littorale*	1				
GOODENIACEAE		*Dampiera alata*	1			1	
		Dampiera hederacea				1	
		Dampiera linearis	1	1		1	1
		Dampiera pedunculata				1	
		Dampiera sp.	1				
		Goodenia micrantha			1		
		Goodenia pulchella	1				
		Goodenia trinervis	1				
		Lechenaultia biloba	1	1	1	1	1
		Scaevola calliptera	1	1	1	1	1
		Scaevola pilosa				1	1
		Goodeniaceae sp.	1				
HAEMODORACEAE		*Anigozanthos manglesii*	1				1
		Anigozanthos sp.	1				
		Conostylis ?caricina subsp. *caricina*	1				
		Conostylis aculeata	1			1	
		Conostylis pusilla	1				1
		Conostylis serrulata	1		1	1	1
		Conostylis setigera	1	1	1		1
		Conostylis setigera subsp. *setigera*	1				
		Conostylis setosa	1	1	1	1	1
		Conostylis sp.	1				
		Haemodorum laxum	1		1	1	1
		Haemodorum spicatum	1			1	
		Haemodorum sp.	1		1		1
		Haemodorum sp. 1					1
		Haemodorum sp. 2					1
		Haemodoraceae sp.		1			
HALORAGACEAE		*Glischrocaryon aureum*	1		1	1	1
		Gonocarpus benthamii			1		
		Gonocarpus cordiger	1	1			
		Gonocarpus diffusus				1	
		Gonocarpus sp.		1			
HEMEROCALLIDACEAE		*Agrostocrinum hirsutum*	1				
		Agrostocrinum scabrum		1		1	1

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY		SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
HEMEROCALLIDACEAE		*Caesia micrantha*	1				
(continued)		*Corynotheca micrantha*	1				
		Dianella revoluta	1	1		1	1
		Johnsonia lupulina	1				
		Stypandra glauca	1				
		Tribonanthes australis	1				
		Tricoryne elatior	1		1	1	1
		Tricoryne humilis				1	1
		Tricoryne sp.	1				
HYPOXIDACEAE		*Pauridia* sp.	1				
IRIDACEAE		*Orthrosanthus laxus*	1				
		Patersonia babianoides			1	1	1
		Patersonia juncea	1				1
		Patersonia occidentalis	1	1	1		1
		Patersonia pygmaea	1		1	1	1
		Patersonia rudis	1		1	1	1
		Patersonia sp.	1				
	*	*Watsonia meriana*	1				
		Iridaceae sp.	1				
JUNCACEAE	*	*Juncus bufonius*				1	
		Juncus planifolius			1		
		Juncus subsecundus			1		
		Juncus sp.	1				
LAMIACEAE		*Hemiandra pungens*	1			1	1
		Hemiandra sp.	1				
		Hemigenia incana	1				
		Hemigenia pritzelii	1	1	1	1	
		Hemigenia viscida	1				
		Hemigenia sp.	1				
	*	*Lavandula stoechas*	1				
LAURACEAE		*Cassytha glabella*	1		1	1	
		Cassytha racemosa			1		
		Cassytha sp.	1				1
LENTIBULARIACEAE		*Utricularia multifida*	1	1		1	
LINDSAEACEAE		*Lindsaea linearis*	1				1
LOGANIACEAE		*Orianthera serpyllifolia*	1		1		
		Phyllangium paradoxum			1	1	
LORANTHACEAE		*Nuytsia floribunda*	1				
MALVACEAE		*Lasiopetalum floribundum*	1	1	1	1	1
		Lasiopetalum glabratum	1	1	1	1	1
		Lasiopetalum glutinosum				1	
		Lasiopetalum sp.	1				
		Thomasia foliosa	1				
		Thomasia paniculata	1		1		1
		Thomasia pauciflora			1		
MENYANTHACEAE		*Liparophyllum capitatum*				1	
MYRTACEAE		*Astartea scoparia*	1		1		1
		Babingtonia camphorosmae	1				1
		Calothamnus lateralis	1				
		Calothamnus quadrifidus	1			1	
		Calothamnus rupestris	1				
		Calothamnus sanguineus	1				

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY	SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
MYRTACEAE	*Calothamnus* sp.					1
(continued)	*Calytrix depressa*	1				
	Calytrix flavescens	1				
	Calytrix variabilis	1				
	Calytrix sp.	1				
	Corymbia calophylla	1	1	1	1	1
	Corymbia calophylla (seedling)					1
^	*Corymbia maculata*	1				
	Darwinia citriodora	1				
^	*Eucalyptus cypellocarpa*	1				
	Eucalyptus drummondii	1				
	Eucalyptus marginata	1	1	1	1	1
	Eucalyptus marginata (seedling)					1
	Eucalyptus megacarpa	1		1		
	Eucalyptus patens	1		1		1
	Eucalyptus patens (seedling)					1
	Eucalyptus rudis	1		1		
	Eucalyptus wandoo	1				
	Eucalyptus sp.	1	1	1		
	Hypocalymma angustifolium	1	1	1	1	1
	Hypocalymma cordifolium	1		1		
	Hypocalymma robustum	1				
	Kunzea glabrescens					1
	Kunzea micrantha	1				
	Kunzea micrantha subsp. *micrantha*	1				
	Kunzea pulchella	1				
	Kunzea recurva	1				1
	Kunzea sp.	1				
	Leptospermum erubescens	1	1			1
*	*Leptospermum laevigatum*	1				
*	*Melaleuca armillaris* subsp. *armillaris*	1				
	Melaleuca incana			1		
	Melaleuca incana subsp. *incana*	1				
	Melaleuca lateritia	1				
	Melaleuca parviceps	1				1
	Melaleuca pauciflora	1				
	Melaleuca preissiana	1		1		1
	Melaleuca rhaphiophylla	1				
	Melaleuca trichophylla	1				
	Melaleuca viminea	1				1
	Melaleuca viminea (seedling)					1
	Melaleuca sp.	1				
	Pericalymma ellipticum	1	1	1		1
	Taxandria linearifolia	1		1		1
	Verticordia densiflora	1				
	Verticordia densiflora var. *densiflora*	1				
	Verticordia pennigera	1				
	Verticordia plumosa	1				0
	Verticordia plumosa var. *plumosa*	1				
	Verticordia sp.	1				
	Myrtaceae sp.	1				
OLACACEAE	*Olax benthamiana*			1		
ORCHIDACEAE	*Caladenia flava*	1		1	1	1
	Caladenia macrostylis			1	1	
	Caladenia reptans	1		1	1	
	Caladenia reptans subsp. *reptans*	1				
	Caladenia sp.	1		1		1
	Caladenia sp. 1					1
	Cryptostylis ovata			1	1	
	Cryptostylis sp.	1				
	Cyanicula sericea	1		1	1	

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY		SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
ORCHIDACEAE		*Cyrtostylis robusta*			1	1	
(continued)	*	*Disa bracteata*			1	1	
		Diuris longifolia	1		1	1	
		Diuris sp.	1				
		Elythranthera brunonis	1		1		1
		Eriochilus dilatatus			1	1	
		Eriochilus scaber			1		
		Eriochilus tenuis			1		
		Leporella fimbriata			1	1	
		Lyperanthus serratus			1		
		Microtis media			1		
		Pheladenia deformis	1		1		
		Prasophyllum brownii			1		
		Prasophyllum elatum				1	
		Prasophyllum sp.	1				1
		Prasophyllum sp.1					1
		Pterostylis barbata	1			1	
		Pterostylis pyramidalis			1	1	
		Pterostylis recurva	1		1	1	
		Pterostylis vittata			1	1	
		Pterostylis sp.	1				1
		Pterostylis sp. 1					1
		Pyrorchis nigricans	1		1	1	
		Thelymitra antennifera	1		1		
		Thelymitra crinita	1		1	1	1
		Thelymitra macrophylla			1	1	
		Thelymitra sp.	1	1	1		1
		Orchidaceae sp.	1	1			1
		Orchidaceae sp. 1	1				1
		Orchidaceae sp. 2	1				1
OROBANCHACEAE	*	*Parentucellia latifolia*	1				
OXALIDACEAE	*	*Oxalis compressa*			1		
	*	*Oxalis corniculata*			1	1	
	*	*Oxalis pes-caprae*	1				
	*	*Oxalis sp.*	1				
PHILYDRACEAE		*Philydrella drummondii*					1
		Philydrella pygmaea			1		
PHYLLANTHACEAE		*Phyllanthus calycinus*	1	1	1	1	1
		Poranthera microphylla	1		1	1	1
PINACEAE	*	*Pinus pinaster*	1				
PITTOSPORACEAE		*Billardiera floribunda*			1	1	
		Billardiera fraseri			1	1	
		Billardiera fusiformis	1		1	1	1
		Billardiera heterophylla	1				
		Billardiera variifolia			1	1	
		Billardiera sp.	1				
		Billardiera sp.1					1
		Marianthus drummondianus	1	1	1		
		Marianthus sp.	1				
PLANTAGINACEAE	*	*Plantago lanceolata*				1	
POACEAE	*	*Aira caryophyllea*			1	1	1
		Amphipogon amphipogonoides	1		1		1
		Amphipogon laguroides	1		1		
		Amphipogon laguroides subsp. *laguroides*	1				
		Austrostipa elegantissima		1			

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY		SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
POACEAE		*Austrostipa mollis*					1
(continued)		*Austrostipa* sp.	1				1
	*	*Avena fatua*			1		
	*	*Briza minor*	1			1	1
		Lachnagrostis filiformis				1	
		Neurachne alopecuroidea	1	1	1	1	1
		Paspalidium sp.?					1
		Rytidosperma acerosum					1
		Rytidosperma caespitosum	1		1		1
		Rytidosperma setaceum				1	
		Rytidosperma sp.					1
		Tetrarrhena laevis	1	1	1	1	1
	*	*Vulpia myuros*			1	1	
		Poaceae sp.	1	1			
POLYGALACEAE		*Comesperma calymega*			1		
		Comesperma virgatum	1	1	1	1	1
		Comesperma sp.	1				1
PRIMULACEAE	*	*Lysimachia arvensis*	1		1	1	1
PROTEACEAE		*Adenanthos barbiger*	1	1	1	1	1
		Adenanthos obovatus	1				
		Banksia armata	1				
		Banksia bipinnatifida	1				1
		Banksia bipinnatifida subsp. *bipinnatifida*	1				
		Banksia dallanneyi subsp. *dallanneyi* var. *dallanneyi*	1	1	1	1	1
		Banksia fraseri		1			
		Banksia grandis	1	1	1	1	1
		Banksia grandis (seedling)					1
		Banksia littoralis	1		1		1
		Banksia seminuda	1				
		Banksia sessilis	1		1		1
		Banksia sphaerocarpa	1	1			
		Banksia squarrosa subsp. *squarrosa*	1				
		Banksia undata var. *undata*	1				
		Conospermum canaliculatum subsp. *canaliculatum*	1				
		Conospermum capitatum	1			1	
		Conospermum capitatum subsp. *glabratum*	1				
		Conospermum huegelii	1				
	P3	*Conospermum scaposum*					1
		Conospermum stoechadis	1				
		Conospermum stoechadis subsp. *sclerophyllum*	1				
		Grevillea bipinnatifida	1				1
		Grevillea diversifolia subsp. *diversifolia*	1				
		Grevillea manglesii subsp. *manglesii*	1				
		Grevillea monticola	1				
		Grevillea pulchella					1
		Grevillea pulchella subsp. ascendens	1				
		Grevillea quercifolia	1			1	
		Grevillea synapheae				1	
		Grevillea wilsonii	1	1	1	1	1
		Grevillea sp.	1				1
		Hakea amplexicaulis	1		1		
		Hakea ceratophylla	1				
		Hakea cyclocarpa	1			1	1
		Hakea gilbertii	1				
		Hakea incrassata	1				
		Hakea lissocarpha	1	1	1	1	1
		Hakea marginata	1				
		Hakea petiolaris subsp. *petiolaris*	1				
		Hakea prostrata	1		1		1

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY	SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
PROTEACEAE	*Hakea ruscifolia*	1		1	1	1
(continued)	*Hakea stenocarpa*	1				
	Hakea sulcata	1				
	Hakea trifurcata	1				
	Hakea undulata	1				
	Hakea varia	1		1		1
	Hakea sp.	1				
	Isopogon dubius	1				
	Persoonia angustiflora	1				
	Persoonia elliptica	1		1	1	
	Persoonia longifolia	1	1	1	1	1
	Persoonia longifolia (seedling)					1
	Persoonia saccata	1				
	Persoonia sp.		1			
	Petrophile macrostachya	1				1
	Petrophile serruriae	1				
	Petrophile squamata	1				
	Petrophile squamata subsp. *squamata*	1				
	Petrophile striata	1				
	Petrophile sp.	1				
	Stirlingia latifolia	1				1
	Stirlingia simplex	1				
	Synaphea cuneata	1				
	Synaphea gracillima	1				
	Synaphea petiolaris	1				
	Synaphea petiolaris subsp. *petiolaris*	1				
	Synaphea sp.	1				1
	Xylomelum occidentale	1				1
	Proteaceae sp.	1				
RANUNCULACEAE	*Clematis pubescens*	1	1	1	1	1
	Ranunculus colonorum	1	1	1		
	* *Ranunculus muricatus*			1		
RESTIONACEAE	*Chaetanthus leptocarpoides*	1				
	Chaetanthus tenellus	1				
	Chordifex ?laxus	1				
	Desmocladus fasciculatus	1		1		1
	Desmocladus flexuosus	1	1	1	1	1
	Empodisma gracillimum			1		
	Hypolaena exsulca	1		1	1	1
	Lepidobolus preissianus	1				
	Lepidobolus preissianus subsp. *preissianus*	1				1
	Leptocarpus canus	1				
	Leptocarpus coangustatus	1		1		
	Leptocarpus scariosus	1				
	Lepyrodia macra	1				
	Lepyrodia riparia	1				
	Loxocarya cinerea	1		1	1	1
	Restio sp.	1				
	Restionaceae sp.	1				1
RHAMNACEAE	*Cryptandra arbutiflora* var. *arbutiflora*	1				1
	Cryptandra arbutiflora var. *tubulosa*	1				
	Cryptandra mutila	1				
	Cryptandra myriantha	1				
	Cryptandra sp.	1				
	Stenanthemum nanum	1				
	Trymalium ledifolium	1	1	1	1	1
	Trymalium odoratissimum	1		1		1
	Trymalium odoratissimum subsp. *odoratissimum*				1	
ROSACEAE	*Acaena echinata*	1				

APPENDIX F: VASCULAR PLANT SPECIES RECORDED IN MYARA, JARRAHDALE AND NEARBY FOREST AREAS AND PLOTS

FAMILY		SPECIES	Myara Mapping	FMP Plots	Huntly/ Myara Plots	Jarrahdale Plots	Myara Plots
RUBIACEAE		*Galium* sp.	1				
		Opercularia apiciflora	1			1	1
		Opercularia echinocephala	1	1	1	1	1
		Opercularia hispidula	1			1	1
		Opercularia vaginata	1	1		1	
		Opercularia sp.	1		1		
RUTACEAE		*Boronia crenulata*	1				1
		Boronia crenulata subsp. *pubescens*	1				
		Boronia crenulata subsp. *viminea*					1
		Boronia fastigiata	1	1	1	1	1
		Boronia molloyae	1		1		
		Boronia scabra subsp. *scabra*	1				
		Boronia sp.	1				
		Cyanothamnus ramosus subsp. anethifolius	1				
		Philotheca spicata	1	1	1		1
SANTALACEAE		*Leptomeria cunninghamii*	1	1	1	1	1
		Santalum acuminatum	1				
SAPINDACEAE		*Dodonaea ceratocarpa*	1				
SOLANACEAE	*	*Solanum nigrum*	1				
STYLIDIACEAE		*Levenhookia pusilla*	1	1	1	1	1
		Levenhookia stipitata		1			
		Stylidium affine	1				
		Stylidium amoenum	1	1	1	1	1
		Stylidium androsaceum	1	1	1	1	
		Stylidium bulbiferum		1			1
		Stylidium calcaratum	1	1	1	1	1
		Stylidium ciliatum		1			
		Stylidium crassifolium				1	
		Stylidium diuroides	1				
		Stylidium emarginatum	1				
		Stylidium hispidum	1	1	1	1	1
		Stylidium junceum	1	1		1	
		Stylidium lateriticola	1			1	1
		Stylidium lineatum	1	1			
		Stylidium piliferum	1	1	1	1	1
		Stylidium repens	1				
		Stylidium schoenoides	1			1	1
		Stylidium spathulatum				1	
		Stylidium thesioides	1			1	
		Stylidium sp.	1		1		
THYMELACEAE		*Pimelea ciliata*	1	1	1	1	1
		Pimelea imbricata	1				
		Pimelea lehmanniana				1	
		Pimelea lehmanniana subsp. *nervosa*	1				
		Pimelea suaveolens	1	1	1	1	1
		Pimelea sp.	1				1
VIOLACEAE		*Hybanthus calycinus*			1	1	
		Hybanthus debilissimus	1		1		
		Hybanthus floribundus	1		1		1
		Hybanthus floribundus subsp. *floribundus*					1
XANTHORRHOEACEAE		*Xanthorrhoea gracilis*	1	1	1	1	1
		Xanthorrhoea preissii	1	1	1	1	1
ZAMIACEAE		*Macrozamia riedlei*	1	1	1	1	1
		Macrozamia riedlei (seedlings)					

APPENDIX G: SUMMARY OF INTRODUCED SPECIES IN THE MYARA NORTH SURVEY AREA AND ADJACENT MYARA/HUNTLY REGION

WONS - Weeds of National Significance - DAWE - Department of Agriculture, Water and the Environment (2021e);

WAOL - Western Australian Organism List DPIRD - WA Department of Primary Industries and Regional Development (2021);

Ecological impact (EI) and invasiveness (IR) ratings - DPAW - WA Department of Parks and Wildlife (2014)

	SPECIES	WONS Weeds (DAWE 2021)	Weeds Status (DPIRD 2021)	EI (DPAW 2014)	IR (DPAW 2014)	Myara former Mapping	Myara 2020 Mapping	Myara Plots	FMP Plots	Huntly Myara Plots	Jarrahdale Plots
*	*Liliaceae sp.*	N	-	-	-	x					
*	*Disa bracteata*	N	-	U	R	x				x	x
*	*Gomphocarpus fruticosus*	N	Declared Pest - s22(2)	U	R		x				
*	Asteraceae sp.	N	Permitted - s11	-	-	x	x		x		
*	*Erigeron* sp.	N	Permitted - s11	-	-	x	x			x	
*	*Medicago* sp.	N	Permitted - s11	-	-	x					
*	*Oxalis compressa*	N	Permitted - s11	-	-					x	
*	*Oxalis corniculata*	N	Permitted - s11	-	-					x	x
*	*Oxalis* sp.	N	Permitted - s11	-	-		x				
*	*Parentucellia latifolia*	N	Permitted - s11	-	-	x	x				
*	*Senecio* sp.	N	Permitted - s11	-	-	x					
*	*Trifolium* sp.	N	Permitted - s11	-	-	x					
*	*Vulpia* sp.	N	Permitted - s11	-	-	x					
*	*Acacia dealbata* subsp. *dealbata*	N	Permitted - s11	H	M	x					
*	*Leptospermum laevigatum*	N	Permitted - s11	H	M	x	x				
*	*Watsonia meriana*	N	Permitted - s11	H	M		x				
*	*Avena fatua*	N	Permitted - s11	H	R					x	
*	*Cynodon dactylon*	N	Permitted - s11	H	R	x					
*	*Oxalis pes-caprae*	N	Permitted - s11	H	S	x	x				
*	*Plantago lanceolata*	N	Permitted - s11	H	U						x
*	*Romulea rosea*	N	Permitted - s11	H	U	x					
*	*Lavandula stoechas*	N	Permitted - s11	L	M		x				
*	*Robinia pseudoacacia*	N	Permitted - s11	L	M	x					
*	*Senecio vulgaris*	N	Permitted - s11	L	M	x					
*	*Verbascum virgatum*	N	Permitted - s11	L	M	x					

APPENDIX G: SUMMARY OF INTRODUCED SPECIES IN THE MYARA NORTH SURVEY AREA AND ADJACENT MYARA/HUNTLY REGION

WONS - Weeds of National Significance - DAWE - Department of Agriculture, Water and the Environment (2021e);

WAOL - Western Australian Organism List DPIRD - WA Department of Primary Industries and Regional Development (2021);

Ecological impact (EI) and invasiveness (IR) ratings - DPAW - WA Department of Parks and Wildlife (2014)

	SPECIES	WONS Weeds (DAWE 2021)	Weeds Status (DPIRD 2021)	EI (DPAW 2014)	IR (DPAW 2014)	Myara former Mapping	Myara 2020 Mapping	Myara Plots	FMP Plots	Huntly Myara Plots	Jarrahdale Plots
*	*Juncus bufonius*	N	Permitted - s11	L	R						x
*	*Arctotheca calendula*	N	Permitted - s11	M	M	x					
*	*Melaleuca armillaris* subsp. *armillaris*	N	Permitted - s11	M	M		x				
*	*Hypochaeris glabra*	N	Permitted - s11	M	R	x	x	x		x	x
*	*Hypochaeris radicata*	N	Permitted - s11	M	R	x					
*	*Hypochaeris* sp.	N	Permitted - s11	M	R	x					
*	*Pinus pinaster*	N	Permitted - s11	M	R		x				
*	*Sonchus oleraceus*	N	Permitted - s11	M	R	x		x			x
*	*Vellereophyton dealbatum*	N	Permitted - s11	M	R	x					
*	*Acacia longifolia*	N	Permitted - s11	U	M		x				
*	*Acacia longifolia* subsp. *longifolia*	N	Permitted - s11	U	M		x				
*	*Hypericum perforatum*	N	Permitted - s11	U	M	x					
*	*Phytolacca octandra*	N	Permitted - s11	U	M	x					
*	*Solanum nigrum*	N	Permitted - s11	U	M		x				
*	*Aira caryophyllea*	N	Permitted - s11	U	R	x		x		x	x
*	*Aira cupaniana*	N	Permitted - s11	U	R	x					
*	*Brassica tournefortii*	N	Permitted - s11	U	R	x					
*	*Briza minor*	N	Permitted - s11	U	R	x	x	x			x
*	*Briza maxima*	N	Permitted - s11	U	R	x					
*	*Centaurium erythraea*	N	Permitted - s11	U	R	x				x	x
*	*Dittrichia graveolens*	N	Permitted - s11	U	R						
*	*Erigeron sumatrensis*	N	Permitted - s11	U	R			x			x
*	*Lotus uliginosus*	N	Permitted - s11	U	R						
*	*Lysimachia arvensis*	N	Permitted - s11	U	R	x	x	x		x	x
*	*Orobanche minor*	N	Permitted - s11	U	R	x					

APPENDIX G: SUMMARY OF INTRODUCED SPECIES IN THE MYARA NORTH SURVEY AREA AND ADJACENT MYARA/HUNTLY REGION

WONS - Weeds of National Significance - DAWE - Department of Agriculture, Water and the Environment (2021e);

WAOL - Western Australian Organism List DPIRD - WA Department of Primary Industries and Regional Development (2021);

Ecological impact (EI) and invasiveness (IR) ratings - DPAW - WA Department of Parks and Wildlife (2014)

SPECIES	WONS Weeds (DAWE 2021)	Weeds Status (DPIRD 2021)	EI (DPAW 2014)	IR (DPAW 2014)	Myara former Mapping	Myara 2020 Mapping	Myara Plots	FMP Plots	Huntly Myara Plots	Jarrahdale Plots
* *Ranunculus muricatus*	N	Permitted - s11	U	R					x	
* *Ursinia anthemoides*	N	Permitted - s11	U	R	x	x				
* *Vulpia myuros*	N	Permitted - s11	U	R	x				x	x
* *Cyperus rotundus*	N	Permitted - s11	U	S					x	
* *Pentameris airoides*	N	Permitted - s11	U	U	x					
* *Trifolium arvense*	N	Permitted - s11	U	U	x					
* *Trifolium dubium*	N	Permitted - s11	U	U					x	x
* *Bellardia trixago*	N	Permitted - s11			x					

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

	Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
*	*Aira caryophyllea*	x			x											x		x	x	x
*	Asteraceae sp.	x																x		
*	*Avena fatua*																		x	
*	*Briza minor*					x														x
*	*Centaurium erythraea*																		x	x
*	*Cyperus rotundus*																			x
*	*Disa bracteata*	x													x	x		x		x
*	*Drosera stolonifera*				x	x										x	x	x		
*	*Erigeron sumatrensis*															x		x	x	x
*	*Hypochaeris glabra*	x	x	x	x				x			x		x		x	x	x	x	x
*	*Juncus bufonius*																			x
*	*Lysimachia arvensis*		x			x														x
*	*Oxalis compressa*																			x
*	*Oxalis corniculata*	x																	x	x
*	*Plantago lanceolata*															x				
*	*Ranunculus muricatus*																		x	x
*	*Sonchus oleraceus*			x										x		x				x
*	*Trifolium dubium*																			x
*	*Vulpia myuros*															x	x		x	x
P3	*Conospermum scaposum*				x															
P3	*Thysanotus anceps*																x			
P4	*Stylidium scabridum*						x		x					x		x	x			
	Acacia alata													x		x				x
	Acacia applanata			x																
	Acacia barbinervis													x		x	x			x
	Acacia browniana													x		x			x	
	Acacia celastrifolia																			x

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Acacia divergens		x					x	x	x										
Acacia drummondii		x											x		x	x	x	x	x
Acacia extensa		x	x		x								x	x	x		x		x
Acacia incrassata	x																		
Acacia lateriticola	x	x											x		x	x	x	x	x
Acacia nervosa													x						
Acacia preissiana															x			x	
Acacia pulchella		x	x		x			x		x			x		x	x	x	x	x
Acacia saligna	x																		
Acacia sp.		x											x		x				
Acacia stenoptera																x			x
Acacia urophylla		x	x			x				x			x		x	x	x	x	x
Acacia varia			x								x				x	x			
Acacia willdenowiana											x		x		x				
Acacia drummondii subsp. *candolleana*													x				x		
Adenanthos barbiger			x								x	x	x	x	x	x	x	x	x
Agrostocrinum scabrum			x								x		x		x	x	x	x	x
Allocasuarina fraseriana			x								x	x	x	x	x	x	x		x
Amphipogon amphipogonoides		x	x	x									x		x	x	x	x	x
Amphipogon laguroides	x	x							x										
Andersonia latiflora															x				
Andersonia lehmanniana					x														
Anigozanthos manglesii	x			x															
Aotus cordifolia								x											
Aphelia cyperoides	x																		
Astartea scoparia	x	x		x	x		x	x	x						x				
Austrostipa eleganthissima										x							x		
Austrostipa mollis					x														

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Austrostipa sp.																			x
Babingtonia camphorosmae				x	x	x							x						
Banksia bipinnatifida															x				
Banksia dallanneyi subsp. *dallanneyi* var. *dallanneyi*			x	x	x	x		x		x	x	x	x	x	x	x	x	x	x
Banksia fraseri													x						
Banksia grandis		x	x								x	x	x	x	x	x	x	x	x
Banksia sessilis			x									x			x	x			
Banksia sphaerocarpa													x						
Banksia littoralis	x	x						x											
Baumea juncea	x	x																	
Billardiera floribunda							x		x							x		x	x
Billardiera sp.1																x			
Billardiera variifolia	x												x		x	x	x	x	x
Billardiera fraseri			x												x				
Billardiera fusiformis	x	x												x	x	x			x
Boronia crenulata								x											
Boronia crenulata subsp. *viminea*								x											
Boronia fastigiata		x	x							x	x	x	x	x	x	x	x	x	x
Boronia molloyae		x					x		x						x				
Bossiaea aquifolium			x				x		x	x		x	x		x	x	x	x	x
Bossiaea ornata		x	x		x						x	x	x		x	x	x	x	x
Bossiaea spinescens													x						
Bossiaea eriocarpa																		x	
Brachyscome pusilla				x															
Bulbine semibarbata		x																	
Burchardia congesta	x	x	x										x	x	x	x	x	x	x
Caladenia flava		x	x	x							x		x	x	x	x	x	x	x

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Caladenia macrostylis															x	x	x		
Caladenia reptans			x												x	x	x		x
Caladenia sp.			x									x			x	x			x
Caladenia sp. 1			x																
Calothamnus quadrifidus																			x
Calothamnus sp.				x															
Cassytha glabella		x													x		x	x	x
Cassytha racemosa									x								x	x	x
Cassytha sp.								x											
Caustis dioica						x													
Centella asiatica		x																	
Centrolepis drummondiana	x																		
Centrolepis aristata	x	x		x							x								x
Chamaescilla corymbosa	x		x	x	x	x				x		x	x		x	x	x	x	x
Chorizema cordatum						x						x	x		x	x	x		x
Chorizema ilicifolium		x																	
Chorizema rhombeum															x			x	x
Clematis pubescens		x	x										x	x	x	x	x	x	x
Comesperma calymega															x				
Comesperma virgatum			x							x	x		x		x	x	x	x	x
Comesperma sp.												x							
Conospermum capitatum			x																
Conostylis aculeata															x	x			x
Conostylis setigera			x			x		x		x		x	x		x	x	x	x	x
Conostylis setosa			x							x	x	x	x	x	x	x	x		x
Conostylis pusilla				x	x										x		x		
Conostylis serrulata			x					x			x	x	x		x	x	x	x	x
Corymbia calophylla			x	x	x	x		x		x	x		x	x	x	x	x	x	x

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Craspedia variabilis				x												x		x	
Cryptandra arbutiflora var. *arbutiflora*					x														
Cryptostylis ovata	x						x								x	x			x
Cyanicula sericea															x		x		
Cyathochaeta avenacea	x		x				x	x		x	x	x	x	x	x	x	x	x	x
Cyperaceae sp.													x						
Cyrtostylis robusta															x	x	x	x	x
Dampiera alata	x	x			x	x									x				x
Dampiera hederacea							x	x											
Dampiera linearis	x	x	x			x		x	x	x	x	x	x		x	x	x		x
Dampiera pedunculata	x	x																	
Dasypogon bromeliifolius																			x
Daucus glochidiatus															x	x		x	x
Daviesia decurrens													x			x			
Daviesia horrida	x					x													
Daviesia physodes																	x		
Daviesia preissii													x						
Daviesia rhombifolia													x						
Desmocladus flexuosus			x			x					x	x	x		x	x	x		x
Desmocladus fasciculatus				x	x	x		x					x		x		x		
Dianella revoluta		x											x		x		x	x	x
Dichopogon capillipes	x															x			x
Diuris longifolia	x	x					x						x	x	x	x	x	x	x
Drosera bulbosa											x				x	x			x
Drosera erythrorhiza	x	x	x									x	x		x	x	x	x	x
Drosera macrantha															x	x	x	x	x
Drosera microphylla			x																
Drosera pallida		x	x										x		x	x	x	x	x

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

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Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Drosera platystigma	x	x							x		x				x				
Drosera pulchella	x	x													x		x		
Drosera sp.													x		x		x	x	x
Drosera sp. (climbing)												x				x			x
Drosera sp. 1	x		x	x	x	x						x	x		x	x			x
Drosera sp. 2	x			x	x	x		x					x		x	x	x		
Drosera stolonifera											x		x	x	x		x	x	x
Elythranthera brunonis						x										x		x	
Empodisma gracillimum	x														x				
Eriochilus dilatatus		x							x				x	x	x	x	x	x	x
Eriochilus scaber																		x	
Eriochilus tenuis															x				x
Eucalyptus marginata		x	x	x		x		x		x	x	x	x	x	x	x	x	x	x
Eucalyptus megacarpa							x		x						x				
Eucalyptus patens		x					x	x	x						x	x		x	
Eucalyptus rudis	x	x																	
Eucalyptus sp.													x		x				
Euchiton sphaericus																		x	
Gahnia decomposita	x	x						x	x						x				
Gastrolobium ebracteolatum		x					x		x										
Gastrolobium spinosum													x						
Gastrolobium villosum													x						
Glischrocaryon aureum													x		x	x			
Gompholobium capitatum															x	x			
Gompholobium cyaninum													x						
Gompholobium knightianum			x							x	x	x	x		x	x			x
Gompholobium marginatum	x	x	x	x	x	x		x		x	x	x	x		x	x	x		x
Gompholobium polymorphum			x	x		x				x	x		x	x	x	x	x	x	x

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

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Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Gompholobium preissii			x	x						x	x	x	x		x	x	x		x
Gompholobium sp.															x				
Gompholobium sp.1																			x
Gompholobium tomentosum																x			
Gonocarpus benthamii															x				
Gonocarpus cordiger																			x
Gonocarpus diffusus	x	x					x		x										
Gonocarpus sp.										x									
Goodenia sp.1						x													
Goodenia trinervis	x				x														
Grevillea bipinnatifida						x													
Grevillea pulchella					x								x						
Grevillea quercifolia											x								
Grevillea synapheae			x															x	
Grevillea variifolia				x															
Grevillea wilsonii			x		x	x						x	x		x	x			x
Haemodoraceae sp.													x					x	
Haemodorum laxum			x										x		x		x	x	x
Haemodorum sp.	x					x		x				x	x		x	x			
Haemodorum sp. 1	x				x	x							x		x	x			
Haemodorum sp. 2					x														
Haemodorum spicatum											x								
Hakea amplexicaulis													x						x
Hakea cyclocarpa						x										x			
Hakea lissocarpha			x		x	x						x	x		x	x		x	x
Hakea prostrata	x				x														
Hakea ruscifolia				x							x		x		x	x			
Hakea varia	x	x																	

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

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Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Hemiandra pungens					x							x			x				
Hemigenia pritzelii		x	x										x		x	x	x	x	x
Hibbertia acerosa	x		x							x			x		x	x	x		x
Hibbertia amplexicaulis		x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x
Hibbertia commutata		x	x	x		x				x	x	x	x	x	x	x	x	x	x
Hibbertia diamesogenos	x																		
Hibbertia huegelii	x		x										x		x				
Hibbertia huegelli															x				
Hibbertia hypericoides			x	x		x							x		x	x	x	x	
Hibbertia lasiopus															x				
Hibbertia lineata						x													
Hibbertia ovata													x		x	x	x	x	x
Hibbertia perfoliata			x	x									x		x	x	x	x	
Hibbertia quadricolor												x		x	x	x	x		
Hibbertia racemosa															x				
Hibbertia sp.													x		x	x		x	x
Hibbertia striata															x				
Hovea chorizemifolia		x	x							x	x	x	x	x	x	x	x	x	x
Hovea trisperma			x			x					x		x		x	x	x	x	x
Hyalosperma cotula	x														x		x		
Hybanthus calycinus													x	x	x	x	x		x
Hybanthus debilissimus			x												x	x	x	x	x
Hybanthus floribundus						x									x	x			x
Hybanthus floribundus subsp. *floribundus*															x	x			x
Hydrocotyle callicarpa	x	x											x		x		x		x
Hypocalymma angustifolium	x	x	x	x	x	x				x	x				x	x	x	x	x
Hypocalymma cordifolium	x	x					x		x						x				
Hypolaena exsulca			x			x	x	x			x				x				

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

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Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Isolepis marginata																	x		
Isotoma hypocrateriformis		x													x			x	
Isotropis cuneifolia	x				x														
Jacksonia alata					x														
Juncus planifolius	x	x																	
Juncus subsecundus	x																		
Kennedia coccinea		x	x								x	x	x		x	x	x	x	x
Kennedia prostrata			x	x	x										x	x	x	x	x
Kingia australis						x													
Kunzea glabrescens						x													
Kunzea recurva						x													
Labichea punctata			x							x	x	x	x	x	x	x	x		x
Lachnagrostis filiformis																			x
Lagenophora huegelii	x	x	x	x									x	x	x	x	x	x	x
Lasiopetalum floribundum		x	x				x	x	x			x	x	x	x	x	x	x	x
Lasiopetalum glabratum			x										x			x			
Lasiopetalum glutinosum			x													x			
Laxmannia squarrosa				x	x														
Lechenaultia biloba			x		x	x		x		x		x	x		x	x	x	x	x
Lepidobolus preissianus subsp. *preissianus*					x														
Lepidosperma gracile													x		x	x			
Lepidosperma leptostachyum													x	x	x	x			x
Lepidosperma longitudinale								x											
Lepidosperma pubisquameum	x		x										x			x			
Lepidosperma sp.	x									x			x		x		x		
Lepidosperma sp.1			x										x			x			x
Lepidosperma squamatum	x	x	x	x	x	x							x		x	x	x		x
Lepidosperma tenue		x	x			x						x	x		x	x			

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

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Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Lepidosperma tetraquetrum		x					x		x						x				
Leporella fimbriata			x								x		x		x		x	x	x
Leptocarpus coangustatus	x	x											x						
Leptomeria cunninghamii	x		x										x		x	x	x	x	x
Leptospermum erubescens				x						x					x				
Leucopogon australis													x						
Leucopogon capitellatus		x	x			x							x		x	x	x	x	x
Leucopogon hirsutus		x																	
Leucopogon parviflorus								x											
Leucopogon sprengelioides					x														
Leucopogon verticillatus			x										x		x	x	x	x	x
Levenhookia pusilla	x	x				x				x	x	x	x		x		x		x
Levenhookia stipitata																			x
Lindsaea linearis			x			x													
Liparophyllum capitatum	x																		
Lobelia gibbosa																x			
Lobelia sp.								x											
Lomandra brittanii						x						x	x	x	x	x	x	x	x
Lomandra caespitosa		x	x	x		x					x		x		x	x	x	x	x
Lomandra drummondii											x		x		x	x	x	x	x
Lomandra hermaphrodita	x	x	x	x		x				x	x	x	x	x	x	x	x	x	x
Lomandra integra	x	x	x				x		x		x		x		x	x	x	x	x
Lomandra micrantha		x	x			x						x	x		x	x	x	x	x
Lomandra micrantha subsp. *micrantha*																			x
Lomandra nigricans			x										x	x	x	x	x	x	x
Lomandra odora											x		x		x	x	x	x	x
Lomandra preissii		x	x			x				x		x	x	x	x	x	x	x	x
Lomandra purpurea													x		x	x	x		x

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Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Lomandra sericea													x	x	x			x	x
Lomandra sonderi		x	x	x						x	x	x	x		x	x	x	x	x
Lomandra sp.	x		x			x	x					x	x		x	x	x	x	x
Lomandra sp.1																x			
Lomandra spartea	x		x		x	x				x		x	x		x	x	x	x	x
Loxocarya cinerea			x					x				x	x		x	x	x	x	x
Lyperanthus serratus																x			
Macrozamia riedlei		x	x	x			x	x	x	x		x	x		x	x	x	x	x
Marianthus drummondianus																			x
Melaleuca incana	x	x																	
Melaleuca parviceps					x														
Melaleuca preissiana	x	x																	
Melaleuca viminea	x																		
Mesomelaena graciliceps											x				x				
Mesomelaena stygia	x																		
Mesomelaena tetragona	x		x																
Microtis media	x	x					x		x								x		x
Millotia tenuifolia				x	x								x		x		x	x	x
Mirbelia dilatata						x		x			x				x	x		x	x
Monotaxis grandiflora			x										x		x	x	x		x
Monotaxis grandiflora var. *grandiflora*												x	x		x	x			
Monotaxis occidentalis													x		x	x	x		x
Neurachne alopecuroidea	x		x	x	x	x	x	x			x		x		x	x	x	x	x
Olax benthamiana																	x		x
Opercularia apiciflora											x		x	x	x	x	x	x	x
Opercularia echinocephala	x		x	x		x		x			x	x	x	x	x	x	x	x	x
Opercularia hispidula																	x	x	x
Opercularia sp.								x								x			

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Opercularia vaginata													x						
Operculina aequisepala													x						
Orchidaceae sp.										x									x
Orchidaceae sp. 1																			x
Orchidaceae sp. 2					x														
Orianthera serpyllifolia													x		x			x	x
Paraserianthes lophantha							x												
Paspalidium sp.?																x			
Patersonia babianoides			x	x		x			x		x	x	x		x	x		x	x
Patersonia juncea	x												x						
Patersonia occidentalis	x	x	x	x	x	x				x		x	x		x	x	x	x	x
Patersonia pygmaea	x				x	x					x		x		x	x		x	x
Patersonia rudis						x						x	x		x	x	x		
Pentapeltis peltigera		x	x	x		x		x		x	x	x	x	x	x	x	x	x	x
Pericalymma ellipticum	x				x	x						x	x						
Persoonia elliptica															x	x	x		x
Persoonia longifolia		x	x								x	x	x	x	x	x	x	x	x
Persoonia sp.													x						
Petrophile macrostachya													x						
Pheladenia deformis			x																
Philotheca spicata				x		x				x					x				
Philydrella drummondii	x																		
Philydrella pygmaea	x																		
Phyllangium paradoxum		x																x	
Phyllanthus calycinus			x		x					x	x	x	x	x	x	x	x	x	x
Pimelea ciliata					x	x							x		x		x	x	x
Pimelea lehmanniana																x			
Pimelea sp.					x														

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Pimelea suaveolens			x	x	x	x							x		x	x	x	x	x
Platysace commutata			x			x						x	x		x	x	x		x
Platysace compressa			x										x		x	x	x	x	x
Platysace filiformis													x		x				
Platysace tenuissima													x	x	x	x	x	x	x
Poaceae sp.																	x		x
Podolepis capillaris	x																		
Podotheca angustifolia				x									x						
Podotheca gnaphalioides					x														
Poranthera microphylla													x		x	x			
Prasophyllum brownii																	x	x	x
Prasophyllum elatum																x			x
Prasophyllum sp.																x			
Prasophyllum sp.1															x	x			
Pseudognaphalium luteoalbum													x					x	
Pteridium esculentum		x					x	x	x				x		x	x	x	x	x
Pterochaeta paniculata												x	x		x				
Pterostylis barbata															x			x	
Pterostylis pyramidalis		x	x								x		x		x	x	x	x	x
Pterostylis recurva									x		x		x	x	x		x		x
Pterostylis sp.			x									x							
Pterostylis sp. 1																x			x
Pterostylis vittata			x										x		x	x	x	x	x
Ptilotus drummondii													x		x				
Ptilotus drummondii var. *drummondii*													x						
Ptilotus manglesii					x						x	x	x			x			x
Pyrorchis nigricans			x										x		x	x			x
Ranunculus colonorum													x		x			x	x

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Restionaceae sp.					x														
Rytidosperma acerosum																	x		
Rytidosperma caespitosum	x	x				x						x	x		x	x	x		x
Rytidosperma setaceum															x				
Rytidosperma sp.						x													
Scaevola calliptera		x	x		x	x				x	x	x	x	x	x	x	x	x	x
Scaevola pilosa	x																	x	x
Scaevola sp.			x																x
Senecio diaschides		x		x											x		x		x
Senecio hispidulus													x		x		x	x	x
Senecio quadridentatus																			x
Senecio sp.	x			x													x		
Senecio sp.1				x															
Sowerbaea laxiflora	x		x										x		x	x			x
Sphaerolobium linophyllum											x		x		x				
Sphaerolobium macranthum						x													
Sphaerolobium medium			x			x							x		x				x
Sphaerolobium sp.						x									x	x			
Stachystemon vermicularis															x	x			
Stackhousia monogyna															x				x
Stirlingia latifolia												x							
Stylidium amoenum			x							x		x	x		x	x	x	x	x
Stylidium androsaceum													x		x		x		x
Stylidium brunonianum						x													
Stylidium bulbiferum										x			x		x				
Stylidium calcaratum	x		x										x		x	x	x	x	x
Stylidium ciliatum						x				x			x		x				

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Stylidium crassifolium	x	x																	
Stylidium hirsutum															x	x			
Stylidium junceum													x		x				
Stylidium lateriticola													x		x	x	x		x
Stylidium lineatum										x									
Stylidium piliferum			x	x	x					x		x	x		x	x	x	x	x
Stylidium recurvum	x																		
Stylidium repens					x										x				
Stylidium rhynchocarpum																			x
Stylidium scariosum													x		x				
Stylidium schoenoides		x									x		x	x	x	x	x	x	x
Stylidium sp.	x											x				x			
Stylidium sp. 1																x			
Stylidium spathulatum	x	x																	
Stylidium thesioides	x	x																	
Stylidium hispidum					x						x		x		x	x	x		x
Styphelia discolor	x		x			x									x		x	x	x
Styphelia erubescens																		x	
Styphelia hispida													x						
Styphelia nitens	x		x							x	x		x		x	x	x	x	x
Styphelia pallida		x											x		x	x		x	x
Styphelia propinqua			x			x		x		x	x		x		x	x	x	x	x
Styphelia tenuiflora				x		x					x		x		x	x	x	x	x
Synaphea sp.						x													
Taxandria linearifolia	x	x					x	x	x						x				
Tetraria capillaris		x	x			x			x		x	x	x	x	x	x	x	x	x
Tetraria octandra	x		x	x	x	x		x			x	x	x		x	x	x		x
Tetraria sp. Jarrah Forest (R. Davis 7391)			x	x	x	x				x		x	x		x	x	x	x	x

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Tetrarrhena laevis	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Tetratheca hirsuta		x	x							x			x	x	x	x	x	x	x
Thelymitra antennifera	x	x							x										
Thelymitra crinita			x				x	x			x		x	x	x	x	x	x	x
Thelymitra macrophylla		x	x										x	x	x	x	x	x	x
Thelymitra sp.								x		x			x		x	x			
Thomasia paniculata	x	x					x	x	x							x			
Thomasia pauciflora																			x
Thysanotus ? scaber													x						
Thysanotus dichotomus												x	x		x	x	x	x	x
Thysanotus fastigiatus					x					x			x		x	x	x		x
Thysanotus gracilis		x																	
Thysanotus manglesianus	x												x		x		x		x
Thysanotus multiflorus			x	x	x	x		x		x	x	x	x	x	x	x	x	x	x
Thysanotus patersonii																x			x
Thysanotus sp.												x			x			x	x
Thysanotus sp.1				x	x								x		x	x			
Thysanotus sparteus																x			
Thysanotus tenellus		x											x		x			x	x
Thysanotus thyrsoideus	x	x	x								x	x	x	x	x	x	x	x	x
Trachymene pilosa		x	x	x	x						x	x	x	x	x		x	x	x
Trichocline spathulata	x		x		x					x		x	x	x	x	x	x	x	x
Tricoryne elatior	x	x	x					x			x		x		x	x	x		x
Tricoryne humilis	x		x								x		x		x	x			
Tripterococcus brunonis	x				x								x		x	x			
Trymalium ledifolium		x	x		x					x		x	x	x	x	x	x	x	x
Trymalium odoratissimum						x									x				
Trymalium odoratissimum subsp. *odoratissimum*															x				x

APPENDIX H: SUMMARY OF SPECIES IN THE VEGETATION PLOTS WITHIN MYARA NORTH AND THE NEARBY MYARA NORTH REGION

Note: * denotes intrdouced species and P3 nd P4 denote Priority Flora species.

Species	A	AC	D	D/DA	DA	E	C	CW	W	PW	SW	P	PS	PT	S	SP	ST	T	TS
Trymalium spatulatum			x																
Utricularia multifida	x																		
Viminaria juncea	x																		
Wahlenbergia preissii																	x	x	
Wurmbea dioica																			x
Xanthorrhoea gracilis	x		x	x				x		x	x	x	x		x	x	x	x	x
Xanthorrhoea preissii	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x
Xanthosia atkinsoniana			x					x			x	x	x		x	x	x	x	x
Xanthosia candida		x	x		x	x					x	x	x		x	x	x	x	x
Xanthosia ciliata			x																
Xanthosia huegelii	x		x	x	x	x					x		x		x	x	x		x
Xanthosia singuliflora													x						
Xylomelum occidentale			x	x															

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

Note: * denotes introduced species, P3 denotes Priority 3 species.

		Site-vegetation Types based on recording sites																				
	Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
*	*Acacia longifolia*			2		1	1					1				1		1			1			
*	*Acacia longifolia* subsp. *longifolia*		1	1																				
*	*Briza minor*									1	1													
*	*Hypochaeris glabra*		2	2		1	3			7	3			3	2	2		2	1		6	1	1	1
*	*Lavandula stoechas*																				1			
*	*Leptospermum laevigatum*																				2			
*	*Lysimachia arvensis*									3	3	1		1									1	
*	*Oxalis pes-caprae*										1													
*	*Pinus pinaster*						1	1				1				1							1	2
*	*Erigeron* sp.																				1			1
*	*Solanum nigrum*																				2	2		
*	*Ursinia anthemoides*			1						5														
*	*Watsonia meriana*											2						1						
^	*Eucalyptus* sp.						1						1		2	1	1							
	Acacia alata	3	27	17	1	20	7	5	5	2	11	28	9	4	7	21		24	8	3	33	9	2	4
	Acacia alata var. *alata*		2			1										3		4	2	2	6	1		1
	Acacia applanata		1	1		5	1		4		2				1	7		3			3			
	Acacia barbinervis					9	2	1	1					1	12	35		60	1	3	26			
	Acacia barbinervis subsp. *barbinervis*		1													2		4			2			
	Acacia browniana			1		2			1					1	3	5		6	1	1	3			
	Acacia browniana ?var. *endlicheri*					2								1		1		3			1			
	Acacia browniana var. *intermedia*					1										2		2						
	Acacia browniana var. *obscura*										1			1							1			
	Acacia celastrifolia					2	2	1		5	1		1	1		9	4	5	1	2	5	1		
	Acacia divergens		19	3	1				1			8		1		1								
P3	*Acacia drummondii* subsp. *affinis*					1												1			1			
	Acacia drummondii subsp. *candolleana*		1			4	1				7		1	2		9	2	23	2	1	53	23	6	5
	Acacia drummondii subsp. *drummondii*					1					1				2	10		9	3	3	4	8	1	4
	Acacia ephedroides										1													
	Acacia gemina							1			1													
	Acacia incurva	3	10	12		3		1						1		1		4		2	2	3		
	Acacia lateriticola					4					1					2	1				9	2	1	3
	Acacia mutlispicata									1														

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

Note: * denotes introduced species, P3 denotes Priority 3 species.

	Site-vegetation Types based on recording sites																					
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Acacia nervosa			1		3	3	2	3	1					4	13		15	1		2			
Acacia obovata					2																		
Acacia oncinophylla							1		3														
Acacia pulchella	4	10	16	1	120	16	4	2	28	62	7	25	54	40	120	2	316	54	60	412	147	50	70
Acacia pulchella var. *glaberrima*									1								2			1	1	1	1
Acacia saligna	9	6	4						1								1	1		2			
Acacia sp.		2	1		1							1			2		3					1	
Acacia stenoptera	4	2	2		4		1	1						2	3					1	1		
Acacia trigonophylla								1							2		1			3			
Acacia urophylla			3		55	1	3	1	3	25		8	35	17	64		151	34	51	384	144	69	102
Acacia willdenowiana		2	5		8	4		3				1		3	17		8		1	4			
Acaena echinata					1						1												
Adenanthos barbiger	1		5		76	5	1	11	1	6		2	35	102	420	6	990	78	101	519	132	23	64
Adenanthos meisneri					1					1													
Adenanthos obovatus		3	9		3									1	2		6		1		1	1	
Adiantum aethiopicum											2												
Agrostocrinum hirsutum	1	1			2												4	1		3	3	2	3
Allocasuarina fraseriana	1	12	18		93	16	6	18	6	15	11	11	16	167	698	10	1264	136	107	153	29	5	16
Allocasuarina humilis		1	1		10	3	2	3	9	5					17		3						
Allocasuarina microstachya	1								1														
Amphipogon amphipogonoides			3		9				7	4		4	5	3	8		23	2	3	32	13	4	10
Amphipogon laguroides subsp. *laguroides*			1																				
Amphipogon laguroides			1																				
Andersonia aristata									1						1								
Andersonia lehmanniana	2	6	14		4	3	1	2	3	5			2		1					1			
Andersonia lehmanniana subsp. *lehmanniana*	2		16		7	3	3		3	3					5		1						
Anigozanthos manglesii					2																		
Anigozanthos sp.					8								1		6		7			2			
Aotus gracillima		1																					
Asparagaceae sp.							1											1		1	1		
Astartea leptophylla											1												
Astartea scoparia	10	71	34	1	3	11	3	2	5	1	23												
Asteraceae sp.	1		1		4		1		3	2	1	2	4	2	11		8		5	11			1
Asterolasia pallida									11	6	1	1	3				1			11	3	1	1

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

Note: * denotes introduced species, P3 denotes Priority 3 species.

	Site-vegetation Types based on recording sites																						
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Austrostipa sp.									1	1													
Babingtonia camphorosmae	6	11	29		57	15	12	9	13	15	1	2	9	26	21	2	9		1	3		1	
Banksia armata								1		1													
Banksia bipinnatifida					5			2						4	1		1			3			
Banksia bipinnatifida subsp. bipinnatifida					5	1	1	1					1	1	4		1	1		1			
Banksia dallanneyi subsp. dallanneyi var. dallanneyi	15	57	105	1	284	71	26	28	15	54	5	23	96	154	453	8	600	33	74	447	71	22	20
Banksia grandis	2	10	28		118	23	6	7	1	10	11	11	56	90	198	5	1318	119	158	719	236	59	163
Banksia littoralis	8	43	45		4	29		4			22	3			4	1	5			2		1	
Banksia seminuda		1																		2			
Banksia sessilis			4		14			1	6	7		3	6	19	87	1	69	3	9	93	6	4	4
Banksia sphaerocarpha						1	1			1					2								
Banksia squarrosa					2			1	2	1					2								
Banksia squarrosa subsp. squarrosa							1			1													
Banksia undata var. undata									3	1					1		1						
Banskia undata									1														
Baumea vaginalis		2									1												
Billardiera fusiformis			1			1			1	1		1	1				3			8		1	1
Billardiera heterophylla		1			1												1			2			
Billardiera sp.		1													1		3			2	1		
Boronia crenulata			1					1			1			2	4		11	2		7			3
Boronia crenulata subsp. pubescens					1																		
Boronia fastigiata	3	14	16	1	61	12	2	2	1	15	5	8	36	50	163		483	76	75	408	102	30	92
Boronia molloyae		1															1						
Boronia scabra subsp. scabra					1			1						5	7		1		1	3			
Boronia sp.			2										1		3				1	1			
Borya sphaerocephala					1				20	2					1								
Bossiaea aquifolium					9			1	2	7	5	4	8	1	5	1	55	5	11	110	47	3	19
Bossiaea eriocarpa																	1						
Bossiaea ornata		7	12		198	15	9	16	4	29	1	9	48	103	460	4	740	47	93	517	81	23	51
Bossiaea pulchella			1		4			2			1		1	8	39		73	2	10	22	3		1
Burchardia congesta					3		1		5	5		1	3	1	4		5	3		8	1	3	5
Burchardia multiflora			1						2	1		1			1					1	5		
Burchardia sp.					2									1									
Caesia micrantha																					1		
Caladenia flava					4	1			6	4	1		1				3	2	1	6	9	4	10

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

Note: * denotes introduced species, P3 denotes Priority 3 species.

	Site-vegetation Types based on recording sites																					
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Caladenia reptans		1			2				4	1				1	1		8			6	1		1
Caladenia reptans subsp. reptans															1								
Caladenia sp.	1		1		6	2	1		1	2	1		3	6	9		20		4	7	8	3	5
Callistachys lanceolata					1						1				1								
Callitris pyramidalis					1										1								
Calothamnus lateralis		3																					
Calothamnus quadrifidus															2								
Calothamnus rupestris					2				4	2									1				
Calothamnus sanguineus			3		4	3		7	3	1				1	20		3			2			
Calothamnus *sp.*														1	1		1						
Calytrix ?depressa									3	3													
Calytrix flavescens						1			3	1	1												
Calytrix sp.	2	2	6		11	5	4	2	9	8		2	1		5		1		1	5	1		
Calytrix variabilis					1				1								1		1				
Cassytha glabella			1																				
Cassytha sp.	1	6	7	1	10	2	1		2	3	6	5		1	4		4			5	3	3	5
Centella asiatica			1							1													
Centrolepis aristata									3	3													
Chaetanthus leptocarpoides		1									1												
Chaetanthus tenellus		1																					
Chamaescilla corymbosa	6	9	24		94	17	4	11	12	12	2	7	34	67	237	2	284	10	25	186	38	6	10
Cheilanthes austrotenuifolia									3	1													
Cheilanthes sieberi									2														
Chelianthes sp.						1			14	3	1									1	1		1
Chorizandra enodis		1	1																				
Chorizema cordatum	1				2						1	3	2	3	1		10		2	7	1	3	1
Chorizema dicksonii					2										1								
Clematis pubescens	3	2	1		6	1			1	18	5	12	7	2	3		45	117	9	27	243	130	161
Comesperma ?virgatum		3	5		4				1	1			1		1		1	1		7			
Comesperma sp.			1				1										1		1				
Comesperma virgatum			2		10	3	2		2	2			1	4	25	3	21	2	1	8	1		
Conospermum canaliculatum subsp*. canaliculatum*					1					1													
Conospermum capitatum		1			4	1				1					13	1	6						
Conospermum sp.										1			1		2		6			7			
Conospermum stoechadis					5	3								1	9	1	8		1	2			

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

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	Site-vegetation Types based on recording sites																					
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Conospermum stoechadis subsp. *sclerophyllum*			1																				
Conospermum capitatum subsp. *glabratum*		1	5		1	2								1			1						
Conostylis ?caricina subsp. *caricina*					1																		
Conostylis aculeata			7		1															2			
Conostylis pusilla	2	7	19		49	12	7	7	12	9		1	4	22	93	3	44		7	37	1		336
Conostylis serrulata		8	32		51	5	3	3	1	8	1	2	16	26	119	3	224	10	18	87	8	3	9
Conostylis setigera		7	12		82	15	1	7	3	15	1	6	28	65	269	2	391	20	50	219	19	8	6
Conostylis setigera subsp. *setigera*		1											1					2		1	1		1
Conostylis setosa		6	3		64	9	4	10		10	1	4	28	49	160	1	250	28	31	149	15	6	18
Conostylis sp.			2		1		1			1		2		2	7		5			3	1		1
Corymbia calophylla	14	77	125	1	363	78	31	35	74	120	47	42	132	157	545	6	846	117	136	1050	277	131	193
Corymbia maculata														1	1								
Craspedia variablis	1	2	7		49	5			2	7	2	2	20	10	19		30	6	2	62	7	4	6
Cryptandra arbutiflora subsp. *tubulosa*						1																	
Cryptandra mutila					1		1																
Cryptandra myriantha									2														
Cryptandra sp.										1													
Cryptostylis sp.																	1	1					2
Cyanicula sericea																	1						
Cyathochaeta avenacea	1	16	18		73	18	7	12	2	15	10	5	18	58	274	7	345	12	48	142	28	15	15
Cyperaceae sp.	1	2	4		6	1	1	3		1			1	3	4		1	1		6	4	6	8
Dampiera alata		6	9		9	1	2	2	1	1	4	1	1	3	12		26	5	5	22	4	1	
Dampiera linearis		3	11		39	7	3	5		2	3		6	14	83		104	3	11	40	5	7	3
Dampiera sp.														1			1						
Darwinia citriodora		1							2		3	2	1	1									
Darwinia sp.														1									
Dasypogon bromeliifolius	3	16	35		10	1							2	1	2		1			2			
Daviesia cordata										2			1		1		1			3	2		
Daviesia decurrens		2	4		23	2	3	3		1			1	9	61		47	1	9	35	2		1
Daviesia horrida		5	8		2	1	2		7	3	1			1	1		1		1	2	1	1	
Daviesia incrassata		1									1				1		1		1	5			
Daviesia preissii					17	4	3	1		4		1	5	7	38	2	60	2	5	47	1		1
Daviesia rhombifolia					2								2	2	4		9			1			
Daviesia sp.			1																				
Dayspogon bromeliifolius		5	11		2											2	1			2			

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Desmocladus fasciculatus	7	29	100		127	33	11	12	5	12	1	6	21	23	60	4	65	5	11	70	7	6	7
Desmocladus flexuosus	1	5	13		39	7		3	1	1	1	3	14	26	124	5	237	17	32	136	15	4	18
Dianella revoluta					8	1			1	2		1		6	20		46	9	6	19	5		
Dillwynia laxiflora															1								
Diuris longifolia									1														
Diuris sp.									1					1	1								
Dodonaea ceratocarpa									11	1													
Drosera erythrorhiza	1	1	3		9			2	4	4		1	3	2	15		16		2	10	2		1
Drosera macrantha					1				6	1			1				2			5	1	1	4
Drosera sp.	23	55	102		203	45	20	20	53	44	9	16	80	108	379	5	565	47	76	509	111	29	58
Drosera sp. (climbing)			4		4		1	1		1		2	3	13	21	1	31	3	7	14	6		6
Drosera sp. 1					1	1			2				1	1	1		4			2			
Drosera sp. 2			1		2	1			1				1	1	2		7	1		5	1		
Drosera stolonifera					5				4	3		1		1	3		22		1	9	2	2	3
Elythranthera brunonis									3						1								
Eriachne sp.																							1
Ericaceae sp.	1	1	1		3					1				1	2		4	1		6	1	4	1
Eucalyptus drummondii							2																
Eucalyptus marginata	11	72	125		421	87	28	38	67	128	43	55	148	210	790	12	1359	158	181	1210	336	151	223
Eucalyptus megacarpa		8	2	1	1			2			12	15	1	2	6		9		2	4	4		3
Eucalyptus patens	13	78	61	1	55	28	9	5	12	8	47	39		4	16		3		3	2	4	12	3
Eucalyptus rudis	6	9	3			2		4			6	1			1								
Eucalyptus sp.			1		1																		
Fabaceae sp.	1														1		1			2			
Gahnia aristata					1				2			1			2		2		1				
Gahnia decomposita	1	25	5			4		1			18	1									1		
*Galium ?*sp.										1								1					
Gastrolobium bilobum									1	1					1					1			
Gastrolobium calycinum					3					1					3		3		1	6			
Gastrolobium retusum						1																	
Gastrolobium sp.			1																				
Gastrolobium spinosum			2		22	6	6	3	22	23	3		4	6	26		10		5	33	13	7	4
Gastrolobium villosum					14		4	15	15	15		3	2	6	29		8		4	9			1
Glischrocaryon aureum					4	1			1	1				2	2		8	1	1	2	1		

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Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Glishrocaryon sp.										1													
Gompholobium capitatum																				1			
Gompholobium cyaninum			3		40	3	5	3	2	9		1	3	13	69	1	27	2	7	32		1	1
Gompholobium knightianum			6		43	5		19	3	10	1	1	7	45	238	3	291	5	14	86	7	2	
Gompholobium marginatum	10	40	70		150	45	14	15	9	19	5	19	47	43	121	2	116	7	19	144	20	12	16
Gompholobium polymorphum		2	5		10	4	1	2		3		2	2	6	21		26	4	5	30	2	2	2
Gompholobium preissii																	1						
Gompholobium scabrum		1	1		1	1							1							2			
Gompholobium sp.					1					1					2		5	3		5			
Gompholobium tomentosum			6		13	2	2		9	1		1		1	5	1	18		6	18	2		
Goodenia pulchella									2	1													
Goodeniaceae sp.					4				1					4	9	1	11		1	4			
Grevillea bipinnatifida		5	5		5	2	30	4	33	29	1	3	4	7	33	1	11			2	1	1	
Grevillea diversifolia	1								4	5	2	2								2			
Grevillea diversifolia subsp. *diversifolia*		2			3						5	2										1	
Grevillea manglesii subsp. *manglesii*			1						2														
Grevillea monticola					1					2													
Grevillea pulchella	1		4		39	8	1	10	7	13	2	3	6	19	62		36	1	8	29	5		1
Grevillea pulchella subsp. ascendens		1	2		30	3	6	7	5	14	1		1	7	44		20		4	13	2		1
Grevillea quercifolia					1										1	1							
Grevillea sp.													1		1								
Grevillea wilsonii		2	1		38	5	5	18	2	11	1	4	4	108	484	4	563	28	94	14	9		4
Grevillea bipinnatifida							1			4													
Grevillea quercifolia							1														1		
Haemodorum laxum					2			1	1	1					4				1				
Haemodorum sp.		1	3		14	3		1	1	1				4	23		17		1	8			
Haemodorum spicatum																	1						
Hakea amplexicaulis		3	3							4				1	5		4	1		13	2		
Hakea ceratophylla	11	1	3												1				1				
Hakea cyclocarpa			2		8				3	2			1	2	19	1	14	2	3	6	1		
Hakea gilbertii			1		1						1				1								
Hakea incrassata		1						1					1	2						1			
Hakea lissocarpha	2	10	21		139	21	15	18	16	49	8	17	57	38	77		62	5	6	227	43	16	23
Hakea marginata											1												
Hakea petiolaris									2	2													

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Hakea petiolaris subsp. *petiolaris*					1																		
Hakea prostrata	7	7	18		14	23	2		2	2				1	3		2		1				
Hakea ruscifolia		2			38	5	6	5	2	11			10	19	77	2	95	1	8	46	9	1	5
Hakea sp.	1								3						1					1			
Hakea stenoptera					3			1							7		2						
Hakea sulcata			1																				
Hakea trifurcata	1	4	3	1	5	2	1		13	3					1					3			
Hakea trisperma								1															
Hakea undulata	1	3	5		11	2	9	12	27	29	1	2	2	5	19		4			7	1		
Hardenbergia comptoniana															3		1		1	5	1		
Hemiandra pungens			1		10	3	2		1	2				1	22	1	8		1	2			
Hemiandra sp.					3	1			1	1			2	1	6	1	1						
Hemigenia incana					1		2		4				1										
Hemigenia pritzelii	1	7	6		17	5	1	1	1	4		2	2	7	35		11	1	1	10	3	1	2
Hemigenia sp.							1										2		1				
Hibbertia acerosa		4	3		13	7	3	2	1			2	25	22	46		55	14	4	73	23	5	10
Hibbertia amplexicaulis	1	8	11		86	18	7	6	4	23	3	14	68	52	124		338	70	71	486	134	61	116
Hibbertia commutata	3	4	11		150	21	12	10	20	51	4	18	84	97	361	4	787	91	119	623	190	64	121
Hibbertia huegelii		1	10		8	2	1					1	11	12	36		73	5	7	92	4		1
Hibbertia hypericoides		4	21		193	19	9	19	10	32		7	20	45	211	3	210	6	27	207	16	17	6
Hibbertia lasiopus															1		5	1		3			
Hibbertia perfoliata		7	7		46	6	1	1	4	18	4	8	20	13	56	1	119	18	7	131	72	28	37
Hibbertia quadricolor										1			2	1	2		4		2	1			
Hibbertia silvestris													1					1					
Hibbertia sp.		2	2		1	1						1	1	1	4		9			6	6		1
Hibbertia stellaris		2	7			2																	
Hovea chorizemifolia	1		5		32	1	2	1	1	9	1	3	14	27	100		280	40	35	225	42	10	28
Hovea elliptica		1			7	3		1				3	1		1		3	1	1	10	2		3
Hovea sp.					4										2		3			1			1
Hovea trisperma	2	4	16		52	3	2	7	3	14		2	8	17	58	3	103	6	8	62	18	9	12
Hovea trisperma var. *grandiflora*			1		3			1		1		1	1	5	6		22	9	1	11	3	4	8
Hyalosperma cotula			1						2														
Hybanthus floribundus			1		1			3	1		1	1	1	2	8		6			4	1		
Hypocalymma angustifolium	31	85	132	1	138	62	25	21	46	49	18	21	145	198	59	1	64	6	11	26	20	22	12
Hypocalymma cordifolium		2	1		2	1	2		1				1	2	9		9	1	2	2			

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Hypocalymma robustum		7	9		2	1		3					1	1	4		2			4			
Hypolaena exsulca	8	35	59		27	9	1	2	2		2	3	1	4	8	1	8			2		1	173
Iridaceae sp.		2																					
Isolepis cernua			1																				
Isopogon dubius					2				1	1							6		2	1			
Isotropis cuneifolia subsp. *cuneifolia*																				2			
Jacksonia furcellata		1	7		2					1							1			2			
Johnsonia lupulina					2		1	1						2	7	1	7			4			
Juncus sp.											1												1
Kennedia coccinea		2	7		116	8	4	8	2	22	2	9	25	43	277	2	516	28	64	391	101	41	55
Kennedia prostrata	4	21	45		98	27	7	4	9	10	2	9	24	29	57	2	110	6	13	101	15	16	9
Kennedia sp.					2																		
Kingia australis	1	1						43	2	1							2			1			
Kunzea ?micrantha subsp. *micrantha*																		1					
Kunzea micrantha		1																					
Kunzea recurva	1	10	8		27	6	5	2	11	5	2	2	2	4	11		8		2	8	1	1	
Kunzea sp.					1	1	1								3		1			1			
Labichea punctata					2					1					2		6			2			1
Lagenophora huegelii	8	16	27		113	21	4	1	14	33	14	20	73	50	90	1	156	57	48	417	191	93	118
Lasiopetalum floribundum		10	2		29	2	3	4	6	18	15	17	33	50	174	3	392	79	49	432	216	88	163
Lasiopetalum glabratum			1		17		2	8		6			2	12	63		58		11	18			2
Lasiopetalum sp.			1		1					2				1	7		11		1	1			
Laxmannia sessiliflora									1	1													
Laxmannia sessiliflora ? subsp. australis					1																		
Laxmannia sp.			1		1				2	3				2	4	1							
Laxmannia squarrosa					3					1													
Lechenaultia biloba		6	19		69	9	6	9	2	14		5	23	29	149		204	16	35	120	20	6	8
Lepdosperma gracile													1	2	1		4						
Lepidobolus preissianus									1														
Lepidosperma asperatum sens. lat.		1	4		2	1				3				1	6		1						
Lepidosperma gracile sens. lat.					1					1							2	1					
Lepidosperma leptostachyum			1																				
Lepidosperma longitudinale sens. lat.	1	2	1				1				1												
Lepidosperma pubisquameum sens. lat.	1	1	5		13	1	2	1					3	3	10	1	21		1	6	1		
Lepidosperma sp.	12	23	42	1	60	13	4	5	9	9	3	5	13	33	129	2	218	12	15	118	8	2	10

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Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Lepidosperma sp. (flat)					1										1		1		1				
Lepidosperma sp. (terete)															1		1		2				
Lepidosperma squamatum sens. lat.	3	13	24		58	9	6	9	3	8	1		5	15	95	2	108	4	7	41			2
Lepidosperma tenue	1		6		6	2			1	3				2	4		2	1	1	3	1		
Lepidosperma tetraquetrum	1	11			2					1	15	3										1	
Leptocarpus coangustatus											1				1								
Leptocarpus scariosus		2									4												
Leptomeria cunninghamii	1	1	5		8	4		2	4	5			8	6	11		26	2	2	29	4	1	3
Leptospermum erubescens	5	2	3		32	14	6	4	15	21	1	1	5	13	76		25	1	6	7			
Lepyrodia macra		2	1																				
Lepyrodia riparia					1																		
Leucopogon ?tenuis					1			2						1	5		1			1			
Leucopogon australis	2	5	8		1	2				1			1		1	1	2	1		1	3	1	
Leucopogon capitellatus		1	5		21	1	1	1	2	9	1	5	8	2	14		49	14	9	97	50	24	37
Leucopogon glabellus						1	1			2										1			
Leucopogon nutans		1			2										1					1			
Leucopogon propinquus										1	1						3						
Leucopogon sp.		1			1			2							2						1		3
Leucopogon verticillatus		3	1		3	1				1	1		3	1	7		14	15	1	47	37	8	39
Levenhookia pusilla					2				3	4		1			1					5			
Lindsaea linearis		8	34		25	9	2	8			2	3	6	7	12	1	6			14			
Lococarya cinerea							1			1					1		2						
Lomandra sonderi																							1
Lomandra ?caespitosa		2	1		2									1	3		7			2	1	1	1
Lomandra ?drummondii																	2						
Lomandra ?hermaphrodita					1												2	1			1		
Lomandra ?nigricans																				1			
Lomandra ?odora					1				1						5		6		1	6	3		1
Lomandra ?preissii														2	1		4		1				
Lomandra ?spartea																				1			
Lomandra britannii																				2		1	
Lomandra caespitosa		8	2		17	6		1		3	1	2	5	7	20		54	5	6	54	25	10	9
Lomandra drummondii			1		2					6		1	1	1	2		6		3	13	13	8	13
Lomandra effusa															1								
Lomandra hermaphrodita	1	8	33		151	24	9	22	4	29	4	8	36	82	347	9	597	43	72	293	58	12	30

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

Note: * denotes introduced species, P3 denotes Priority 3 species.

	Site-vegetation Types based on recording sites																					
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Lomandra integra															1		5		1				
Lomandra micrantha					3					1				4	9		18	1	1	7	4		1
Lomandra micrantha subsp. micrantha			2		12					1			9	1	11		27	4	2	20	5	7	6
Lomandra nigricans			1		3	1							3	6	19		41	4	10	59	13	6	9
Lomandra preissii		1	1		6			2				1	1	4	15		32	4	3	25	14	5	6
Lomandra purpurea														1	4		2			3	1		1
Lomandra sericea					2							1		4	8		12	4	4	2	3	7	10
Lomandra sonderi		9	17		127	18	8	10	1	16	4	12	46	115	479	8	1022	102	124	641	146	42	89
Lomandra sp.	2	18	26		80	15	6	6	3	9	7	6	23	33	135	3	259	22	28	245	64	22	34
Lomandra spartea		3	3		83	8	3	8	5	19	3	7	31	73	262	1	388	16	52	308	39	7	16
Lomandra suaveolens								1															
Loxocarya cinerea		6	22		19	4		1	1	2	4	3	13	14	72	2	130	7	18	88	10	5	15
Lyginia barbata	3				1	1			2					1	1		1		1	1	1		
Lyginia imberbis		4	7		1										1								
Lysinema pentapetalum						1																	
Macrozamia riedlei	1	10	22		190	17	9	5	28	74	22	41	87	56	203	1	498	125	100	792	302	141	205
Marianthus drummondianus																							1
Marianthus sp.		1	12		1					1				4	10		14	1	1	1			
Melaleuca ?lateritia	5		6						1														
Melaleuca ?parviceps			1		3		1		4	3					1								
Melaleuca ?trichophylla										1					2								
Melaleuca ?viminea	1																						
Melaleuca armillaris subsp. armillaris	1																						
Melaleuca incana subsp. incana					2						1												
Melaleuca parviceps			2		1				1														
Melaleuca pauciflora	1	2	2								1												
Melaleuca preissiana	36	117	153	1	3	28	3	1	1		6			1	4		2			1			
Melaleuca rhaphiophylla	5	10	4		2			1			2												
Melaleuca sp.		6	5			1	1		3	1		1	1	1	3		1		1				
Melaleuca trichophylla													1										
Melaleuca viminea		1																					
Mesomelaena gracilis		1			4					2				1	4		3			1			
Mesomelaena tetragona	9	36	69		48	18	12	14		4	3	1	2	2	9				1	2			
Millotia tenuifolia									6	2										1			
Mirbelia dilatata	2	18	3	1	15	4	2	2	9	10	26	18	15	5	13		10	5	5	47	21	19	23

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

Note: * denotes introduced species, P3 denotes Priority 3 species.

	Site-vegetation Types based on recording sites																					
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Monotaxis occidentalis		2			1		1		1	1			1	2	1			1					
Myrtaceae sp.		1			1					1				1			1			1			
Neurachne alopecuroidea	1	7	7		39	6	1	6	7	10		2	3	15	39	4	39	1	5	27	9	1	5
Nuytsia floribunda	8	20	25		18	6	2	3	9	4	1	1			2		2	1		2			
Olearia paucidentata									1														
Opercularia apiciflora		1	1		6	1								3	2		5		1	4		1	
Opercularia echinocephala	1	19	31		202	25	7	12	6	35	10	17	74	68	260	3	577	61	71	551	169	71	89
Opercularia hispidula														1									
Opercularia sp.					2	2						1		1			4	2	2	8	3	3	5
Opercularia vaginata					1										2		1			1			
Orchidaceae sp.	1	4	8	1	25	5	1		2	4	2	1	16	19	52	1	81	8	6	80	21	13	14
Orchidaceae sp. 1										1			1		1			1		2	1		
Orchidaceae sp. 2										1			1		1			1		2	1		
Orianthera serpyllifolia														1			3		1	4	5		
Orthrosanthus laxus					1																		
Oxalis sp.			1							1	1	1			1		1	1	1	2	1	8	5
Paraserianthes lophantha		6				1					3	1	1	1	5		18		3	8	5	1	3
Patersonia juncea	2	3	2		1					3	1				4				1				
Patersonia occidentalis	6	6	20		81	14	11	5	2	26	1	3	21	38	131	2	172	13	42	131	27	4	13
Patersonia pygmaea	2	7	11		15	8		4	1		1	2	5	13	40		47	2	2	30	8	1	3
Patersonia rudis	2	3	5		71	2	3	6	3	9	1		9	25	108	3	103	5	12	68	12	1	6
Patersonia sp.					1									2	6		6						
Pauridia sp.					5							1			1								
Pelargonium littorale	2																			1	5	3	2
Pentapeltis peltigera	1	9	12		97	15	4	6	1	17	7	12	48	66	181	1	367	48	45	274	80	33	64
Pericalymma ellipticum	17	40	57		33	15	9	8	3	5	1	1			18	1	7	3		5	3		1
Persoonia angustiflora										1				1	1					1			
Persoonia elliptica					13	1	1	1		4		2	9	13	71	2	281	25	38	128	38	4	11
Persoonia longifolia		4	13		131	19	4	3	4	23	3	11	67	74	165	4	560	70	79	500	161	84	130
Persoonia saccata					1					1							1						
Petrophile serruriae					7	1	3	4	5	4					13		4			6			
Petrophile sp.																	1						
Petrophile squamata					2				1						3								
Petrophile squamata subsp. *squamata*					2	2											1		1	1			
Petrophile striata					6					4				3	3		8		1	8			

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

Note: * denotes introduced species, P3 denotes Priority 3 species.

	Site-vegetation Types based on recording sites																					
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Pheladenia deformis	1								2	1										2	2		
Philotheca spicata		6	13		20	6	1			2		1	3				8	1	1	7	1		2
Phyllanthus calycinus	2	7	4		105	14	5	1	18	48	9	25	88	69	126		332	78	61	397	157	63	75
Pimelea ?imbricata														1									
Pimelea ?suaveolens										1					1		1						
Pimelea ciliata										1			1				1			1	3		3
Pimelea lehmanniana subsp. *nervosa*									2	3		1	1							11	2	1	
Pimelea sp.					3				2	3		1	2	1	12		4		1	11	1	1	1
Pimelea suaveolens		1	3		43	6	2	1	8	14		4	23	31	71	2	168	15	18	91	28	8	15
Pinus pinaster					1						1			1	3		5		2	2			
Platysace compressa		15	24		96	12	2	2	2	22	16	23	41	43	186	3	569	83	75	503	166	69	120
Platysace tenuissima			3		2								1				8			4			2
Platytheca galioides					3										2								
Poaceae sp.		14	15		35	5	6	1	6	7	10	9	11	19	46		53	20	13	89	35	18	24
Podolepis lessonii									1														
Podolepis sp.																				1			
Prasophyllum sp.		1			5	2				2				5	8		37	1	1	4	1		
Proteaceae sp.															1								
Pteridium esculentum	1	16	3		6	2			2	2	27	19	1		3		8	67	4	14	111	108	157
Pterochaeta paniculata		1	1		4	2			3	1			1	1	3		5						
Pterostylis recurva						1							1	1			3		1	3	2		
Pterostylis sp.		1	2		6	1	1		4	1	1	3	2	10	47		64	4	6	51	12	5	7
Ptilotus drummondii																	2						
Ptilotus manglesii	12	9	13		48	6	5	8	5	6		5	14	33	117	2	95	8	11	49	6	11	5
Pyrorchis nigricans			2		8					2	1	2	3	3	15		32	5	9	26	6	2	7
Ranunculus colonorum															2		2		2	8	7	3	
Restio sp.			1								2			1		1				2	1		
Restionaceae sp.		2	3		2	2					2				1			1	1				1
Rytidosperma caespitosum		2			11	2	1		2	6		4	3		7	1	18	2		14	5	4	4
Santalum acuminatum									1														
Scaevola calliptera		10	21		61	7	3	7	4	15	2	5	15	25	119	2	175	13	26	140	37	14	21
Schoenus clandestinus	1	1	4		6		2	2		1				1	3								
Schoenus sp.	1	1	1																				

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

Note: * denotes introduced species, P3 denotes Priority 3 species.

	Site-vegetation Types based on recording sites																						
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Senecio diaschides			1		9				2	1	1	1	3		6	1	11	2	1	10	3	12	16
Senecio hispidulus					5							2	1	3	2		5	1	2	7	3	3	4
Senecio quadridentatus	1											1	2		1		5		1	2	3		2
Senecio sp.	1	3	5		13	4			3	3	2	2	4	1	8		15	4	4	23	18	14	11
Sowerbaea laxiflora										1													
Sphaerolobium medium		3			10				2	1		1	3	1	8		16		3	16	2	1	2
Stackhousia monogyna									7	1													1
Stenanthemum nanum															1								
Stirlingia latifolia	2	3	20		14	6			1				1	3	25	12	23		1	10			1
Stirlingia simplex			1											2	4	1	6						
Stphelia discolor					1																		
Stylidium ?hispidum																	1						
Stylidium ?junceum			2																				
Stylidium ?lateriticola									1	1					2								
Stylidium ?thesioides		2			1			1												1			
Stylidium affine																				2			
Stylidium amoenum	2	5	9		47	4	2	5	2	31	3	4	9	27	121		211	19	32	227	50	12	23
Stylidium androsaceum					2				1	2		1					1			2	2		2
Stylidium bulbiferum			1		1					1				1	2		4			5	1		1
Stylidium calcaratum									3								1				1		
Stylidium diuroides									1					1	5		2			2	1		
Stylidium emarginata									1														
Stylidium hispidum		1	4		34	1	1	3	3	4		2	14	17	62	1	87	10	18	72	8	2	2
Stylidium junceum		3	2		12	2	2	2		1				7	28	1	45		4	9			
Stylidium lateriticola																		1					
Stylidium lineatum					1										1	1	1			1			
Stylidium piliferum	1	6	11		111	17	5	4	6	29	1	7	40	73	251	1	385	21	66	397	56	15	27
Stylidium repens			1			2		1	3	2							1						
Stylidium schoenoides					2												5	1	1	1	2		
Stylidium sp.	2	2	10		13	6	4	3	3	2			3	10	27	1	19	1	2	19		1	1
Stylidium ?diuroides									2						1								
Stypandra glauca									4														
Stypehlia sp.																	2						
Styphelia ?epacridis					1		1	1									1			1			
Styphelia ?propinqua			1										1		1		2	3	1	4	2		3

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	Site-vegetation Types based on recording sites																					
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Styphelia discolor	1	6	12		44	8	4	3	3	14	6	2	12	16	27		45	4	11	75	18	10	14
Styphelia erectifolia					2				4	1							1			2			
Styphelia nitens		7	8		17	9	2			11	1	7	14	17	33		54	15	12	80	10	5	15
Styphelia pallida		3	2		20	5	2	2	4	2	1	2	5	8	14		8	5	1	38	16	11	10
Styphelia propinqua		1	5		28	2		1		6	1	1	9	10	26	1	38	15	17	55	32	7	23
Styphelia sp.	1	1	1		3		1			1		1		1	9		11			9	3		1
Styphelia stricta					1				2														
Styphelia tenuiflora	1	3	5		60	5	6	4	2	13			19	30	139	4	250	6	22	129	13	5	8
Synaphea ?petiolaris							1								1								
Synaphea cuneata		1	1		1									1	2								
Synaphea gracillima	1		3		5	1	3	2		1						1							
Synaphea petiolaris		5	3		9	2		7		2			1	7	23	1	26	1	2	6			
Synaphea propinqua																			1				
Synaphea sp.	4	10	20		13	7	2	7	4	2		1	1	9	33		21		2	2			
Synaphea petiolaris subsp. *petiolaris*		4	1		3		1		1				1	1	7		6		2	3			
Syphelia pallida										1													
Taxandria linearifolia	5	71	27	1	5	15	1	3		1	59	6		7	7		5	1	1	3			
Tetraria octandra															1								
Tetraria sp. Jarrah Forest (R. Davis 7391)	5	27	48		237	44	18	12	8	58	12	31	69	111	412	2	672	71	102	575	125	55	93
Tetrarrhena laevis	2	9	8		47	9	2	3	4	15	13	12	26	21	80		220	38	33	162	74	31	53
Tetratheca hirsuta	1	13	4		48	10	3	4	2	11	6	5	23	34	101		274	36	40	214	69	16	37
Tetratheca sp.															1								
Thelymitra anterifera									2														
Thelymitra crinita																				3			
Thelymitra sp.									1						1								
Thomasia glabratum					1																		
Thomasia paniculata		22	1	1	1	1					21	1		2	4		1			3		1	
Thsyanotus thyrsoides																	1						
Thysanotus dichotomus	1								1		4	2		2	7		18	2	3	7	7	3	2
Thysanotus fastigiatus		1	2		8	1				2	1	2	4	14	65		112	18	9	34	10	6	13
Thysanotus manglesii	1				2				1	2	1	4	1		2		5	1		6	4	10	6
Thysanotus multiflorus		2	1		7					3		2	3	11	28		58	2	7	23	13	4	7
Thysanotus patersonii	1									1							1		1		1		1
Thysanotus scaber	1									1										2	6		
Thysanotus sp.	1		2		1	4		1	1	1	1	1	3	4	13		16	3	2	9	8	3	2

APPENDIX I: SUMMARY OF VASCULAR PLANT SPECIES BY RECORDING SITES IN MYARA NORTH SURVEY AREA

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	Site-vegetation Types based on recording sites																					
Species	A	AC	AD	AW	D	DA	DG	E	G	R	CW	W	SW	PW	P	PJ	PS	PT	SP	S	ST	T	TS
Thysanotus thyrsoideus			1		6				1	2		4		1	5		15	2	2	9	7	2	4
Thysanouts fastigiatus																		1					
Trachymene pilosa		1	2		6	2			6	9	1	2	5		1	2	8	1		8	16	4	11
Tribonanthes australis	3	4			2				3														
Trichocline spathulata		1	2		89	4	7	11	2	20	1	5	24	89	356	3	705	68	80	366	78	20	49
Tricoryne elatior	1	2	1		1										1					1			
Tricoryne sp.					5	2		1		1				1									
Tripterococcus brunonis		1			7	1	1	1	3	3			1	1	7		3			3	1		
Trymalium ledifolium	2	11	15		63	13	5	21	29	27	9	9	21	58	251		430	36	27	227	31	10	18
Trymalium odoratissimum	5	9	4		23	4	1	2	20	37	38	33	19	4	3		14	8	1	53	44	34	31
Utricularia multifida	2								1														
Verticordia densiflora							1		1		1			1	1								
Verticordia pennigera									1	1													
Verticordia plumosa	1	2					4		27	4					1					1			
Verticordia plumosa var. *plumosa*			1				1			1													
Verticordia sp.			1						1						1								
Viminaria juncea	2	4	3			1									1								
Wurmbea sp.		3	2		1				4														
Xanthorrhoea gracilis	1	30	34		161	25	11	14	5	44	12	13	54	77	293	4	437	59	91	576	143	67	111
Xanthorrhoea preissii	32	96	139	1	326	74	37	28	56	98	34	45	100	98	292	4	292	45	62	569	104	47	56
Xanthosia atkinsoniana		1	4		42	9	1	5	8	15	5	4	22	26	171	1	323	33	47	250	81	28	35
Xanthosia candida	4	15	20		142	20	7	16	10	37	9	19	37	89	327	4	493	27	47	273	91	45	50
Xanthosia ciliata					1								2				1			1	1	2	
Xanthosia huegelii	1	15	24		60	15	8	1	2	10	4	4	16	13	35	1	51	7	7	79	18	17	12
Xanthosia sp.		1				1				1	1		1	2	3		3			4	1	4	3
Xylomelum occidentale		1	9		30	18				1		1	2	3	8		9		2	7	1		

APPENDIX J1: SUMMARY OF DENSITY ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: All data is plants/m^2 and rounded to 2 decimals places (so if 0.00 then value is < 0.01)

	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Acacia alata		0.01			0.03				0.01									
	Acacia applanata																		
	Acacia barbinervis																		
	Acacia browniana	0.01						0.13	0.49		0.31								
	Acacia celastrifolia																		
	Acacia divergens																		
	Acacia drummondii	0.04		0.01			0.05										0.08		0.01
	Acacia extensa												0.01						
	Acacia lateriticola	0.01					0.06		0.36	0.01				0.08		0.06	0.14		
	Acacia nervosa																		
	Acacia preissiana								0.05		0.66								
	Acacia pulchella	0.01													0.01				
	Acacia saligna																		
	Acacia sp.						0.01												
	Acacia stenoptera																		
	Acacia urophylla																		
	Acacia varia																		
	Acacia willdenowiana			0.29		0.01	0.04												
	Acacia drummondii subsp. candolleana																		
	Adenanthos barbiger		0.01	0.03		0.98	0.64		0.04	0.56		1.68			0.45		0.50		0.01
	Agrostocrinum scabrum														0.15	0.01			
	Aira caryophyllea													0.01					
*	*Allocasuarina fraseriana*					0.03					0.03	0.01				0.26			
	Amphipogon amphipogonoides				0.01	0.18							0.03	0.20	0.19	0.25	0.03	0.14	0.06
	Andersonia lehmanniana																		
	Anigozanthos manglesii																		
	Aotus cordifolia																		
	Aphelia cyperoides																		
	Astartea scoparia																		
	Asteraceae sp.																		
	Austrostipa eleganthissima																		
	Austrostipa mollis																		
*	*Austrostipa sp.*																		
	Babingtonia camphorosmae																		
	Banksia bipinnatifida																		
	Banksia dallanneyi subsp. dallanneyi var. dallanneyi	0.01		0.06	2.20	0.53	0.10	0.31	0.09	0.01	0.35		0.04		0.45	0.65	0.65		
*	*Banksia fraseri*																		
	Banksia grandis					0.01	0.06		0.01	0.35		0.60	0.03		0.08	<000.1	0.10		
	Banksia sessilis						0.03												
	Banksia sphaerocarpa																		
	Banksia grandis (seedling)																		
	Banksia littoralis																		
	Billardiera floribunda																		0.05
	Billardiera sp.1																		
	Billardiera variifolia														0.06	0.08			

APPENDIX J1: SUMMARY OF DENSITY ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: All data is plants/m^2 and rounded to 2 decimals places (so if 0.00 then value is < 0.01)

	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Billardiera fraseri																		
	Billardiera fusiformis																		
	Boronia crenulata																		
	Boronia crenulata subsp. viminea																		
	Boronia fastigiata	0.19	0.48	0.29	0.04	0.16	0.13	0.18	0.10	0.09	0.26	0.24	0.09	0.03	0.14	0.04	0.05	0.01	
	Bossiaea aquifolium							1.28	0.08	2.13	0.09				0.01		0.79	0.44	0.45
	Bossiaea ornata			0.46		0.53	0.01				0.73	0.20	0.01		0.33	0.24	0.01		0.23
	Bossiaea spinescens																		
	Bossiaea eriocarpa																0.01		
	Brachyscome pusilla																		
	Briza minor																		
	Burchardia congesta																		
	Caladenia flava														0.01			0.04	
	Caladenia macrostylis																		
	Caladenia reptans																		
	Caladenia sp.			0.05			0.01	0.03						0.01					
*	*Caladenia sp. 1*																		
	Calothamnus quadrifidus																		
	Calothamnus sp.																		
	Cassytha glabella																		
	Cassytha sp.																		
	Caustis dioica																		
	Centaurium erythraea																		
	Centrolepis aristata																		
	Chamaescilla corymbosa				0.05											0.34	0.06		
	Chorizema cordatum						0.03								0.05	0.01		0.03	
	Chorizema rhombeum								0.01										
	Clematis pubescens	0.12		0.08			0.08		0.03					0.55				0.38	
	Comesperma virgatum										0.01					0.05		0.01	
	Comesperma sp.																		
*	*Conospermum capitatum*																		
	Conospermum scaposum																		
	Conostylis aculeata																		
	Conostylis setigera	0.26		0.19	1.01	0.76	0.09	0.15	0.10	0.20	0.49		0.04						
	Conostylis setosa			0.05						0.01			0.10	0.01		0.05			
	Conostylis pusilla																		
	Conostylis serrulata	0.23			0.01										0.01	0.01	0.03		
	Corymbia calophylla	0.08	0.09	0.10	0.05	0.03	0.01	0.15	0.13		0.24		0.15	0.34	0.16	0.04	0.28	0.21	
	Corymbia calophylla (seedling)																		
	Craspedia variabilis																		
	Cryptandra arbutiflora var. arbutiflora																		
	Cryptostylis ovata																		
	Cyanicula sericea																		
	Cyathochaeta avenacea	0.01		0.41	0.18				0.01	0.10		0.01	0.71		0.01			0.01	0.01
	Cyperaceae sp.																		

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	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Cyrtostylis robusta																	0.13	
	Dampiera alata																		
	Dampiera hederacea																		
	Dampiera linearis					0.06							0.01		0.04				
	Dasypogon bromeliifolius																		
	Daucus glochidiatus																		
	Daviesia decurrens					0.00													
	Daviesia horrida																		
	Daviesia preissii																		
	Daviesia rhombifolia																		
	Desmocladus flexuosus			0.01	0.03	0.01						0.08							
	Desmocladus fasciculatus	0.01																	
*	*Dianella revoluta*					0.03	0.01								0.01				
	Disa bracteata																		
	Diuris longifolia																		
	Drosera bulbosa																		
	Drosera erythrorhiza		0.06	0.03	0.26		0.03	0.03	0.01			0.01	0.08	0.01					
	Drosera macrantha																		
	Drosera microphylla																		
	Drosera pallida			0.01									0.01	0.04	0.13	0.03	0.05		
	Drosera platystigma																		
	Drosera pulchella																		
	Drosera sp.	0.01	0.14			0.05	0.06		0.06					0.01	0.06	0.06	0.03		
	Drosera sp. (climbing)																		
	Drosera sp. 1																		
	Drosera sp. 2																		
	Drosera stolonifera						0.03												
	Elythranthera brunonis																		
	Erigeron sumatrensis																		
*	*Eriochilus dilatatus*												0.05						
	Eucalyptus marginata	0.23	0.41	0.30	0.15	0.14	0.16	0.39	0.56	0.23	0.35	0.38	0.58	0.73	1.14	0.66	0.65	0.45	0.43
	Eucalyptus marginata (seedling)																		
	Eucalyptus patens																		
	Eucalyptus patens (seedling)																		
	Eucalyptus sp.					0.04	0.14												
	Gahnia decomposita																		
	Gastrolobium spinosum																		
	Gastrolobium villosum																		
	Glischrocaryon aureum																		
	Gompholobium cyaninum				0.04														
	Gompholobium knightianum			0.19			0.04								0.08				
	Gompholobium marginatum			0.04	0.01		0.03					0.04							
	Gompholobium polymorphum	0.01		0.04					0.03						0.05	0.01	0.01		
	Gompholobium preissii															0.04			
	Gompholobium sp.									0.01									

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	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
*	*Gompholobium sp.1*																		
	Gompholobium tomentosum																		
	Gonocarpus cordiger																		
	Gonocarpus sp.																		
	Goodenia sp.1																		
	Goodenia trinervis																		
	Grevillea bipinnatifida																		
	Grevillea pulchella																		
	Grevillea quercifolia																		
	Grevillea synapheae																		
	Grevillea wilsonii						0.03									0.23			
	Haemodoraceae sp.																		
	Haemodorum laxum															0.01	0.03	0.01	
	Haemodorum sp.				0.01	0.03				0.03	0.06								
	Haemodorum sp. 1																		
	Haemodorum sp. 2																		
	Haemodorum spicatum																		
	Hakea amplexicaulis					0.10													
	Hakea cyclocarpa																		
	Hakea lissocarpha															0.03			
	Hakea prostrata																		
	Hakea ruscifolia															0.01			
	Hakea varia																		
	Hemiandra pungens																		
	Hemiandra pungens																		
	Hemigenia pritzelii				0.28														0.01
	Hibbertia acerosa				0.85	0.03	0.21	0.01		0.36	0.21	0.01	0.16						
	Hibbertia amplexicaulis		0.04			0.14	0.70		0.01	0.15	0.15	0.40	0.20	0.16	0.31	0.21	0.14	0.35	
	Hibbertia commutata		0.01	0.03		0.80	0.88	0.05	0.04	0.18		0.59	0.04	0.03	0.24	0.21	0.14	0.14	
	Hibbertia commutata (seedling)																		
	Hibbertia huegelii					0.01								0.05					
	Hibbertia hypericoides					0.05													
	Hibbertia lasiopus							0.03			0.05								
	Hibbertia lineata																		
	Hibbertia ovata					0.06							0.09		0.01				
	Hibbertia perfoliata					0.18						0.05							
	Hibbertia quadricolor												0.05						
	Hibbertia racemosa												0.01						
	Hibbertia sp.																		
	Hibbertia striata																		
	Hovea chorizemifolia	0.04	0.10	0.58	0.05		0.03	0.04	0.16	0.01	0.11	0.08	0.05		0.05	0.01	0.03	0.04	0.03
	Hovea trisperma																		
	Hyalosperma cotula																		
	Hybanthus calycinus												0.06		0.01			0.11	
	Hybanthus floribundus											0.34	0.01						

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	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Hybanthus floribundus subsp. floribundus																		
	Hydrocotyle callicarpa													0.98		0.15			
	Hypocalymma angustifolium													0.64					
	Hypochaeris glabra													0.01					
	Hypolaena exsulca																		
	Isolepis marginata																		
	Isotropis cuneifolia																		
	Jacksonia alata																		
	Juncus bufonius																		
	Kennedia coccinea											0.08			0.01				
	Kennedia prostrata																		
	Kingia australis																		
	Kunzea glabrescens																		
	Kunzea recurva																		
	Labichea punctata												0.04		0.09	0.11			
	Lachnagrostis filiformis																		
	Lagenophora huegelii		0.09				0.05	0.16	0.05	0.03				0.63	0.08		0.08		
	Lasiopetalum floribundum	0.09	0.74			1.20						0.86	0.01	0.03	0.90	0.06	0.15	1.76	0.13
	Lasiopetalum glabratum															1.18			
	Lasiopetalum glutinosum																		
	Laxmannia squarrosa																		
	Lechenaultia biloba	0.06	0.05				0.03	0.08	0.01		0.10		0.03				0.06		
	Lepidobolus preissianus subsp. preissianus																		
	Lepidosperma leptostachyum																		
	Lepidosperma longitudinale																		
	Lepidosperma pubisquameum																		
	Lepidosperma sp.																		
	Lepidosperma sp.1																		
	Lepidosperma squamatum												0.01						
	Lepidosperma tenue					0.25		0.13			0.16		0.01						
*	*Leporella fimbriata*																		
	Leptocarpus coangustatus					0.01													
	Leptomeria cunninghamii			0.00		0.04													
	Leptospermum erubescens																		
	Leucopogon australis																		
	Leucopogon capitellatus					0.01	0.08					0.04			0.18	0.03	0.04		0.01
*	*Leucopogon parviflorus*																		
	Leucopogon sprengelioides																		
	Leucopogon verticillatus					0.13					0.01	0.06			0.04		0.00		
	Levenhookia pusilla				0.15			0.01						0.01		0.41			
	Levenhookia stipitata																		
	Lindsaea linearis																		
	Lobelia sp.																		
	Lomandra brittanii													0.01	0.01				
	Lomandra caespitosa	0.81	0.36	0.08	1.23	0.02	0.08	0.06	0.13	0.40	0.43	1.15	0.43	0.29	0.08	0.09	0.16	0.04	0.14

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Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Lomandra drummondii		0.29							0.01									
Lomandra hermaphrodita	0.35	0.15	0.36	0.03	0.15	0.34	0.15	0.21	0.05	0.24	0.08	0.10	0.10		0.36	0.04		
Lomandra integra																		
Lomandra micrantha														0.69	0.08	0.83		0.18
Lomandra micrantha subsp. micrantha																		
Lomandra nigricans			0.03									0.04	0.03			0.04		
Lomandra odora			0.10		0.04	0.01												
Lomandra preissii	0.51						0.16	0.13				0.03	0.01			0.01	0.28	
Lomandra purpurea						0.03												
Lomandra sericea		0.03													0.01	0.01		
Lomandra sonderi	0.08	0.19	0.11	0.03	0.06	0.20	0.16	0.43	0.11	0.04	0.28	0.55	0.10	0.13	0.44	0.39		0.08
Lomandra sp.				0.04	0.13						0.04		0.01			0.01		
Lomandra sp.1																		
Lomandra spartea		0.06	0.13		0.18	0.21	0.09		0.04		0.13	0.09	0.04	0.11	0.13	0.06		
Loxocarya cinerea				0.01				0.15		0.10	0.13	0.01			0.28			
Lysimachia arvensis																		
Macrozamia riedlei	0.06	0.06	0.04			0.04	0.11	0.11	0.04		0.03		0.14	0.10		0.05	0.29	0.03
Macrozamia riedlei (seedling)																		
Marianthus drummondianus																		
Melaleuca parviceps																		
Melaleuca preissiana																		
Melaleuca viminea																		
Melaleuca viminea (seedling)																		
Mesomelaena graciliceps																		
Mesomelaena stygia																		
Mesomelaena tetragona																		
Microtis media																	0.30	
Millotia tenuifolia				0.10									0.04					
Mirbelia dilatata																		
Monotaxis grandiflora													0.03					
Monotaxis grandiflora var. grandiflora																		
Monotaxis occidentalis																		
Neurachne alopecuroidea											0.04				0.13			0.01
Opercularia apiciflora														0.01			0.06	0.06
Opercularia echinocephala	0.04	0.45		0.06		0.01	0.04	0.13					0.03			0.03		
Opercularia hispidula																		
Opercularia sp.																		
Opercularia vaginata					0.01													
Orchidaceae sp.																		
Orchidaceae sp. 1																		
Orchidaceae sp. 2																		
Orianthera serpyllifolia		0.09												0.01				
Oxalis corniculata																		
Paspalidium sp.?																		
Patersonia babianoides														0.03	0.01	0.04		

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	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Patersonia juncea																		
	Patersonia occidentalis								0.01				0.01			0.13	0.08		
	Patersonia pygmaea								0.03										
	Patersonia rudis															0.01			
*	*Pentapeltis peltigera*	0.03	0.19	0.04	0.24	0.49	0.54	0.39	0.08	0.34	0.51	0.94	0.36	0.20	0.73	0.45	0.41	0.14	
	Pericalymma ellipticum				0.01														
	Persoonia elliptica												0.00						
	Persoonia longifolia					0.10	0.01			0.01		0.01	0.06	0.06	0.21	0.01	0.01	0.01	
	Persoonia longifolia (seedling)																		
	Persoonia sp.																		
	Petrophile macrostachya																		
	Philotheca spicata							0.01				0.01							
	Philydrella drummondii																		
	Phyllanthus calycinus	0.11	0.11	0.58	0.35		0.28	0.06	0.08		0.01	0.25	0.01		0.03	0.54	0.41		
	Pimelea ciliata																		
	Pimelea lehmanniana																		
	Pimelea sp.																		
	Pimelea suaveolens			0.06				0.01								0.03			
	Platysace commutata																		
	Platysace compressa	0.01	2.31					0.84	2.13		0.04			0.16	0.31		0.34		
	Platysace filiformis			0.45		0.01	0.01				0.03								
	Platysace tenuissima	0.04			0.34								0.18						
	Poaceae sp.																		
	Podolepis capillaris																		
	Podotheca angustifolia																		
	Podotheca gnaphalioides																		
	Poranthera microphylla															0.01			
	Prasophyllum elatum																		
	Prasophyllum sp.																		
	Prasophyllum sp.1																		
	Pseudognaphalium luteoalbum				0.15														
	Pteridium esculentum		0.10		0.01	0.01												0.24	0.43
	Pterochaeta paniculata										0.03								
*	*Pterostylis barbata*																		
*	*Pterostylis pyramidalis*																		
*	*Pterostylis recurva*												0.04						
	Pterostylis sp.																		
	Pterostylis sp. 1																		
	Pterostylis vittata												0.04						
	Ptilotus drummondii				0.18														
	Ptilotus drummondii var. drummondii																		
	Ptilotus manglesii																		
	Pyrorchis nigricans															0.03			
	Ranunculus colonorum																		
	Restionaceae sp.																		

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	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Rytidosperma acerosum																		
	Rytidosperma caespitosum															0.19			
	Rytidosperma setaceum																		
	Rytidosperma sp.																		
	Scaevola calliptera	0.01		0.03	0.03	0.11						0.01			0.03		0.03		0.04
	Scaevola pilosa																		
	Scaevola sp.																		
	Senecio diaschides																		
	Senecio hispidulus													0.06					
	Senecio quadridentatus																		
	Senecio sp.																		
	Senecio sp.1																		
	Sonchus oleraceus																		
	Sowerbaea laxiflora					0.01													
*	*Sphaerolobium linophyllum*																		
	Sphaerolobium macranthum																		
	Sphaerolobium medium														0.01				
	Sphaerolobium sp.																		
	Stackhousia monogyna																		
	Stirlingia latifolia																		
	Stylidium amoenum		0.04	0.14	0.09		0.09									0.03	0.05		
	Stylidium androsaceum						0.03												
	Stylidium brunonianum																		
	Stylidium bulbiferum																		
	Stylidium calcaratum		0.01						0.01					0.18					
	Stylidium ciliatum																		
	Stylidium hirsutum																		
	Stylidium hispidum															0.10			
	Stylidium junceum										0.04		0.01			0.01			
	Stylidium lateriticola																		
	Stylidium lineatum																		
	Stylidium piliferum		0.65			0.01	0.05	0.05	0.10							0.01			
	Stylidium recurvum																		
	Stylidium repens																		
	Stylidium rhynchocarpum																		
	Stylidium scabridum																		
	Stylidium scariosum																		
	Stylidium schoenoides					0.01													
	Stylidium sp.																		
	Stylidium sp. 1																		
	Styphelia discolor														0.01				
*	*Styphelia hispida*																		
	Styphelia nitens		0.03			0.01		0.03	0.03	0.01	0.04	0.04			0.01				
	Styphelia pallida		0.03			0.14	0.08		0.03		0.03								
	Styphelia propinqua								0.01					0.01					0.01

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	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Styphelia tenuiflora	0.01				0.01	0.01			0.03			0.01		0.01	0.04	0.03		
	Synaphea sp.																		
	Taxandria linearifolia																		
	Tetraria capillaris	1.17	0.24	0.30	0.63	2.80	0.58	0.34	0.39	0.24		0.26	0.43	0.14	0.63	0.50	0.90	0.01	0.26
	Tetraria octandra				0.03											0.09			
	Tetraria sp. Jarrah Forest (R. Davis 7391)																		
	Tetrarrhena laevis	0.06	0.09	0.45		0.53	0.23	0.09	0.10		0.38	0.41	0.13	0.26	0.65	0.25	0.09	0.36	0.06
	Tetratheca hirsuta			0.03		0.10	0.14			0.10		0.30	0.03		0.33	0.09	0.06	0.01	0.05
	Thelymitra crinita						0.03						0.25	0.01	0.04		0.01		0.01
	Thelymitra macrophylla													0.03					
	Thelymitra sp.						0.04									0.01			
*	*Thomasia paniculata*																		
	Thysanotus ? scaber																		
	Thysanotus dichotomus					0.65	0.01												
	Thysanotus fastigiatus										0.04								
	Thysanotus manglesianus														0.01				
	Thysanotus multiflorus			0.11									0.03		0.01			0.05	
	Thysanotus patersonii																		
	Thysanotus sp.																0.01		
	Thysanotus sp.1																		
	Thysanotus sparteus																		
	Thysanotus tenellus	0.01	0.05					0.20	0.06		0.01								
	Thysanotus thyrsoideus	0.03			0.04	0.06	0.01						0.05		0.41	0.36	0.06	0.04	0.08
	Trachymene pilosa		0.11	0.18	0.20		0.01	0.20	0.14		0.20	0.09		0.86	0.10				0.11
	Trichocline spathulata	0.04	0.04		0.05	0.24				0.04		0.06	0.10	0.03	0.11	0.19			0.10
	Tricoryne elatior																		
	Tricoryne humilis																		
	Trifolium dubium																		
	Tripterococcus brunonis																		
	Trymalium ledifolium	0.20	0.21		0.43			0.48	0.05	0.04	0.25		0.06	0.03			0.14		
	Trymalium odoratissimum							0.04											
	Trymalium odoratissimum subsp. odoratissimum																		
	Utricularia multifida																		
	Vulpia myuros																		
	Wahlenbergia preissii																		
	Xanthorrhoea gracilis	0.04		0.11		0.06	0.35		0.05	0.21	0.04	0.39	0.50	0.03	0.25	0.45	0.09	0.03	0.04
	Xanthorrhoea preissii						0.14		0.01	0.01		0.14	0.03		0.08			0.04	
	Xanthosia atkinsoniana	0.01		0.28				0.09		0.04		0.05	0.04						0.01
	Xanthosia candida				0.06	0.03					0.04	0.16		0.06		0.14			0.01
	Xanthosia ciliata																		
	Xanthosia huegelii		0.03							0.01			0.01						
	Xanthosia singuliflora					0.01													
	Xylomelum occidentale																		

APPENDIX J1: SUMMARY OF DENSITY ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: All data is plants/m^2 and rounded to 2 decimals places (so if 0.00 then value is < 0.01)

	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
	Acacia alata									0.14														
	Acacia applanata																							
	Acacia barbinervis												0.01						2.00					
	Acacia browniana																							
	Acacia celastrifolia													0.01										
	Acacia divergens																							
	Acacia drummondii					0.01			0.03											1.00		1.00		1.00
	Acacia extensa																							1.00
	Acacia lateriticola					0.01																		1.00
	Acacia nervosa																							1.00
	Acacia preissiana																							
	Acacia pulchella	1.48	0.34			0.13	0.01					0.01		0.01	1.00			1.50	2.00	1.00				2.00
	Acacia saligna																							
	Acacia sp.															1.00								
	Acacia stenoptera																							
	Acacia urophylla	0.11	0.03	0.04	0.24	0.10			0.04		0.16	0.06		0.08	1.00			2.00	1.50	1.00		1.50	1.33	
	Acacia varia						0.03	0.23																
	Acacia willdenowiana							0.03																
	Acacia drummondii subsp. candolleana																							
	Adenanthos barbiger	0.15	0.03	0.05		0.64	0.35	0.56	0.10	0.38	0.01	0.01	1.23	0.11	1.92	1.88	1.60		2.33	1.30	2.00	1.00		3.07
	Agrostocrinum scabrum			0.01	0.01	0.01	0.03	0.06				0.02	0.01			1.00	1.00				2.00			
	Aira caryophyllea		1.88																					
*	*Allocasuarina fraseriana*	0.01		0.03		0.01	0.09	0.04		0.16		0.00	0.16											1.67
	Amphipogon amphipogonoides																							
	Andersonia lehmanniana																							
	Anigozanthos manglesii																							
	Aotus cordifolia																							
	Aphelia cyperoides																							
	Astartea scoparia																							
	Asteraceae sp.																10.00							
	Austrostipa eleganthissima																1.00	1.00						
	Austrostipa mollis																							
*	*Austrostipa sp.*																							
	Babingtonia camphorosmae																							
	Banksia bipinnatifida																							
	Banksia dallanneyi subsp. dallanneyi var. dallanneyi						0.36	1.25		1.09			1.13		4.00	6.46		5.47	3.38	3.33	1.00		6.82	
*	*Banksia fraseri*																							
	Banksia grandis	0.01	0.01	0.13		0.05	0.08	0.01	0.03	0.08	0.01	0.28	0.01	0.11	1.38		0.60		1.38	1.58		1.00	1.00	1.00
	Banksia sessilis																							
	Banksia sphaerocarpa															1.38								
	Banksia grandis (seedling)																							
	Banksia littoralis																							
	Billardiera floribunda				0.00																			
	Billardiera sp.1																							
	Billardiera variifolia												0.04											

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	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
	Billardiera fraseri						0.01																	
	Billardiera fusiformis					0.01																		
	Boronia crenulata																							
	Boronia crenulata subsp. viminea																							
	Boronia fastigiata	0.54	0.04	0.09	0.03	0.21	0.03	0.04	0.01	0.10			0.08	0.24		2.07	1.56	1.00	2.27	1.00	1.00	1.00	1.00	1.50
	Bossiaea aquifolium		0.01												1.67	1.50	1.67	1.43	1.33	2.00	1.50			
	Bossiaea ornata			0.61	0.25	0.06	0.16	0.04	0.03	0.03		0.21	3.68	0.15	1.25	2.33	1.40		1.83	1.50	1.00	1.00	2.10	2.08
	Bossiaea spinescens																							
	Bossiaea eriocarpa																							
	Brachyscome pusilla																							
	Briza minor	0.03																						
	Burchardia congesta	0.14	0.44	1.89	2.03	0.58	0.59		0.04			0.06		1.36							1.00		3.00	
	Caladenia flava	0.09	0.03	0.12	0.26	0.03	0.01	0.05		0.28	0.14	0.03		0.17										
	Caladenia macrostylis			0.03					0.01															
	Caladenia reptans						0.09		0.09															
	Caladenia sp.																							
*	*Caladenia sp. 1*																							
	Calothamnus quadrifidus		0.00																					
	Calothamnus sp.																							
	Cassytha glabella	0.36	0.06								0.08													
	Cassytha sp.																							
	Caustis dioica																							
	Centaurium erythraea		0.69																					
	Centrolepis aristata							0.23																
	Chamaescilla corymbosa									1.31			1.06			2.00		6.00						10.00
	Chorizema cordatum														1.00		1.00		1.00	2.00	2.00			
	Chorizema rhombeum																							
	Clematis pubescens	0.01	0.18	0.08	0.06				0.01		0.67	0.11		0.46								1.59	1.50	
	Comesperma virgatum	0.13	0.03	0.06	0.07	0.11	0.03	0.03	0.03				0.03	0.02				1.00						1.00
	Comesperma sp.																							
*	*Conospermum capitatum*						0.01																	
	Conospermum scaposum																							
	Conostylis aculeata								0.01				0.01	0.09										
	Conostylis setigera														1.00	1.78	1.17	1.57	2.33		2.50		1.00	2.31
	Conostylis setosa						0.03	2.06	0.01	0.17			0.65		1.00	1.25		1.60	1.00		1.00			
	Conostylis pusilla																							
	Conostylis serrulata	0.01					0.03	0.13	0.00	0.01			0.21											
	Corymbia calophylla			0.20	1.91		0.05	0.09	0.21	0.09	0.41	0.18	0.21	0.51	1.00			1.75	1.17	2.08	1.64	1.28	1.00	1.00
	Corymbia calophylla (seedling)																							
	Craspedia variabilis																					3.50		
	Cryptandra arbutiflora var. arbutiflora																							
	Cryptostylis ovata			0.11																				
	Cyanicula sericea			0.06					0.05															
	Cyathochaeta avenacea		0.05	0.11	0.17	0.17	3.78	2.58	1.99	2.01			3.19	0.29	1.00	2.00	3.00	4.17	3.83	3.14			2.25	
	Cyperaceae sp.																		1.00					

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	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
	Cyrtostylis robusta		0.05	0.10		0.78								0.75										
	Dampiera alata																							
	Dampiera hederacea																							
	Dampiera linearis						1.21	0.16				0.01	0.06	0.64				1.00	1.00					2.00
	Dasypogon bromeliifolius																							
	Daucus glochidiatus		2.26		0.04						0.17			1.17										
	Daviesia decurrens									0.03			0.04						1.00					
	Daviesia horrida																							
	Daviesia preissii																		1.00					
	Daviesia rhombifolia																							
	Desmocladus flexuosus	0.41						0.01	3.62			2.33	0.30			1.00			1.33				1.00	
	Desmocladus fasciculatus																							
*	*Dianella revoluta*																			1.00				
	Disa bracteata										0.01			0.03										
	Diuris longifolia	0.03				0.03				0.04				0.01										
	Drosera bulbosa			0.06		0.04		1.22					0.19	0.01										
	Drosera erythrorhiza	0.01		0.07			0.22						0.13	0.10										
	Drosera macrantha					0.03							0.01											
	Drosera microphylla						0.13																	
	Drosera pallida	0.30		0.03		0.03	0.03		0.18	0.16			0.03											
	Drosera platystigma							0.14																
	Drosera pulchella																							
	Drosera sp.																1.67			1.00			1.00	
	Drosera sp. (climbing)																							
	Drosera sp. 1																							
	Drosera sp. 2																							
	Drosera stolonifera							0.40			0.08													
	Elythranthera brunonis																							
	Erigeron sumatrensis		0.13																					
*	*Eriochilus dilatatus*					0.01			0.05	0.08		0.01												
	Eucalyptus marginata			2.43	2.45	0.61	0.50	0.45	1.09	0.15	1.83	0.58	0.36	1.93	1.63	1.43	2.38	1.38	1.42	2.25	1.69	2.47	0.93	1.77
	Eucalyptus marginata (seedling)																							
	Eucalyptus patens																							
	Eucalyptus patens (seedling)																							
	Eucalyptus sp.																		3.50					2.80
	Gahnia decomposita																							
	Gastrolobium spinosum																							
	Gastrolobium villosum																							1.00
	Glischrocaryon aureum									0.11			0.04											
	Gompholobium cyaninum																							2.00
	Gompholobium knightianum							0.04					0.14					1.00						1.00
	Gompholobium marginatum	0.21						0.03		0.14								1.00	1.00				1.00	
	Gompholobium polymorphum			0.03			0.03	0.71		0.06					1.00	1.00	1.00	1.60	1.00				1.00	
	Gompholobium preissii	0.29	0.10				0.18	1.20		0.48			0.61					3.00			1.00			2.20
	Gompholobium sp.																							

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	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
*	*Gompholobium sp.1*																							
	Gompholobium tomentosum																							
	Gonocarpus cordiger																						1.00	
	Gonocarpus sp.																	1.00						
	Goodenia sp.1																							
	Goodenia trinervis																							
	Grevillea bipinnatifida																							
	Grevillea pulchella																							
	Grevillea quercifolia							0.02																
	Grevillea synapheae						0.10																	
	Grevillea wilsonii	0.03					0.16									1.53			1.00					1.00
	Haemodoraceae sp.															1.00						1.00		
	Haemodorum laxum			0.01										0.01										
	Haemodorum sp.																							
	Haemodorum sp. 1																							
	Haemodorum sp. 2																							
	Haemodorum spicatum							0.01																
	Hakea amplexicaulis																							
	Hakea cyclocarpa												0.04											
	Hakea lissocarpha				0.00					0.08		0.01											1.00	
	Hakea prostrata																							
	Hakea ruscifolia					0.11		0.05					0.10											
	Hakea varia																							
	Hemiandra pungens																							
	Hemiandra pungens																							
	Hemigenia pritzelii			0.01		0.01	0.30							0.03		1.00								
	Hibbertia acerosa																	1.00					1.00	
	Hibbertia amplexicaulis	1.90	0.41	0.39	0.90	0.36		1.04	0.19	0.09	0.48	0.13		0.48	1.46	3.93	3.92	2.15	3.00	3.89	1.00	3.08		2.18
	Hibbertia commutata	0.53	0.20	0.35	0.60	0.61	0.94	0.92	0.44	1.17	0.01	0.18	0.53	0.26	2.57	2.85	2.50	3.00	6.83	1.33		10.07	3.13	1.33
	Hibbertia commutata (seedling)																							
	Hibbertia huegelii						0.01																	2.00
	Hibbertia hypericoides																					2.00		
	Hibbertia lasiopus																							
	Hibbertia lineata																							
	Hibbertia ovata																							
	Hibbertia perfoliata																1.00		2.00	2.00		2.33		
	Hibbertia quadricolor																							
	Hibbertia racemosa																							
	Hibbertia sp.														1.00					2.00		3.00	1.00	
	Hibbertia striata																							
	Hovea chorizemifolia			0.09	0.05	0.35	0.08	0.01	0.11	0.03	0.06		0.09	0.13			1.00	1.00	1.00	1.20	1.00		1.00	2.00
	Hovea trisperma	0.45	0.39	0.10	0.28	0.43	0.21	3.57	3.27	0.46	0.27	0.17		0.14										
	Hyalosperma cotula																							
	Hybanthus calycinus									0.04			0.13											
	Hybanthus floribundus																							

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	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
	Hybanthus floribundus subsp. floribundus																							
	Hydrocotyle callicarpa									1.35														
	Hypocalymma angustifolium	0.01					0.01	0.21					0.00					4.47					1.57	
	Hypochaeris glabra	0.09	5.24	0.04		0.04	0.01	0.09	0.01	0.04	0.02			0.02										
	Hypolaena exsulca						0.15	1.21																
	Isolepis marginata																							
	Isotropis cuneifolia																							
	Jacksonia alata																							
	Juncus bufonius													0.06										
	Kennedia coccinea	0.10	0.09	0.41	0.22	0.05	0.25	0.04	0.06	0.03		0.01	0.02	0.05						1.00		1.00		1.00
	Kennedia prostrata																						1.92	
	Kingia australis																							
	Kunzea glabrescens																							
	Kunzea recurva																							
	Labichea punctata	0.01		0.09		0.02	0.03	0.01				0.04	0.01			1.00		1.00		1.00				
	Lachnagrostis filiformis		2.85																					
	Lagenophora huegelii	0.89	0.89	0.26	0.14	0.08			1.27	0.08	0.70	0.05	0.01	0.38	1.00	1.00	2.00		1.00			1.30	3.79	1.00
	Lasiopetalum floribundum			0.80	0.88	1.00			5.80		0.95	0.18		0.76	2.63		2.79		5.00	3.77		3.00	7.90	3.22
	Lasiopetalum glabratum						0.92			0.94			0.01											1.00
	Lasiopetalum glutinosum						0.11						0.01											
	Laxmannia squarrosa																							
	Lechenaultia biloba		0.18	0.04					0.01	0.04			0.04	0.03	1.00	3.50	1.00	3.00						2.33
	Lepidobolus preissianus subsp. preissianus																							
	Lepidosperma leptostachyum	0.40	0.01						0.76	0.04	0.14	0.18	0.51	0.01										
	Lepidosperma longitudinale																							
	Lepidosperma pubisquameum																							
	Lepidosperma sp.															1.00	1.00	1.00						
	Lepidosperma sp.1																							
	Lepidosperma squamatum	0.20	0.01				0.13			0.13			0.59											
	Lepidosperma tenue									0.01			0.16											
*	*Leporella fimbriata*			0.08		0.04	0.24	0.24	0.46	0.26														
	Leptocarpus coangustatus																							
	Leptomeria cunninghamii	0.45			0.01	0.05			0.13						1.50									
	Leptospermum erubescens																							
	Leucopogon australis														1.00									
	Leucopogon capitellatus	0.01	0.14	0.33	1.22	0.11			0.18		0.13	0.16		0.36	1.00				2.25	1.00			1.00	
*	*Leucopogon parviflorus*																							
	Leucopogon sprengelioides																							
	Leucopogon verticillatus			0.07	0.14	0.04					0.01	0.06		0.00	1.00				2.33					
	Levenhookia pusilla	0.04						0.41	1.65	4.18						2.00	5.00	10.00					15.00	1.00
	Levenhookia stipitata																						5.00	
	Lindsaea linearis						0.48																	
	Lobelia sp.																							
	Lomandra brittanii	0.15		0.06						0.46			0.15											
	Lomandra caespitosa	0.05			0.27	0.04		0.26	0.07	0.46	0.02	0.01	0.01	0.03										

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Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Lomandra drummondii	0.15	0.21	0.48	0.65	0.86		0.07	1.01	0.26	0.24	0.41	0.03				1.00		2.00			2.25		1.00
Lomandra hermaphrodita	0.33		0.13	0.18	0.15	0.07	1.31	0.21	0.48	0.01	0.04	0.83	0.27	2.29	2.11	2.83	2.00	1.40	1.75	1.33	3.00	2.75	2.83
Lomandra integra							0.01																
Lomandra micrantha			0.20	0.03	0.20						0.01			6.00				3.80	1.60			1.00	
Lomandra micrantha subsp. micrantha																							
Lomandra nigricans			1.17	0.38	0.44	0.01		0.01		0.11	0.21		0.46			1.00				1.00	2.00	1.00	
Lomandra odora	0.15	0.24			0.11		0.71	0.94	0.19			0.09	0.05										
Lomandra preissii	0.05	0.04	0.09	0.01	0.19	0.03		0.21	0.10	0.03	0.05	0.06	0.31		1.00	3.67	1.75			1.00	1.33		
Lomandra purpurea									0.07			0.16											
Lomandra sericea																							
Lomandra sonderi			0.06		0.15	0.38	1.91	0.38	0.39			0.53	0.01	2.00	1.14	1.25	1.00	1.00	1.00	1.00	1.00	1.00	1.33
Lomandra sp.																2.50				1.00	1.00	1.00	
Lomandra sp.1																							
Lomandra spartea				0.01	0.04			0.10	0.02			0.03		1.00	1.75	1.00	1.25	1.71		1.50			1.38
Loxocarya cinerea					1.71	0.31																	
Lysimachia arvensis		0.44																					
Macrozamia riedlei	0.30	0.20	0.23	0.06	0.03			0.03		0.07	0.05		0.19	1.00			0.50		1.00	1.00	1.58	1.00	
Macrozamia riedlei (seedling)																							
Marianthus drummondianus																						2.00	
Melaleuca parviceps																							
Melaleuca preissiana																							
Melaleuca viminea																							
Melaleuca viminea (seedling)																							
Mesomelaena graciliceps							0.01																
Mesomelaena stygia																							
Mesomelaena tetragona						0.01																	
Microtis media																							
Millotia tenuifolia								0.17															
Mirbelia dilatata	0.10		0.01	0.15			0.53			0.01	0.01												
Monotaxis grandiflora						0.05			0.16			0.31	0.01										
Monotaxis grandiflora var. grandiflora																							
Monotaxis occidentalis									0.10			0.15											
Neurachne alopecuroidea	1.04	0.40	0.18	0.21	0.88	0.07	0.31	0.90	0.68	0.16	0.19	0.71	0.69	1.00				1.00					1.33
Opercularia apiciflora			0.22	0.21	0.14		0.01			0.13	0.03		0.13										
Opercularia echinocephala	0.59	0.10		0.03	0.01		0.10	0.04	1.16			0.01	0.21	1.00				3.09	2.50	1.75		3.14	2.00
Opercularia hispidula										0.52													
Opercularia sp.																							
Opercularia vaginata																							2.00
Orchidaceae sp.																	1.00						
Orchidaceae sp. 1																							
Orchidaceae sp. 2																							
Orianthera serpyllifolia																							
Oxalis corniculata	0.21	0.45		0.03									0.21										
Paspalidium sp.?																							
Patersonia babianoides			0.13	0.07		0.02	0.11	0.35		0.01	0.11	0.04	0.03										

APPENDIX J1: SUMMARY OF DENSITY ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: All data is plants/m^2 and rounded to 2 decimals places (so if 0.00 then value is < 0.01)

	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
	Patersonia juncea																							
	Patersonia occidentalis																	1.67				1.00		1.00
	Patersonia pygmaea							0.01	0.01	0.05			0.02											
	Patersonia rudis									0.20			0.25											
*	*Pentapeltis peltigera*	0.08	0.18	0.63	0.15	0.18	0.66	2.06	1.30	0.79	0.54	0.36	0.51	0.24	2.00		1.50	3.36	3.10		1.00	1.50	4.42	2.00
	Pericalymma ellipticum																		0.00					
	Persoonia elliptica										0.01		0.02											
	Persoonia longifolia		0.06	0.06	0.03	0.38	0.04	0.01	0.04		0.04	0.06	0.03	0.08	1.00	2.00	1.00		1.25	1.11		1.20	1.00	1.14
	Persoonia longifolia (seedling)																							
	Persoonia sp.																							1.00
	Petrophile macrostachya																							
	Philotheca spicata																	1.00						
	Philydrella drummondii																							
	Phyllanthus calycinus	0.10	0.06					0.01	0.01	0.09			0.01		2.00		3.00	6.68	3.00			2.33	5.47	5.06
	Pimelea ciliata	0.35							0.13	0.03											1.00	1.00		
	Pimelea lehmanniana												0.01											
	Pimelea sp.																							
	Pimelea suaveolens									0.06			0.01			1.40								
	Platysace commutata																							
	Platysace compressa			0.51	0.01									1.13			1.33		4.00	1.00	2.29		3.00	1.75
	Platysace filiformis																							
	Platysace tenuissima																							
	Poaceae sp.																1.00						1.00	
	Podolepis capillaris																							
	Podotheca angustifolia																							
	Podotheca gnaphalioides																							
	Poranthera microphylla									0.98														
	Prasophyllum elatum										0.08	0.04												
	Prasophyllum sp.																							
	Prasophyllum sp.1																							
	Pseudognaphalium luteoalbum																							
	Pteridium esculentum	0.04	0.15		0.03						0.60	0.19		1.25								1.80		
	Pterochaeta paniculata																							
*	*Pterostylis barbata*					0.09																		
*	*Pterostylis pyramidalis*						0.03	0.01	0.65	0.01			0.09											
*	*Pterostylis recurva*							0.01																
	Pterostylis sp.																							
	Pterostylis sp. 1																							
	Pterostylis vittata			0.03		0.11	0.03		0.02	0.01			0.01	0.08										
	Ptilotus drummondii																							
	Ptilotus drummondii var. drummondii																							4.00
	Ptilotus manglesii							0.02															5.80	
	Pyrorchis nigricans		0.01																					
	Ranunculus colonorum														1.00	1.25				1.00			1.00	2.75
	Restionaceae sp.																							

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	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
	Rytidosperma acerosum																							
	Rytidosperma caespitosum																							
	Rytidosperma setaceum					0.03																		
	Rytidosperma sp.																							
	Scaevola calliptera	0.23		0.64	0.46	0.09	0.54	0.08	0.34	0.60	0.48	0.05	0.06	0.34				1.00			1.00		1.40	2.00
	Scaevola pilosa										0.02													
	Scaevola sp.																							
	Senecio diaschides		0.09																					
	Senecio hispidulus								0.13	0.16														
	Senecio quadridentatus		0.01																					
	Senecio sp.																							
	Senecio sp.1																							
	Sonchus oleraceus					0.01	0.01			0.03														
	Sowerbaea laxiflora																							
*	*Sphaerolobium linophyllum*			0.01				0.17		0.01														
	Sphaerolobium macranthum																							
	Sphaerolobium medium	0.30																						
	Sphaerolobium sp.																							
	Stackhousia monogyna																						1.00	
	Stirlingia latifolia																							
	Stylidium amoenum					0.42			0.24	0.03		0.24			3.00		1.00	1.00	4.00	2.00				
	Stylidium androsaceum																4.00						6.00	
	Stylidium brunonianum																							
	Stylidium bulbiferum					0.01												1.00		1.00				1.00
	Stylidium calcaratum				0.38		0.06		0.15		0.25				1.00						6.00			
	Stylidium ciliatum															5.00				3.00	1.00			
	Stylidium hirsutum																							
	Stylidium hispidum	0.64	0.06					2.31	0.61	2.15														
	Stylidium junceum																		1.00					
	Stylidium lateriticola					0.13			0.11				0.04											
	Stylidium lineatum																	2.00						
	Stylidium piliferum						0.01		0.34						2.50	3.75	1.00	3.00	1.33	1.00	5.50		1.00	1.00
	Stylidium recurvum																							
	Stylidium repens																							
	Stylidium rhynchocarpum																							
	Stylidium scabridum																							
	Stylidium scariosum																							
	Stylidium schoenoides			0.06		0.04		0.06																
	Stylidium sp.																							
	Stylidium sp. 1																							
	Styphelia discolor		0.00	0.03	0.02		0.01				0.01									2.00			1.00	
*	*Styphelia hispida*																		2.00					2.50
	Styphelia nitens			0.00				0.20							1.50	1.50		1.00						
	Styphelia pallida											0.04	0.01	0.03										
	Styphelia propinqua	0.04	0.01	0.01	0.07		0.01	0.13					0.03	0.00	1.00	2.00		1.33	1.00	1.00				1.00

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	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
	Styphelia tenuiflora	0.01						0.01					0.01			1.00	1.00			1.00		1.00		
	Synaphea sp.																							
	Taxandria linearifolia																							
	Tetraria capillaris	0.58	0.49	1.06	1.80	0.64	0.13	0.33	0.86	0.14	3.88	1.83	2.03	2.58										
	Tetraria octandra						0.45	3.34	0.09				0.29											
	Tetraria sp. Jarrah Forest (R. Davis 7391)														4.27	1.50	1.67	6.90	3.33	3.25	2.33	2.33	3.78	4.40
	Tetrarrhena laevis	0.06	0.20	0.58	0.57	0.45	0.39	0.20	0.36	0.28	1.19	0.39	0.64	0.85	6.00	1.33	2.00	3.00	1.00	7.00		4.17	1.25	
	Tetratheca hirsuta	0.39		0.09	0.03	0.47					0.01	0.06	0.04	0.06	1.60	1.70		4.00	1.20	3.00		1.00	4.00	1.14
	Thelymitra crinita	0.14		0.06	0.04	0.13	0.38	0.06	0.15	0.19	0.15	0.05	0.13	0.18										
	Thelymitra macrophylla								0.09		0.01	0.01												
	Thelymitra sp.																	1.00						
*	*Thomasia paniculata*																							
	Thysanotus ? scaber																							
	Thysanotus dichotomus									0.26			0.29			2.00	1.00				1.00			
	Thysanotus fastigiatus														1.50	1.50	2.00	1.00	1.00		1.00		1.00	1.00
	Thysanotus manglesianus															3.00								
	Thysanotus multiflorus	0.18	0.11	0.05	0.26	0.71	0.48	1.59	1.76	1.13	0.03	0.03	0.08	0.38		1.50	1.00	1.00	1.00	1.00	2.00			1.00
	Thysanotus patersonii		0.01								0.01													
	Thysanotus sp.																							
	Thysanotus sp.1																							
	Thysanotus sparteus												0.03											
	Thysanotus tenellus																							
	Thysanotus thyrsoideus	0.89	0.29	0.10	0.02	0.08	0.36	0.34	0.56	0.75	0.03	0.06	0.05	0.14	1.00	1.00	2.00		2.80		2.00		1.75	3.20
	Trachymene pilosa	1.06	1.03	0.01	0.22	0.01	0.65	0.04	1.18	0.13	0.09			0.05			12.50						23.25	1.00
	Trichocline spathulata			0.04		0.24			0.50	0.34	0.06	0.24	0.46		2.17	1.25	1.67	1.86	2.00	1.00	1.00		2.00	1.83
	Tricoryne elatior							0.02		0.14				0.01										
	Tricoryne humilis						0.06	0.08					0.04											
	Trifolium dubium													0.04										
	Tripterococcus brunonis																							1.00
	Trymalium ledifolium	1.55	0.01			0.03				10.85					1.00	2.09		2.75	3.25				3.00	9.00
	Trymalium odoratissimum																							
	Trymalium odoratissimum subsp. odoratissimum			0.02							0.06													
	Utricularia multifida																							
	Vulpia myuros										0.19		0.15	0.24										
	Wahlenbergia preissii																							
	Xanthorrhoea gracilis	0.04	0.13	0.21	0.26	0.35	0.01	0.78	0.58	0.32	0.23	0.01	0.44	0.16		2.00		2.78				1.80		
	Xanthorrhoea preissii	0.26	0.25		0.23	0.23	0.08	0.19	0.02		0.01	0.74			1.46	1.67	1.00	2.00		1.75		1.00		
	Xanthosia atkinsoniana					0.03		1.64	1.65	0.06			0.01			1.00				1.67		1.00		5.60
	Xanthosia candida	0.31	0.01		0.08	0.71	1.11	0.93	3.67	4.16	0.24		0.07	0.13	1.00	1.00						2.50	10.00	2.71
	Xanthosia ciliata						0.01																	
	Xanthosia huegelii	0.10					0.04	0.04	0.01	0.01		0.01												1.00
	Xanthosia singuliflora																							
	Xylomelum occidentale																							

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	Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
	Acacia alata																		1.67				1.00
	Acacia applanata			1.50																			
	Acacia barbinervis														1.00	1.00			1.33				
	Acacia browniana																						
	Acacia celastrifolia																						
	Acacia divergens											1.00											
	Acacia drummondii														1.00								
	Acacia extensa			1.50													2.00				1.00		
	Acacia lateriticola														1.00								
	Acacia nervosa																						
	Acacia preissiana																						
	Acacia pulchella			17.10		2.11	1.90					1.50					3.73	2.47			5.15		
	Acacia saligna				4.33																		
	Acacia sp.																						
	Acacia stenoptera														1.00	1.00							
	Acacia urophylla			3.47			1.00	2.00					1.00					1.67			1.45		
	Acacia varia																						
	Acacia willdenowiana																						
	Acacia drummondii subsp. candolleana																	4.72			1.00		1.00
	Adenanthos barbiger	3.00	1.75	2.55		2.47	1.69		3.33	1.83			3.06	4.29	1.20	2.00		2.60					3.00
	Agrostocrinum scabrum																						
	Aira caryophyllea																			14.86			
*	*Allocasuarina fraseriana*		1.00							1.33	1.18			1.00		1.00							1.36
	Amphipogon amphipogonoides														5.00	4.00				1.00		4.60	1.00
	Andersonia lehmanniana																4.25						
	Anigozanthos manglesii				1.00															4.63			
	Aotus cordifolia											2.67											
	Aphelia cyperoides				97.00																		
	Astartea scoparia				1.00							1.80					1.00			2.00			
	Asteraceae sp.				6.00																		
	Austrostipa eleganthissima																						
	Austrostipa mollis																2.00						
*	*Austrostipa sp.*						1.00																
	Babingtonia camphorosmae							6.85									2.50			5.25			1.00
	Banksia bipinnatifida																					3.00	
	Banksia dallanneyi subsp. dallanneyi var. dallanneyi	16.83	6.00				15.40	8.87	5.11	3.00	2.50	5.25	10.25			1.50	3.75	1.50	3.33	3.44	4.00	4.59	1.71
*	*Banksia fraseri*																						
	Banksia grandis		1.20	1.63		1.38	1.14		1.20	1.00	1.00			1.50		1.25		1.00	1.40		2.00		
	Banksia sessilis	5.50	1.00						1.00														
	Banksia sphaerocarpa																						
	Banksia grandis (seedling)	1.00	1.00			1.33				1.00													
	Banksia littoralis											1.00											
	Billardiera floribunda																						
	Billardiera sp.1															1.00							
	Billardiera variifolia																						

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	Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
	Billardiera fraseri																						
	Billardiera fusiformis										2.50												
	Boronia crenulata											8.00											
	Boronia crenulata subsp. viminea											5.40											
	Boronia fastigiata	1.00	1.25	1.29		1.50			1.00	3.00	1.36		2.00	1.00	1.00			1.67	2.82			1.86	1.00
	Bossiaea aquifolium									6.00			2.00										
	Bossiaea ornata		1.00	5.31		3.50	1.00		8.00	2.50	2.00		1.92	1.82	2.00	1.33	1.00		2.00		2.92	3.90	2.85
	Bossiaea spinescens																						2.00
	Bossiaea eriocarpa																						
	Brachyscome pusilla																			12.86			
	Briza minor																10.00						
	Burchardia congesta																						
	Caladenia flava	1.50																3.00		2.60			
	Caladenia macrostylis																						
	Caladenia reptans																						
	Caladenia sp.	1.00				1.00			2.50	3.00	1.25		1.00										
*	*Caladenia sp. 1*	1.00																					
	Calothamnus quadrifidus																						
	Calothamnus sp.																			1.00			
	Cassytha glabella																						
	Cassytha sp.											12.00											
	Caustis dioica							4.33															
	Centaurium erythraea																						
	Centrolepis aristata				72.65															1.00			
	Chamaescilla corymbosa	6.00	4.75					3.00								2.00	5.00		1.00	1.00		5.20	3.00
	Chorizema cordatum						1.00	1.00	2.00	2.00			2.00										
	Chorizema rhombeum																						
	Clematis pubescens						1.00											2.38			1.60	1.00	
	Comesperma virgatum													1.00									
	Comesperma sp.		2.00																				
*	*Conospermum capitatum*																						
	Conospermum scaposum																			1.00			
	Conostylis aculeata																						
	Conostylis setigera	3.30	2.70			1.00	4.00	11.00	2.50	2.33	2.50	3.00	9.20						1.00				2.67
	Conostylis setosa	2.83	1.75						8.00		2.75		4.11			2.15							4.71
	Conostylis pusilla																4.43	3.00		6.00	2.50	2.20	
	Conostylis serrulata					2.00	2.40		3.25	2.00	2.00	2.33	3.80					2.00	2.00		1.60		
	Corymbia calophylla	1.00		1.00			1.00	1.00	1.00				1.00		1.33		1.00		1.00	1.33	1.00	1.00	
	Corymbia calophylla (seedling)	2.00		3.80		1.00	1.00	1.00					2.00										
	Craspedia variabilis										2.00									2.09			
	Cryptandra arbutiflora var. arbutiflora																1.67						
	Cryptostylis ovata																						
	Cyanicula sericea																						
	Cyathochaeta avenacea			1.00	5.00	4.27	1.00		5.13	5.42		6.60	5.13	1.00	5.53			6.60	1.00			3.33	4.67
	Cyperaceae sp.																						

APPENDIX J1: SUMMARY OF DENSITY ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: All data is plants/m^2 and rounded to 2 decimals places (so if 0.00 then value is < 0.01)

	Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
	Cyrtostylis robusta																						
	Dampiera alata				2.50			5.00							2.00		4.25					1.00	
	Dampiera hederacea											2.00											
	Dampiera linearis			1.40	2.00	2.00		4.00	3.50	4.38		3.00	1.00		3.67						2.00	3.00	1.67
	Dasypogon bromeliifolius						4.00																
	Daucus glochidiatus																						
	Daviesia decurrens								1.00														1.00
	Daviesia horrida							1.00															
	Daviesia preissii																						
	Daviesia rhombifolia																						
	Desmocladus flexuosus	2.00	1.00	3.25			2.43	2.00		3.00	8.29		7.71	4.00	5.58						2.00	2.00	
	Desmocladus fasciculatus							4.45				3.50					1.71			5.25	2.67	4.00	
*	*Dianella revoluta*						1.00																
	Disa bracteata																						
	Diuris longifolia																						
	Drosera bulbosa																						
	Drosera erythrorhiza	1.67	3.33																			3.67	
	Drosera macrantha																						
	Drosera microphylla																						
	Drosera pallida																						
	Drosera platystigma																						
	Drosera pulchella																					1.00	
	Drosera sp.																				1.00	2.00	
	Drosera sp. (climbing)						1.00		1.00	3.00													
	Drosera sp. 1	2.00		2.00	1.33	3.60		3.50		1.00					1.00	1.00	1.60		1.50	1.00			1.00
	Drosera sp. 2				10.00	1.00		3.50	1.00			2.00					2.00	2.57		2.67		2.00	1.00
	Drosera stolonifera															2.00	2.00	2.33	1.67	1.00		1.00	
	Elythranthera brunonis							2.50															
	Erigeron sumatrensis																						
*	*Eriochilus dilatatus*																						
	Eucalyptus marginata	3.00	1.00	1.89		1.90	4.18	1.17	2.56	1.00	1.30	1.00	2.29	2.00	2.09	1.20		1.33	1.70	1.20	1.43	1.92	
	Eucalyptus marginata (seedling)	1.00	1.11	1.86		1.75	5.00	1.00	3.00	1.00	2.88	1.00	1.75										
	Eucalyptus patens																						
	Eucalyptus patens (seedling)											1.00											
	Eucalyptus sp.																						
	Gahnia decomposita																						
	Gastrolobium spinosum																						2.36
	Gastrolobium villosum																						2.00
	Glischrocaryon aureum																						3.33
	Gompholobium cyaninum																						
	Gompholobium knightianum	1.50		2.00		1.00	1.00		8.94	2.50													
	Gompholobium marginatum	3.25	1.00	2.00		2.00		4.71	4.17	1.67	1.50	2.50	1.00				4.82	16.75	2.00	8.44		3.44	1.67
	Gompholobium polymorphum							1.00							2.50	2.00		1.00	1.00	1.00		2.67	
	Gompholobium preissii			13.85		4.64			5.93	9.93	1.67					2.24		3.64	9.00	2.00	10.93	9.69	14.15
	Gompholobium sp.																						

APPENDIX J1: SUMMARY OF DENSITY ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: All data is plants/m^2 and rounded to 2 decimals places (so if 0.00 then value is < 0.01)

	Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
*	*Gompholobium sp.1*														1.00								
	Gompholobium tomentosum								1.00		2.00												
	Gonocarpus cordiger																						
	Gonocarpus sp.																						
	Goodenia sp.1							2.00															
	Goodenia trinervis				12.76												3.00						
	Grevillea bipinnatifida							1.33															
	Grevillea pulchella																1.00						1.67
	Grevillea quercifolia																						
	Grevillea synapheae																						
	Grevillea wilsonii		2.25			1.00		1.00	4.25	2.27				2.00			4.00		1.00				1.00
	Haemodoraceae sp.																						
	Haemodorum laxum																						3.50
	Haemodorum sp.		1.00		3.64	1.50		3.50	1.00			1.00	1.00	1.00		1.00							3.00
	Haemodorum sp. 1				3.00			3.00					1.00			2.00	1.50						4.00
	Haemodorum sp. 2																1.33						
	Haemodorum spicatum																						
	Hakea amplexicaulis																						
	Hakea cyclocarpa							3.07	2.00														
	Hakea lissocarpha							1.00	1.00	1.00							1.00						2.00
	Hakea prostrata																1.83						
	Hakea ruscifolia																			1.00			
	Hakea varia				1.50															2.00			
	Hemiandra pungens																					2.00	
	Hemiandra pungens									3.29							3.00						
	Hemigenia pritzelii								2.00														
	Hibbertia acerosa	1.00									1.33		1.83									1.00	
	Hibbertia amplexicaulis	2.14	1.00	4.11		2.63	3.00	3.00	1.60		3.56		2.71	1.00				2.63		2.67	1.00	1.00	
	Hibbertia commutata		1.50	3.64		1.57	2.38	3.14	2.63	1.60	1.33		1.33	1.80	1.00			3.50	4.43	5.60	1.67		
	Hibbertia commutata (seedling)								4.00														
	Hibbertia huegelii				1.00								1.56									2.00	
	Hibbertia hypericoides	1.33		2.00				2.38	6.47							2.08				1.45	2.63	4.06	3.71
	Hibbertia lasiopus																						
	Hibbertia lineata							5.00															
	Hibbertia ovata																						
	Hibbertia perfoliata			2.00										1.67				3.75		3.00	1.80	3.20	
	Hibbertia quadricolor		2.28																				
	Hibbertia racemosa																						
	Hibbertia sp.										2.00												
	Hibbertia striata												1.00										
	Hovea chorizemifolia	1.75		1.00		1.29			2.00	1.00	1.44		1.40	1.80	2.00	1.00			1.00				
	Hovea trisperma							3.00			1.00			1.00									
	Hyalosperma cotula				79.40																3.00	7.50	
	Hybanthus calycinus																						
	Hybanthus floribundus						1.00	1.00								2.00			2.00				

APPENDIX J1: SUMMARY OF DENSITY ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

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	Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
	Hybanthus floribundus subsp. floribundus														2.00	2.14						1.00	
	Hydrocotyle callicarpa																						
	Hypocalymma angustifolium				2.67	1.00		8.95			1.00		1.00				3.00	2.00		1.00	1.00	1.00	
	Hypochaeris glabra			2.00	2.00							6.00	1.00							7.29	6.60		
	Hypolaena exsulca							17.00				164.29											
	Isolepis marginata																				6.00		
	Isotropis cuneifolia				3.40												1.00						
	Jacksonia alata																3.00						
	Juncus bufonius																						
	Kennedia coccinea			1.60		1.00	1.00		3.67	3.00				1.00	2.87	1.00		1.71	2.67		1.00	1.83	2.00
	Kennedia prostrata			2.86												1.50	1.00		1.75	2.46	2.09		
	Kingia australis							5.41															
	Kunzea glabrescens							1.00															
	Kunzea recurva							2.40															
	Labichea punctata	1.00	1.00								1.00		2.00					1.00					
	Lachnagrostis filiformis																						
	Lagenophora huegelii			1.00			1.00											1.50	2.50	1.00	2.81	3.00	2.00
	Lasiopetalum floribundum		1.00			2.50	3.07				4.29	2.00	1.00	1.00	4.00	1.00		2.33					3.00
	Lasiopetalum glabratum								2.50														3.25
	Lasiopetalum glutinosum																						
	Laxmannia squarrosa																6.00			2.00			
	Lechenaultia biloba	1.00				4.00	1.00	2.57	1.25	2.00		1.00			2.00	5.00	1.75		1.00			1.20	2.00
	Lepidobolus preissianus subsp. preissianus																12.40						
	Lepidosperma leptostachyum																						
	Lepidosperma longitudinale											15.00											
	Lepidosperma pubisquameum			2.00	4.00				4.00														3.50
	Lepidosperma sp.				20.67								3.00									1.00	4.00
	Lepidosperma sp.1			3.00			6.25									1.67							5.00
	Lepidosperma squamatum							11.00			3.00				4.00	1.60	2.00	1.00		1.00		1.50	1.75
	Lepidosperma tenue	3.00						2.00	6.60	3.50	1.83												
*	*Leporella fimbriata*																						
	Leptocarpus coangustatus																						
	Leptomeria cunninghamii														1.00	1.00							
	Leptospermum erubescens																		2.33				
	Leucopogon australis																						
	Leucopogon capitellatus			10.40		1.00	1.00	1.00													1.00		
*	*Leucopogon parviflorus*											1.50											
	Leucopogon sprengelioides																4.70						
	Leucopogon verticillatus	2.00					1.00								1.00				1.00				
	Levenhookia pusilla				10.00			10.00		1.00												3.00	
	Levenhookia stipitata																						
	Lindsaea linearis							1.00															
	Lobelia sp.											2.00											
	Lomandra brittanii						3.00	1.00		2.00													
	Lomandra caespitosa			7.00		1.00	1.75	4.00			2.50			1.00	1.00				2.90	1.20		5.33	4.67

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Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Lomandra drummondii																					1.00	
Lomandra hermaphrodita	4.00	1.00	1.00	2.00	2.58	1.86	2.50	2.86	2.36	2.60		2.22	1.00	1.83	1.78		3.79	3.38	1.50		2.00	2.83
Lomandra integra																						
Lomandra micrantha	1.00					4.00	4.00	5.00	2.00	2.00				1.00						1.00		
Lomandra micrantha subsp. micrantha														2.00								
Lomandra nigricans						3.00											5.60	1.00		4.43		
Lomandra odora														2.00								
Lomandra preissii						2.00	1.88	1.50	4.00	1.75		2.33	1.00	1.00							2.75	2.20
Lomandra purpurea																						
Lomandra sericea																						
Lomandra sonderi	1.00	2.55	3.33		2.78	1.20		4.14	3.83	4.77		7.36	7.75	1.63			3.00	2.00	1.00		4.00	
Lomandra sp.	1.00	1.00	1.00	1.00			1.50			1.33										4.33		
Lomandra sp.1															1.00							
Lomandra spartea	1.50	1.00			1.33	1.50	2.29	1.00	2.00	8.17		1.00	6.10	1.50	2.00	1.33	2.00				1.50	1.50
Loxocarya cinerea						1.00			1.00	4.70	3.00	3.25	2.00	3.00								
Lysimachia arvensis																20.00						
Macrozamia riedlei		1.00	2.09		1.00	1.38				1.00	1.50		1.00	1.00				1.00	1.00	1.25	1.00	
Macrozamia riedlei (seedling)						3.00																
Marianthus drummondianus																						
Melaleuca parviceps																3.00						
Melaleuca preissiana																						
Melaleuca viminea				4.77																		
Melaleuca viminea (seedling)				7.00																		
Mesomelaena graciliceps																					1.00	
Mesomelaena stygia				11.00																		
Mesomelaena tetragona				8.13																		
Microtis media																						
Millotia tenuifolia																26.50			15.63	14.17		
Mirbelia dilatata						2.60	1.00				5.00											
Monotaxis grandiflora																						
Monotaxis grandiflora var. grandiflora									2.00						1.00						6.00	6.50
Monotaxis occidentalis																						
Neurachne alopecuroidea	2.00		1.33	1.00	1.00	2.50	11.00			1.00	6.83	1.80	3.00	2.67	2.00	5.13	2.00	1.00	1.50		1.00	2.20
Opercularia apiciflora																						
Opercularia echinocephala			4.37	1.00	2.00	4.82	6.50	1.50	4.00	2.00	1.00				2.40		10.56	6.85	7.00	10.63	2.00	3.00
Opercularia hispidula																						
Opercularia sp.										2.00	2.00											
Opercularia vaginata																						
Orchidaceae sp.														1.00								
Orchidaceae sp. 1														1.83								
Orchidaceae sp. 2																1.00						
Orianthera serpyllifolia																						
Oxalis corniculata																						
Paspalidium sp.?															2.00							
Patersonia babianoides			1.50		1.00	1.00	1.00	2.00	2.00	2.50		1.25	1.50		1.33			2.25	2.00			1.50

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	Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
	Patersonia juncea				8.89																		3.00
	Patersonia occidentalis			2.00	1.67			2.00	1.60	1.00					1.00		1.00	1.50		2.25	1.00		1.67
	Patersonia pygmaea				13.00			2.29					1.00				1.67						1.00
	Patersonia rudis							1.50	2.43	2.00			3.50					5.00					
*	*Pentapeltis peltigera*	1.00	3.80	5.00		1.00	2.40	4.00	1.86	4.83	4.00	2.00	4.73		4.74			2.60	1.50	1.50		3.88	2.25
	Pericalymma ellipticum				1.20			4.45		1.00							4.80						
	Persoonia elliptica																						
	Persoonia longifolia			1.00		1.00	1.50				1.00										1.00	2.00	
	Persoonia longifolia (seedling)		1.00				1.00																
	Persoonia sp.																						
	Petrophile macrostachya																						1.00
	Philotheca spicata							1.33												1.00			
	Philydrella drummondii				1.83																		
	Phyllanthus calycinus	6.09	1.00			4.38	1.00				2.75		2.55				1.00	3.63	1.50		2.65		
	Pimelea ciliata							2.00									3.50	1.00					
	Pimelea lehmanniana																						
	Pimelea sp.																1.00						
	Pimelea suaveolens	1.00						6.00								1.00	1.00	2.33		1.33		1.00	2.00
	Platysace commutata	2.86	1.67	5.89		5.30	7.92	2.00		1.00	1.00		14.18					3.20	3.50		11.22		1.00
	Platysace compressa																						
	Platysace filiformis																						
	Platysace tenuissima																						
	Poaceae sp.																						
	Podolepis capillaris				9.33																		
	Podotheca angustifolia																			5.00			1.00
	Podotheca gnaphalioides																20.00						
	Poranthera microphylla																					13.50	2.40
	Prasophyllum elatum																						
	Prasophyllum sp.															1.00							
	Prasophyllum sp.1					1.00			1.00														
	Pseudognaphalium luteoalbum																						
	Pteridium esculentum						4.11					1.67			3.10						3.67		
	Pterochaeta paniculata									16.43												5.00	2.00
*	*Pterostylis barbata*																						
*	*Pterostylis pyramidalis*																						
*	*Pterostylis recurva*																						
	Pterostylis sp.	1.00	1.00																				
	Pterostylis sp. 1														1.00	1.00							
	Pterostylis vittata																						
	Ptilotus drummondii																						
	Ptilotus drummondii var. drummondii																						
	Ptilotus manglesii									3.00	5.00					1.83	2.50						2.00
	Pyrorchis nigricans																						
	Ranunculus colonorum																						
	Restionaceae sp.																1.00						

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	Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
	Rytidosperma acerosum																				1.33		
	Rytidosperma caespitosum		1.00		1.00	1.00		2.67															1.00
	Rytidosperma setaceum																						
	Rytidosperma sp.							3.00															
	Scaevola calliptera	1.00					2.00	1.00	4.70	9.00	1.50		1.00		2.38		2.00	2.00			1.50	8.20	2.00
	Scaevola pilosa																						
	Scaevola sp.			1.00			1.00																
	Senecio diaschides																		1.25	2.00	2.00		
	Senecio hispidulus																						
	Senecio quadridentatus																						
	Senecio sp.				1.00															1.50	2.00		
	Senecio sp.1																			6.00			
	Sonchus oleraceus																						
	Sowerbaea laxiflora			2.00	3.40		1.00				1.00		1.00										
*	*Sphaerolobium linophyllum*																						
	Sphaerolobium macranthum							1.00															
	Sphaerolobium medium			1.00			2.00	2.67							1.00							1.00	3.57
	Sphaerolobium sp.							2.00			1.00		1.00										
	Stackhousia monogyna												1.00										
	Stirlingia latifolia									4.40													
	Stylidium amoenum		1.00	1.50		4.00			5.25					2.33	1.83				5.00			5.00	1.00
	Stylidium androsaceum					1.00	1.50						1.00								5.69		3.00
	Stylidium brunonianum							2.00															
	Stylidium bulbiferum																						
	Stylidium calcaratum															1.00							
	Stylidium ciliatum							4.00														3.33	
	Stylidium hirsutum															1.00			5.33			10.14	
	Stylidium hispidum								8.00						1.00		3.50	2.50	3.00		9.00		
	Stylidium junceum																						
	Stylidium lateriticola																						
	Stylidium lineatum																						
	Stylidium piliferum	2.43	2.00	2.00		2.33	3.50		4.38	3.83						1.00	3.50	2.88	4.40	4.00	2.50	8.00	3.17
	Stylidium recurvum				22.14																		
	Stylidium repens																4.00					1.00	
	Stylidium rhynchocarpum														1.50								
	Stylidium scabridum					1.50		6.33	4.33		2.00	3.33										5.56	6.50
	Stylidium scariosum																					12.29	7.63
	Stylidium schoenoides										1.00				1.00	1.00			1.50			1.00	
	Stylidium sp.				20.00				3.00	2.00													
	Stylidium sp. 1								4.00														
	Styphelia discolor					3.00		1.00															
*	*Styphelia hispida*																						
	Styphelia nitens	2.67							1.00														
	Styphelia pallida												5.00										
	Styphelia propinqua	1.50						1.00	1.00		5.00	1.00		1.00					6.00		1.00		

APPENDIX J1: SUMMARY OF DENSITY ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: All data is plants/m^2 and rounded to 2 decimals places (so if 0.00 then value is < 0.01)

	Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
	Styphelia tenuiflora							1.50	1.00						1.00					1.00			
	Synaphea sp.							2.00															
	Taxandria linearifolia											10.00											
	Tetraria capillaris			1.00		5.17	4.00	5.00	9.33	2.00	3.80		1.50	4.29									
	Tetraria octandra			2.00			3.25	3.36	2.00	2.67		2.00	6.50	1.00		1.00	1.00	1.00		2.67		7.38	6.29
	Tetraria sp. Jarrah Forest (R. Davis 7391)	7.57	2.54	2.00		2.20	2.50	9.00	8.33	15.00	11.45		3.00	26.50	1.50	5.71	5.20	3.50	2.82	3.25	1.75	8.75	8.00
	Tetrarrhena laevis	1.50	1.00	1.80		1.00	2.00	4.25		3.00	3.00	1.00	2.60	1.00	2.50		1.50	1.00	1.00		2.00	1.33	
	Tetratheca hirsuta			2.00		4.00			1.33		1.25		1.00	1.00	2.29	1.00			1.43			1.75	2.00
	Thelymitra crinita										1.00	1.33	1.00										
	Thelymitra macrophylla																						
	Thelymitra sp.								1.00		1.00	1.00											
*	*Thomasia paniculata*								2.00			1.89											
	Thysanotus ? scaber																						6.50
	Thysanotus dichotomus								1.00	4.00								1.50					
	Thysanotus fastigiatus						1.00							2.00			2.00						
	Thysanotus manglesianus																				1.80		
	Thysanotus multiflorus			2.25		1.20	1.75	3.50		2.00	1.67	1.50			4.13	3.33	4.00	5.40	3.50	1.00	3.00	3.00	7.60
	Thysanotus patersonii						1.00		2.00														
	Thysanotus sp.						1.00			1.00									1.00				
	Thysanotus sp.1					1.50			1.00		1.00					1.00	2.67			1.00			2.00
	Thysanotus sparteus																						
	Thysanotus tenellus																						
	Thysanotus thyrsoideus								3.00	1.00	1.00										1.50	1.40	
	Trachymene pilosa		1.75				1.00										1.00			6.33	3.83	2.00	
	Trichocline spathulata	2.40	2.50		2.00	2.00	2.00		2.00	3.40	3.38		2.67	4.75	3.33	1.50	2.33	1.33	3.00			5.00	1.67
	Tricoryne elatior			16.22	4.00	5.00	8.14					3.33	14.60									1.67	
	Tricoryne humilis																						2.67
	Trifolium dubium																						
	Tripterococcus brunonis																2.00		2.00				6.25
	Trymalium ledifolium	5.50					1.00		5.70	2.00	1.71					1.00	4.00						
	Trymalium odoratissimum	2.00						3.00															
	Trymalium odoratissimum subsp. odoratissimum																						
	Utricularia multifida				9.60																		
	Vulpia myuros																						
	Wahlenbergia preissii																				3.00		
	Xanthorrhoea gracilis	1.50	1.50			5.50	2.88		2.45	1.57	2.56	2.00	1.75	1.00	3.09			3.50		1.00		1.89	1.00
	Xanthorrhoea preissii				1.80			3.55	1.00	2.50	1.00	4.83	3.50	4.00	1.33		1.00			1.00		1.00	1.00
	Xanthosia atkinsoniana	1.00	1.00			4.00	1.60			11.86	4.71	1.00	2.00					2.14	5.11		1.50	1.00	
	Xanthosia candida	2.00				2.75		10.36	4.90	7.10	3.20			1.50	4.40	1.60	2.60	4.92	2.00		2.60	7.27	3.00
	Xanthosia ciliata																						
	Xanthosia huegelii				4.50		1.00	3.00	3.00								2.00	3.00		10.38	4.00	2.00	
	Xanthosia singuliflora																						
	Xylomelum occidentale																			3.56			

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Acacia alata		0.01			0.30				0.20									
Acacia applanata																		
Acacia barbinervis																		
Acacia browniana	0.50						5.20	19.60		6.30								
Acacia celastrifolia																		
Acacia divergens																		
Acacia drummondii	0.03		0.30			2.30										0.10		0.05
Acacia drummondii subsp. *candolleana*																		
Acacia extensa												0.00						
Acacia incrassata																		
Acacia lateriticola	3.60					5.00		25.00	0.50				0.04		0.01	0.26		
Acacia nervosa																		
Acacia preissiana								3.00		14.40								
Acacia pulchella	0.01													0.00				
Acacia saligna																		
Acacia stenoptera																		
Acacia urophylla																		
Acacia varia																		
Acacia willdenowiana			18.30		0.10	1.10												
Acacia sp.						0.02												
Adenanthos barbiger		0.03	0.40		59.50	43.80		1.60	26.72		39.90			1.29		3.67		0.26
Agrostocrinum scabrum														0.01	0.00			
* *Aira caryophyllea*													0.00					
Allocasuarina fraseriana					6.00					1.70	0.50				20.97			
Amphipogon amphipogonoides				0.02	2.81							0.00	0.04	0.02	0.06	0.01	0.08	0.01
Amphipogon laguroides																		
Andersonia latiflora																		
Andersonia lehmanniana																		
Anigozanthos manglesii																		
Aotus cordifolia																		
Aphelia cyperoides																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Astartea scoparia																		
* Asteraceae sp.																		
Austrostipa elegantissima																		
Austrostipa mollis																		
Austrostipa sp.																		
* *Avena fatua*																		
Babingtonia camphorosmae																		
Banksia bipinnatifida																		
Banksia dallanneyi subsp. *dallanneyi* var. *dallanneyi*	1.00		2.90	56.35	19.00	5.00	9.50	1.75	0.25	56.70		0.15		0.64	0.81	0.75		
Banksia fraseri																		
Banksia grandis					4.50	1.30		0.10	22.97		29.20	4.50		3.99	0.03	1.42		
Banksia grandis (seedling)																		
Banksia littoralis																		
Banksia sessilis						0.30												
Banksia sphaerocarpa																		
Baumea juncea																		
Billardiera floribunda																		0.01
Billardiera variifolia														0.00	0.10			
Billardiera fraseri																		
Billardiera fusiformis																		
Billardiera sp.1																		
Boronia crenulata																		
Boronia crenulata subsp. *viminea*																		
Boronia fastigiata	1.49	4.48	4.80	1.52	3.60	2.10	1.81	0.61	0.50	4.90	2.90	0.02	0.01	0.02	0.00	0.01	0.00	
Boronia molloyae																		
Bossiaea aquifolium							165.00	12.00	211.50	1.40				0.00		6.64	18.68	5.00
Bossiaea ornata			6.00		5.98	0.10				20.40	2.90	0.00		0.03	0.01	0.00		0.03
Bossiaea eriocarpa																0.00		
Bossiaea spinescens																		
Brachyscome pusilla																		
* *Briza minor*																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Bulbine semibarbata																		
Burchardia congesta																		
Caladenia flava														0.00			0.00	
Caladenia macrostylis																		
Caladenia reptans																		
Caladenia sp.			0.29			0.01	0.06						0.00					
Caladenia sp. 1																		
Calothamnus quadrifidus																		
Calothamnus sp.																		
Cassytha glabella																		
Cassytha racemosa																		
Cassytha sp.																		
Caustis dioica																		
* *Centaurium erythraea*																		
Centella asiatica																		
Centrolepis drummondiana																		
Centrolepis aristata																		
Chamaescilla corymbosa				0.40											0.02	0.01		
Chorizema cordatum						0.30								0.00	0.00		0.00	
Chorizema ilicifolium																		
Chorizema rhombeum								0.80										
Clematis pubescens	2.55		4.40			2.70		0.20					1.57				0.41	
Comesperma calymega																		
Comesperma virgatum										0.10					0.00		0.00	
Comesperma sp.																		
Conospermum capitatum																		
Conospermum scaposum																		
Conostylis aculeata																		
Conostylis setigera	3.75		2.60	3.90	16.20	1.40	0.70	0.72	0.77	5.70		0.02						
Conostylis setosa			0.70						0.01			0.05	0.00		0.00			
Conostylis pusilla																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Conostylis serrulata	3.90			0.10										0.03	0.00	0.01		
	Corymbia calophylla	1.47	0.88	3.00	0.42	0.30	0.50	1.35	5.40		17.80		10.49	9.66	3.58	3.01	1.82	7.22	
	Corymbia calophylla (seedling)																		
	Craspedia variabilis																		
	Cryptandra arbutiflora var. *arbutiflora*																		
	Cryptostylis ovata																		
	Cyanicula sericea																		
	Cyathochaeta avenacea	0.02		78.00	1.70				0.10	4.60		0.00	1.88		0.01			0.00	0.05
*	*Cyperus rotundus*																		
	Cyperaceae sp.																		
	Cyrtostylis robusta																	0.01	
	Dampiera alata																		
	Dampiera hederacea																		
	Dampiera linearis					0.90							0.00		0.00				
	Dampiera pedunculata																		
	Dasypogon bromeliifolius																		
	Daucus glochidiatus																		
	Daviesia decurrens					0.00													
	Daviesia horrida																		
	Daviesia physodes																		
	Daviesia preissii																		
	Daviesia rhombifolia																		
	Desmocladus fasciculatus	0.01																	
	Desmocladus flexuosus			0.20	0.10	0.40						0.14							
	Dianella revoluta					0.10	1.50								0.00				
	Dichopogon capillipes																		
*	*Disa bracteata*																		
	Diuris longifolia																		
	Drosera bulbosa																		
	Drosera erythrorhiza		0.15	0.08	1.18		0.50	0.03	0.05			0.10	0.00	0.00					
	Drosera macrantha																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Drosera microphylla																		
	Drosera pallida			0.05									0.00	0.01	0.01	0.00	0.00		
	Drosera platystigma																		
	Drosera pulchella																		
	Drosera sp.	0.05	0.58			0.16	0.35		0.32					0.00	0.01	0.00	0.01		
	Drosera sp. (climbing)																		
	Drosera sp. 1																		
	Drosera sp. 2																		
	Drosera stolonifera						0.50												
	Elythranthera brunonis																		
	Empodisma gracillimum																		
*	*Erigeron sumatrensis*																		
	Eriochilus dilatatus												0.00						
	Eriochilus scaber																		
	Eriochilus tenuis																		
	Eucalyptus marginata	14.21	6.69	7.50	23.38	1.54	5.88	3.87	12.29	1.42	71.70	23.32	26.96	24.81	22.15	12.97	53.17	33.03	22.94
	Eucalyptus marginata (seedling)																		
	Eucalyptus megacarpa																		
	Eucalyptus patens																		
	Eucalyptus patens (seedling)																		
	Eucalyptus rudis																		
	Eucalyptus sp.					0.14	8.30												
	Euchiton sphaericus																		
	Gahnia decomposita																		
	Gastrolobium ebracteolatum																		
	Gastrolobium spinosum																		
	Gastrolobium villosum																		
	Glischrocaryon aureum																		
	Gompholobium capitatum																		
	Gompholobium cyaninum				0.03														
	Gompholobium knightianum			3.40			1.50								0.01				

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Gompholobium marginatum			0.70	0.10		0.20					0.13							
Gompholobium polymorphum	0.01		0.30					0.60						0.02	0.00	0.01		
Gompholobium preissii															0.00			
Gompholobium tomentosum																		
Gompholobium sp.									0.20									
Gompholobium sp.1																		
Gonocarpus benthamii																		
Gonocarpus cordiger																		
Gonocarpus sp.																		
Goodenia sp.1																		
Goodenia trinervis																		
Grevillea bipinnatifida																		
Grevillea pulchella																		
Grevillea quercifolia																		
Grevillea synapheae																		
Grevillea variifolia																		
Grevillea wilsonii						22.00									5.69			
Haemodorum laxum															0.00	0.01	0.00	
Haemodocum spicatum																		
Haemodorum sp.				0.20	0.30				2.50	0.30								
Haemodorum sp. 1																		
Haemodorum sp. 2																		
Haemodoraceae sp.																		
Hakea amplexicaulis					6.20													
Hakea cyclocarpa																		
Hakea lissocarpha															0.01			
Hakea prostrata																		
Hakea ruscifolia															0.02			
Hakea varia																		
Hemiandra pungens																		
Hemigenia pritzelii				0.42														0.00

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Hibbertia acerosa				21.44	0.90	7.20	0.01		12.10	12.00	1.00	0.64						
Hibbertia amplexicaulis		0.25			1.50	15.40		0.40	0.95	3.70	2.40	0.02	0.01	0.05	0.05	0.04	0.20	
Hibbertia commutata		0.01	0.30		13.20	23.40	4.50	1.10	3.67		9.55	0.01	0.02	0.20	0.18	0.04	0.06	
Hibbertia commutata (seedling)																		
Hibbertia diamesogenos																		
Hibbertia huegelii					0.20								0.06					
Hibbertia hypericoides					1.25													
Hibbertia lasiopus							1.50			2.80								
Hibbertia lineata																		
Hibbertia ovata					0.90							0.16		0.00				
Hibbertia perfoliata					1.70						0.50							
Hibbertia quadricolor												0.06						
Hibbertia racemosa												0.05						
Hibbertia sp.																		
Hibbertia striata																		
Hovea chorizemifolia	0.13	0.64	7.90	0.07		1.05	0.10	0.92	0.02	1.00	0.34	0.00		0.01	0.00	0.01	0.01	0.00
Hovea trisperma																		
Hyalosperma cotula																		
Hybanthus calycinus												0.01		0.00			0.02	
Hybanthus debilissimus																		
Hybanthus floribundus											7.77	0.00						
Hybanthus floribundus subsp. *floribundus*																		
Hydrocotyle callicarpa													0.00		0.00			
Hypocalymma angustifolium													2.23					
Hypocalymma cordifolium																		
* *Hypochaeris glabra*													0.00					
Hypolaena exsulca																		
Isolepis marginata																		
Isotoma hypocrateriformis																		
Isotropis cuneifolia																		
Jacksonia alata																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
* *Juncus bufonius*																		
Juncus planifolius																		
Juncus subsecundus																		
Kennedia coccinea											0.36			0.01				
Kennedia prostrata																		
Kingia australis																		
Kunzea glabrescens																		
Kunzea recurva																		
Labichea punctata												0.00		0.01	0.02			
Lachnagrostis filiformis																		
Lagenophora huegelii		0.40				1.20	0.19	0.40	0.02				0.04	0.01		0.02		
Lasiopetalum floribundum	29.00	32.80			146.72						117.50	0.10	3.85	6.28	0.00	1.13	9.48	1.35
Lasiopetalum glabratum															0.53			
Lasiopetalum glutinosum																		
Laxmannia squarrosa																		
Lechenaultia biloba	0.41	0.07				0.40	0.20	0.10		0.90		0.00				0.00		
Lepidobolus preissianus subsp. *preissianus*																		
Lepidosperma gracile																		
Lepidosperma leptostachyum																		
Lepidosperma longitudinale																		
Lepidosperma pubisquameum																		
Lepidosperma squamatum												0.00						
Lepidosperma tenue					4.00		1.10			4.40		0.00						
Lepidosperma tetraquetrum																		
Lepidosperma sp.																		
Lepidosperma sp.1																		
Leporella fimbriata																		
Leptocarpus coangustatus					0.01													
Leptomeria cunninghamii			0.00		6.00													
Leptospermum erubescens																		
Leucopogon australis																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Leucopogon capitellatus					0.30	11.00					0.20			0.29	0.00	0.01		0.05
Leucopogon hirsutus																		
Leucopogon parviflorus																		
Leucopogon sprengelioides																		
Leucopogon verticillatus					6.10					2.00	1.30			0.19		0.02		
Levenhookia pusilla				0.03			1.00						0.00		0.01			
Levenhookia stipitata																		
Lindsaea linearis																		
Liparophyllum capitatum																		
Lobelia gibbosa																		
Lobelia sp.																		
Lomandra brittanii													0.00	0.00				
Lomandra caespitosa	27.60	2.53	1.20	8.63	0.50	2.00	0.32	1.82	3.12	8.10	29.10	0.51	0.33	0.05	0.01	0.03	0.00	0.39
Lomandra drummondii		7.35							0.20									
Lomandra hermaphrodita	1.01	0.20	9.00	0.32	2.90	7.70	2.43	1.01	0.43	3.70	0.32	0.03	0.05		0.03	0.01		
Lomandra integra																		
Lomandra micrantha														2.05	0.03	0.82		0.37
Lomandra micrantha subsp. *micrantha*																		
Lomandra nigricans			4.00									0.00	0.00			0.01		
Lomandra odora			1.90		0.40	0.10												
Lomandra preissii	3.20						0.30	1.00				0.01	0.01			0.02	0.11	
Lomandra purpurea						0.30												
Lomandra sericea		0.07													0.00	0.01		
Lomandra sonderi	3.50	7.80	6.60	0.80	1.00	19.60	1.00	20.50	4.20	6.70	35.50	1.61	0.02	0.37	0.98	1.44		0.40
Lomandra sp.				0.01	3.20						0.80		0.00			0.00		
Lomandra sp.1																		
Lomandra spartea		0.60	5.10		3.80	17.50	4.10		0.08		4.50	0.01	0.06	0.01	0.14	0.01		
Loxocarya cinerea				0.01				0.60		1.20	6.35	0.00			0.11			
Lyperanthus serratus																		
Lysimachia arvensis																		
Macrozamia riedlei	33.50	34.50	9.00			57.00	42.60	82.40	13.00		7.10		2.20	2.83		0.98	13.10	1.01

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Macrozamia riedlei (seedling)																		
Marianthus drummondianus																		
Melaleuca incana																		
Melaleuca parviceps																		
Melaleuca preissiana																		
Melaleuca viminea																		
Melaleuca viminea (seedling)																		
Mesomelaena graciliceps																		
Mesomelaena stygia																		
Mesomelaena tetragona																		
Microtis media																	0.02	
Millotia tenuifolia				0.02									0.00					
Mirbelia dilatata																		
Monotaxis grandiflora													0.01					
Monotaxis grandiflora var. *grandiflora*																		
Monotaxis occidentalis																		
Neurachne alopecuroidea											0.10				0.01			0.01
Olax benthamiana																		
Opercularia apiciflora														0.00			0.03	0.02
Opercularia echinocephala	0.70	1.16		0.19		0.50	0.30	1.42					0.01			0.01		
Opercularia hispidula																		
Opercularia vaginata					0.10													
Opercularia sp.																		
Orchidaceae sp.																		
Orchidaceae sp. 1																		
Orchidaceae sp. 2																		
Orianthera serpyllifolia		0.03												0.01				
* *Oxalis compressa*																		
* *Oxalis corniculata*																		
Paraserianthes lophantha																		
Paspalidium sp.?																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Patersonia babianoides														0.00	0.00	0.00		
Patersonia juncea																		
Patersonia occidentalis								0.10				0.03			0.25	0.16		
Patersonia pygmaea								0.05										
Patersonia rudis															0.00			
Pentapeltis peltigera	0.03	0.24	0.40	0.21	5.70	6.75	1.24	0.52	0.85	3.80	6.49	0.09	0.11	0.11	0.04	0.10	0.02	
Pericalymma ellipticum				0.80														
Persoonia elliptica												0.10						
Persoonia longifolia					10.50	0.50			1.50		2.00	0.07	0.24	1.41	0.01	0.01	0.10	
Persoonia longifolia (seedling)																		
Persoonia sp.																		
Petrophile macrostachya																		
Pheladenia deformis																		
Philotheca spicata							0.01				0.10							
Philydrella drummondii																		
Philydrella pygmaea																		
Phyllangium paradoxum																		
Phyllanthus calycinus	6.00	2.80	37.40	20.55		27.90	3.10	4.20		0.10	9.00	0.00		0.28	1.96	0.86		
Pimelea ciliata																		
Pimelea lehmanniana																		
Pimelea suaveolens			2.80				0.05								0.01			
Pimelea sp.																		
Plantago lanceolata																		
Platysace commutata																		
Platysace compressa	0.01	37.20					5.54	40.40		0.30			0.01	0.02		0.07		
Platysace filiformis			9.30		2.00	0.10				0.20								
Platysace tenuissima	1.00			1.00								0.00						
Poaceae sp.																		
Podolepis capillaris																		
Podotheca angustifolia																		
Podotheca gnaphalioides																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Poranthera microphylla															0.00			
Prasophyllum brownii																		
Prasophyllum elatum																		
Prasophyllum sp.																		
Prasophyllum sp.1																		
Pseudognaphalium luteoalbum				0.62														
Pteridium esculentum		8.20		0.02	0.42												1.32	2.25
Pterochaeta paniculata										0.10								
Pterostylis barbata																		
Pterostylis pyramidalis																		
Pterostylis recurva												0.00						
Pterostylis vittata												0.00						
Pterostylis sp.																		
Pterostylis sp. 1																		
Ptilotus drummondii				0.54														
Ptilotus drummondii var. *drummondii*																		
Ptilotus manglesii																		
Pyrorchis nigricans															0.00			
Ranunculus colonorum																		
Ranunculus muricatus																		
Restionaceae sp.																		
Rytidosperma acerosum																		
Rytidosperma caespitosum															0.02			
Rytidosperma setaceum																		
Rytidosperma sp.																		
Scaevola calliptera	0.01		0.10	0.03	0.96						0.02			0.01		0.00		0.01
Scaevola sp.																		
Scaevola pilosa																		
Senecio diaschides																		
Senecio hispidulus													0.01					
Senecio sp.																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Senecio sp.1																		
	Senecio quadridentatus																		
*	*Sonchus oleraceus*																		
	Sowerbaea laxiflora					0.20													
	Sphaerolobium linophyllum																		
	Sphaerolobium macranthum																		
	Sphaerolobium medium														0.00				
	Sphaerolobium sp.																		
	Stachystemon vermicularis																		
	Stackhousia monogyna																		
	Stirlingia latifolia																		
	Stylidium amoenum		0.30	0.90	0.06		0.40									0.00	0.01		
	Stylidium androsaceum						0.04												
	Stylidium brunonianum																		
	Stylidium bulbiferum																		
	Stylidium calcaratum		0.10						0.10					0.00					
	Stylidium ciliatum																		
	Stylidium crassifolium																		
	Stylidium hirsutum																		
	Stylidium junceum										0.20		0.00			0.00			
	Stylidium lateriticola																		
	Stylidium lineatum																		
	Stylidium piliferum		1.48			0.10	0.70	0.40	0.41							0.00			
	Stylidium recurvum																		
	Stylidium repens																		
	Stylidium rhynchocarpum																		
	Stylidium scabridum																		
	Stylidium scariosum																		
	Stylidium schoenoides					0.50													
	Stylidium spathulatum																		
	Stylidium thesioides																		

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Note: if cover is 0.00 then value is <0.01

Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
Stylidium hispidum															0.01			
Stylidium sp.																		
Stylidium sp. 1																		
Styphelia discolor														0.00				
Styphelia erubescens																		
Styphelia hispida																		
Styphelia nitens		1.00			3.00		1.70	0.90	0.25	2.00	8.20			0.10				
Styphelia pallida		0.90			7.50	5.00		0.20		1.00								
Styphelia propinqua								0.02					0.10					0.03
Styphelia tenuiflora	1.50				4.00	8.00			2.50			0.00		0.05	0.01	0.13		
Synaphea sp.																		
Taxandria linearifolia																		
Tetraria capillaris	5.17	3.80	3.20	1.65	85.80	17.80	1.35	4.04	1.22		0.40	0.16	0.08	0.13	0.06	1.12	0.00	0.09
Tetraria octandra				0.05											0.02			
Tetraria sp. Jarrah Forest (R. Davis 7391)																		
Tetrarrhena laevis	6.16	0.36	4.60		2.69	1.38	0.48	0.43		3.60	2.69	0.02	0.07	0.40	0.05	0.01	0.05	0.02
Tetratheca hirsuta			0.20		0.68	1.90			0.26		2.34	0.01		0.03	0.00	0.00	0.00	0.00
Thelymitra antennifera																		
Thelymitra crinita						0.05						0.02	0.00	0.00		0.00		0.00
Thelymitra macrophylla													0.01					
Thelymitra sp.						0.15									0.00			
Thomasia paniculata																		
Thomasia pauciflora																		
Thysanotus anceps																		
Thysanotus dichotomus					27.40	0.10												
Thysanotus fastigiatus										0.30								
Thysanotus gracilis																		
Thysanotus manglesianus														0.00				
Thysanotus multiflorus			0.70									0.00		0.00			0.00	
Thysanotus patersonii																		
Thysanotus ? scaber																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

	Species	HU1040	HU1041	HU1042	HU1043	HU1044	HU1045	HU1046	HU1047	HU1048	HU1049	HU1050	HU1075	HU1076	HU1077	HU1078	HU1079	HU1080	HU1081
	Thysanotus sp.																0.00		
	Thysanotus sp.1																		
	Thysnaotus sparteus																		
	Thysanotus tenellus	0.02	0.20					0.92	0.11		0.10								
	Thysanotus thyrsoideus	0.20			0.30	0.29	0.20						0.00		0.01	0.01	0.00	0.01	0.01
	Trachymene pilosa		0.35	0.29	0.47		0.01	0.61	0.23		4.50	0.80		0.02	0.01				0.00
	Trichocline spathulata	0.05	0.05		0.05	0.88				0.03		0.07	0.01	0.00	0.01	0.02			0.01
	Tricoryne elatior																		
	Tricoryne humilis																		
	Tripterococcus brunonis																		
*	*Trifolium dubium*																		
	Tripterococcus brunonis																		
	Trymalium ledifolium	1.10	11.00		10.17			16.02	3.20	0.71	8.90		0.00	0.03			0.07		
	Trymalium odoratissimum							0.10											
	Trymalium odoratissimum subsp. *odoratissimum*																		
	Trymalium spatulatum																		
	Utricularia multifida																		
	Viminaria juncea																		
*	*Vulpia myuros*																		
	Wahlenbergia preissii																		
	Wurmbea dioica																		
	Xanthorrhoea gracilis	0.60		12.50		11.30	61.10		4.50	29.10	3.50	57.60	6.65	0.03	1.86	2.37	0.37	0.06	0.35
	Xanthorrhoea preissii						22.60		58.70	9.80		20.00	0.01		4.15			3.09	
	Xanthosia atkinsoniana	0.01		2.80				0.18		0.04		0.05	0.01						0.00
	Xanthosia candida				0.07	0.20					0.50	2.65		0.02		0.01			0.00
	Xanthosia ciliata																		
	Xanthosia huegelii		0.02							0.01			0.00						
	Xanthosia singuliflora					0.05													
	Xylomelum occidentale																		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Acacia alata									0.06														
Acacia applanata																							
Acacia barbinervis												0.01						5.00					
Acacia browniana																							
Acacia celastrifolia													0.06										
Acacia divergens																							
Acacia drummondii					0.00			0.00											0.20		0.10		0.20
Acacia drummondii subsp. *candolleana*																							
Acacia extensa																							0.50
Acacia incrassata																							
Acacia lateriticola					0.01																		0.10
Acacia nervosa																							0.75
Acacia preissiana																							
Acacia pulchella	20.90	12.70			0.11	0.00					0.40		0.01	0.40			1.15	0.72	0.01				0.10
Acacia saligna																							
Acacia stenoptera																							
Acacia urophylla	1.10	1.66	0.17	0.98	1.75			0.03		1.86	0.69		0.31	0.10			1.00	1.43	0.50		0.50	0.88	
Acacia varia						0.04	0.07																
Acacia willdenowiana							0.03																
Acacia sp.															0.20								
Adenanthos barbiger	1.17	0.25	0.03		5.75	2.31	3.94	0.58	5.21	0.02	0.01	5.73	1.71	2.87	4.37	2.83		2.67	2.45	2.00	3.67		5.36
Agrostocrinum scabrum			0.01	0.01	0.01	0.06	0.02				0.02	0.01			0.65	0.35				0.30			
* *Aira caryophyllea*		0.03																					
Allocasuarina fraseriana	0.00		0.46		8.73	25.70	0.01		0.26		2.10	20.33				40.00							16.86
Amphipogon amphipogonoides																							
Amphipogon laguroides																							
Andersonia latiflora																							
Andersonia lehmanniana																							
Anigozanthos manglesii																							
Aotus cordifolia																							
Aphelia cyperoides																							

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Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Astartea scoparia																							
* Asteraceae sp.																0.10							
Austrostipa elegantissima																0.50	0.10						
Austrostipa mollis																							
Austrostipa sp.																							
* *Avena fatua*																							
Babingtonia camphorosmae																							
Banksia bipinnatifida																							
Banksia dallanneyi subsp. *dallanneyi* var. *dallanneyi*						0.59	1.70		1.60			3.66		4.50	8.31		5.81	3.69	2.33	3.00		6.32	
Banksia fraseri															0.50								
Banksia grandis	0.30	0.25	5.95		1.36	0.69	0.03	0.00	0.00	0.00	8.16	0.17	1.81	13.76		2.13		7.87	13.91		5.70	2.00	0.50
Banksia grandis (seedling)																							
Banksia littoralis																							
Banksia sessilis																							
Banksia sphaerocarpa															7.00								
Baumea juncea																							
Billardiera floribunda				0.00																			
Billardiera variifolia												0.01											
Billardiera fraseri						0.02																	
Billardiera fusiformis					0.00																		
Billardiera sp.1																							
Boronia crenulata																							
Boronia crenulata subsp. *viminea*																							
Boronia fastigiata	0.58	0.15	0.21	0.10	0.29	0.08	0.05	0.00	0.07			0.09	0.22		1.05	0.52	0.50	0.96	0.10	0.30	0.20	0.67	0.18
Boronia molloyae																							
Bossiaea aquifolium		5.00												6.38	8.46	1.28	4.15	2.30	9.51	1.70			
Bossiaea ornata			2.26	0.41	0.10	0.22	0.04	0.00	0.02		0.91	11.41	0.37	0.15	0.88	0.26		0.31	0.46	0.48	0.50	0.44	0.30
Bossiaea eriocarpa																							
Bossiaea spinescens																							
Brachyscome pusilla																							
* *Briza minor*	0.00																						

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

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Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Bulbine semibarbata																							
Burchardia congesta	0.01	0.05	0.16	0.10	0.03	0.06		0.01			0.00		0.26							0.10		0.50	
Caladenia flava	0.01	0.00	0.01	0.01	0.01	0.00	0.00		0.04	0.01	0.00		0.01										
Caladenia macrostylis			0.00					0.00															
Caladenia reptans						0.02		0.01															
Caladenia sp.																							
Caladenia sp. 1																							
Calothamnus quadrifidus		0.05																					
Calothamnus sp.																							
Cassytha glabella	0.08	0.07								0.85													
Cassytha racemosa																							
Cassytha sp.																							
Caustis dioica																							
* *Centaurium erythraea*		0.00																					
Centella asiatica																							
Centrolepis drummondiana																							
Centrolepis aristata							0.00																
Chamaescilla corymbosa									0.20			0.12			0.10		0.10						0.75
Chorizema cordatum														0.10		0.60		0.30	0.88	1.50			
Chorizema ilicifolium																							
Chorizema rhombeum																							
Clematis pubescens	0.10	0.36	0.24	0.16				0.20		2.51	0.60		2.65	0.35							2.10	1.20	
Comesperma calymega																							
Comesperma virgatum	0.04	0.02	0.02	0.01	0.02	0.00	0.01	0.00				0.01	0.00				0.15						0.10
Comesperma sp.																							
Conospermum capitatum						0.01																	
Conospermum scaposum																							
Conostylis aculeata								0.01				0.01	0.08										
Conostylis setigera														0.30	0.40	0.26	0.37	0.50		1.36		0.28	0.45
Conostylis setosa						0.01	0.74	0.01	0.09			0.71		0.10	0.26		0.35	0.20		0.55			
Conostylis pusilla																							

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	Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
	Conostylis serrulata	0.01					0.06	0.23	0.03	0.05			0.28											
	Corymbia calophylla			0.62	30.57		0.57	0.07	0.52	0.04	14.33	1.82	9.87	9.65	11.40			13.61	15.88	20.21	16.98	6.88	14.33	0.50
	Corymbia calophylla (seedling)																							
	Craspedia variabilis																					0.75		
	Cryptandra arbutiflora var. *arbutiflora*																							
	Cryptostylis ovata			0.02																				
	Cyanicula sericea			0.01					0.00															
	Cyathochaeta avenacea		0.00	0.08	1.20	0.24	13.48	7.98	5.85	7.17			15.34	1.54	0.10	0.40	0.90	3.63	1.44	2.04			0.48	
*	*Cyperus rotundus*																							
	Cyperaceae sp.																		0.20					
	Cyrtostylis robusta		0.03	0.00		0.14								0.10										
	Dampiera alata																							
	Dampiera hederacea																							
	Dampiera linearis						0.44	0.03				0.05	0.02	0.19				0.20	0.50					0.10
	Dampiera pedunculata																							
	Dasypogon bromeliifolius																							
	Daucus glochidiatus		0.09		0.00						0.01			0.45										
	Daviesia decurrens									0.02			0.68						0.75					
	Daviesia horrida																							
	Daviesia physodes																							
	Daviesia preissii																		1.50					
	Daviesia rhombifolia															0.20								
	Desmocladus fasciculatus																							
	Desmocladus flexuosus	1.15						0.01	2.79			8.91	0.66			0.10			0.17				0.20	
	Dianella revoluta																			1.45				
	Dichopogon capillipes																							
*	*Disa bracteata*										0.00			0.01										
	Diuris longifolia	0.00				0.00				0.01				0.00										
	Drosera bulbosa			0.00		0.02		0.17					0.01	0.01										
	Drosera erythrorhiza	0.00		0.03			0.06						0.06	0.07										
	Drosera macrantha					0.15							0.01											

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Drosera microphylla						0.00																	
Drosera pallida	0.03		0.05		0.01	0.00		0.22	0.04			0.01											
Drosera platystigma							0.01																
Drosera pulchella																							
Drosera sp.																0.04			0.10			0.20	
Drosera sp. (climbing)																							
Drosera sp. 1																							
Drosera sp. 2																							
Drosera stolonifera							0.05			0.05													
Elythranthera brunonis																							
Empodisma gracillimum																							
* *Erigeron sumatrensis*		0.01																					
Eriochilus dilatatus					0.00			0.00	0.01		0.00												
Eriochilus scaber																							
Eriochilus tenuis																							
Eucalyptus marginata			51.90	35.71	19.86	14.87	0.19	1.08	0.89	35.67	21.71	44.12	60.29	28.17	23.54	16.01	31.50	36.15	22.55	13.16	23.47	30.79	14.21
Eucalyptus marginata (seedling)																							
Eucalyptus megacarpa																							
Eucalyptus patens																							
Eucalyptus patens (seedling)																							
Eucalyptus rudis																							
Eucalyptus sp.																		0.15					0.46
Euchiton sphaericus																							
Gahnia decomposita																							
Gastrolobium ebracteolatum																							
Gastrolobium spinosum																							
Gastrolobium villosum																							0.10
Glischrocaryon aureum									0.03			0.02											
Gompholobium capitatum																							
Gompholobium cyaninum																							0.50
Gompholobium knightianum							0.01					0.10					0.20						0.50

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Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Gompholobium marginatum	0.03						0.00		0.01								0.24	0.10				0.20	
Gompholobium polymorphum			0.02			0.02	0.29		0.07					0.20	0.20	0.70	0.19	0.10				0.18	
Gompholobium preissii	0.30	0.29				0.03	0.13		0.09			0.27					0.75			0.20			0.26
Gompholobium tomentosum																							
Gompholobium sp.																							
Gompholobium sp.1																							
Gonocarpus benthamii																							
Gonocarpus cordiger																						0.20	
Gonocarpus sp.																	0.05						
Goodenia sp.1																							
Goodenia trinervis																							
Grevillea bipinnatifida																							
Grevillea pulchella																							
Grevillea quercifolia							0.24																
Grevillea synapheae						0.07																	
Grevillea variifolia																							
Grevillea wilsonii	0.13					4.76									18.56			15.00					3.00
Haemodorum laxum			0.00										0.00										
Haemodocum spicatum							0.01																
Haemodorum sp.																							
Haemodorum sp. 1																							
Haemodorum sp. 2																							
Haemodoraceae sp.															0.10						0.20		
Hakea amplexicaulis																							
Hakea cyclocarpa												0.61											
Hakea lissocarpha				0.05					0.22		0.11											1.20	
Hakea prostrata																							
Hakea ruscifolia					0.82		0.69					0.92											
Hakea varia																							
Hemiandra pungens																							
Hemigenia pritzelii			0.00		0.01	0.00							0.00		0.75								

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Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Hibbertia acerosa																	0.08					0.10	
Hibbertia amplexicaulis	1.39	0.18	0.20	0.57	0.47		0.69	0.08	0.01	1.19	0.18		0.40	0.48	1.69	1.03	0.38	1.32	0.71	0.25	2.38		0.87
Hibbertia commutata	0.59	0.45	0.38	0.63	0.71	0.83	0.51	0.23	0.53	0.01	0.31	0.58	0.22	2.18	2.15	1.00	1.50	8.25	1.32		10.93	2.64	0.61
Hibbertia commutata (seedling)																							
Hibbertia diamesogenos																							
Hibbertia huegelii						0.00																	1.50
Hibbertia hypericoides																					5.40		
Hibbertia lasiopus																							
Hibbertia lineata																							
Hibbertia ovata																							
Hibbertia perfoliata																1.00		1.00	1.50		0.92		
Hibbertia quadricolor																							
Hibbertia racemosa																							
Hibbertia sp.														1.00					0.40		1.50	0.20	
Hibbertia striata																							
Hovea chorizemifolia			0.12	0.07	0.38	0.11	0.00	0.05	0.01	0.11		0.10	0.16			0.32	0.10	0.05	0.34	0.08		0.01	0.30
Hovea trisperma	0.32	0.32	0.15	0.15	0.26	0.23	0.65	0.39	0.08	0.39	0.22		0.24										
Hyalosperma cotula																							
Hybanthus calycinus									0.01			0.06											
Hybanthus debilissimus																							
Hybanthus floribundus																							
Hybanthus floribundus subsp. *floribundus*																							
Hydrocotyle callicarpa									0.01														
Hypocalymma angustifolium	0.01					0.09	0.09					0.01					8.42					1.90	
Hypocalymma cordifolium																							
* *Hypochaeris glabra*	0.05	0.58	0.01		0.00	0.00	0.00	0.00	0.00	0.00			0.00										
Hypolaena exsulca						0.20	1.75																
Isolepis marginata																							
Isotoma hypocrateriformis																							
Isotropis cuneifolia																							
Jacksonia alata																							

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
* *Juncus bufonius*													0.03										
Juncus planifolius																							
Juncus subsecundus																							
Kennedia coccinea	0.39	0.08	0.40	0.20	0.11	0.58	0.02	0.13	0.06		0.01	0.01	0.07						0.10		0.10		0.10
Kennedia prostrata																						0.60	
Kingia australis																							
Kunzea glabrescens																							
Kunzea recurva																							
Labichea punctata	0.03		0.09		0.02	0.02	0.01				0.03	0.02			0.10		0.10		0.20				
Lachnagrostis filiformis		0.01																					
Lagenophora huegelii	0.17	0.16	0.08	0.04	0.04			0.44	0.03	0.32	0.04	0.00	0.13	0.20	0.20	0.06		0.20			0.21	0.73	1.00
Lasiopetalum floribundum			21.62	16.73	10.65			4.90		16.18	1.38		21.60	2.66	3.50	8.11		6.89	4.47		5.22	5.21	0.90
Lasiopetalum glabratum						0.78			0.78			0.02											0.20
Lasiopetalum glutinosum						0.35						0.28											
Laxmannia squarrosa																							
Lechenaultia biloba		0.10	0.01					0.01	0.01			0.04	0.03	0.10	1.51	0.10	0.75						0.37
Lepidobolus preissianus subsp. *preissianus*																							
Lepidosperma gracile																							
Lepidosperma leptostachyum	0.12	0.03						0.38	0.01	0.27	1.27	0.65	0.03										
Lepidosperma longitudinale																							
Lepidosperma pubisquameum																							
Lepidosperma squamatum	0.03	0.01				0.18			0.06			1.95											
Lepidosperma tenue									0.01			0.07											
Lepidosperma tetraquetrum																							
Lepidosperma sp.															1.00	0.50	0.10						
Lepidosperma sp.1																							
Leporella fimbriata			0.00		0.00	0.00	0.00	0.01	0.02														
Leptocarpus coangustatus																							
Leptomeria cunninghamii	1.49			0.03	0.11			0.21						1.58									
Leptospermum erubescens																	0.10						
Leucopogon australis														1.50									

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Leucopogon capitellatus	0.24	0.42	1.92	5.91	0.55			0.25		0.22	2.69		3.96	4.13				0.63	2.00			2.20	
Leucopogon hirsutus																							
Leucopogon parviflorus																							
Leucopogon sprengelioides																							
Leucopogon verticillatus			1.01	1.28	1.02					0.75	0.66		0.10	1.00				1.50					
Levenhookia pusilla	0.00						0.50	0.01	0.02						0.10	0.10	0.08					0.13	0.05
Levenhookia stipitata																						0.05	
Lindsaea linearis						0.67																	
Liparophyllum capitatum																							
Lobelia gibbosa																							
Lobelia sp.																							
Lomandra brittanii	0.04		0.00						0.03			0.01											
Lomandra caespitosa	0.03			0.09	0.02		0.34	0.01	0.46	0.01	0.01	0.01	0.05										
Lomandra drummondii	0.36	0.50	1.10	2.35	1.82		0.06	1.43	0.36	1.05	1.09	0.05				1.00		0.80			1.38		0.10
Lomandra hermaphrodita	0.07		0.08	0.05	0.07	0.02	0.43	0.03	0.15	0.01	0.08	0.36	0.12	0.66	0.59	1.40	0.38	0.30	0.21	0.47	0.40	0.63	0.28
Lomandra integra							0.00																
Lomandra micrantha			0.27	0.00	0.50						0.00			2.27				1.59	0.34			0.50	
Lomandra micrantha subsp. *micrantha*																							
Lomandra nigricans			1.41	0.10	0.20	0.00		0.01		0.07	0.11		0.19			0.50				0.50	0.50	0.10	
Lomandra odora	0.07	0.08			0.03		0.47	0.19	0.03			0.00	0.02										
Lomandra preissii	0.02	0.02	0.00	0.00	0.09	0.09		0.05	0.05	0.01	0.05	0.04	0.16		0.10	1.53	0.90			0.20	1.33		
Lomandra purpurea									0.03			0.16											
Lomandra sericea																							
Lomandra sonderi			0.50		1.09	0.82	5.21	0.51	1.66			2.61	0.23	4.00	2.41	3.25	3.50	3.00	1.60	4.50	0.50	1.50	1.65
Lomandra sp.																1.50				0.80	1.00	0.50	
Lomandra sp.1																							
Lomandra spartea				0.00	0.12			0.09	0.02			0.01		0.63	1.28	0.18	0.39	0.83		0.40			0.45
Loxocarya cinerea					2.22	0.46																	
Lyperanthus serratus																							
Lysimachia arvensis		0.00																					
Macrozamia riedlei	10.98	5.55	3.88	1.67	1.10			1.33		2.59	1.67		4.17	0.33	2.50	0.50	1.00		9.33	27.50	18.21	3.75	

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Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Macrozamia riedlei (seedling)																							
Marianthus drummondianus																						0.83	
Melaleuca incana																							
Melaleuca parviceps																							
Melaleuca preissiana																							
Melaleuca viminea																							
Melaleuca viminea (seedling)																							
Mesomelaena graciliceps							0.02																
Mesomelaena stygia																							
Mesomelaena tetragona						1.50																	
Microtis media																							
Millotia tenuifolia								0.00															
Mirbelia dilatata	0.43		0.60	5.00			0.14																
Monotaxis grandiflora						0.20			0.22			0.35	5.00										
Monotaxis grandiflora var. *grandiflora*																							
Monotaxis occidentalis									0.02			0.05											
Neurachne alopecuroidea	0.23	0.10	0.12	0.22	0.40	0.04	0.10	0.32	0.21	0.05	0.26	0.46	0.77	0.40				0.10					0.20
Olax benthamiana																							
Opercularia apiciflora			0.23	0.08	0.11		0.03			0.23	0.05		0.07										
Opercularia echinocephala	0.22	0.04		0.04	0.02		0.01	0.00	0.11			0.01	0.26	0.28				1.03	1.00	0.71		0.61	0.10
Opercularia hispidula										2.34													
Opercularia vaginata																							0.45
Opercularia sp.																							
Orchidaceae sp.																	0.01						
Orchidaceae sp. 1																							
Orchidaceae sp. 2																							
Orianthera serpyllifolia																							
* *Oxalis compressa*																							
* *Oxalis corniculata*	0.02	0.03		0.00									0.05										
Paraserianthes lophantha																							
Paspalidium sp.?																							

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Patersonia babianoides			0.01	0.01		0.00	0.05	0.01		0.00	0.00	0.00	0.01										
Patersonia juncea																							
Patersonia occidentalis																	0.90				1.96		0.71
Patersonia pygmaea							0.00	0.00	0.02			0.01											
Patersonia rudis									0.34			1.86											
Pentapeltis peltigera	0.44	0.19	1.25	0.23	0.13	0.90	1.19	0.59	0.31	13.33	2.09	0.39	0.33	0.20		0.10	0.42	0.38		0.13	0.15	0.50	0.37
Pericalymma ellipticum																		2.00					
Persoonia elliptica										0.00		4.25											
Persoonia longifolia		0.39	0.19	0.20	2.07	1.09	0.01	0.12		9.76	0.43	2.26	2.14	0.95	8.00	1.00		4.38	2.40		1.98	3.67	2.36
Persoonia longifolia (seedling)																							
Persoonia sp.																							0.20
Petrophile macrostachya																							
Pheladenia deformis																							
Philotheca spicata																	1.00						
Philydrella drummondii																							
Philydrella pygmaea																							
Phyllangium paradoxum																							
Phyllanthus calycinus	0.11	0.21					0.00	0.00	0.13			0.00		0.20		0.50	11.71	1.50			2.67	3.02	3.59
Pimelea ciliata	2.55							2.44	0.01											0.10	0.25		
Pimelea lehmanniana												0.04											
Pimelea suaveolens									0.03			0.05			0.46								
Pimelea sp.																							
Plantago lanceolata																							
Platysace commutata																							
Platysace compressa			1.93	0.01									2.37			0.13		3.01	0.16	0.83		2.50	0.34
Platysace filiformis																							
Platysace tenuissima																							
Poaceae sp.																0.30						0.10	
Podolepis capillaris																							
Podotheca angustifolia																							
Podotheca gnaphalioides																							

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Poranthera microphylla									0.01														
Prasophyllum brownii																							
Prasophyllum elatum										0.02	0.01												
Prasophyllum sp.																							
Prasophyllum sp.1																							
Pseudognaphalium luteoalbum																							
Pteridium esculentum	0.22	1.83		0.03						7.11	3.52		15.14								4.99		
Pterochaeta paniculata																							
Pterostylis barbata					0.02																		
Pterostylis pyramidalis						0.00	0.00	0.04	0.00			0.01											
Pterostylis recurva							0.00																
Pterostylis vittata			0.02		0.05	0.00		0.00	0.01			0.01	0.01										
Pterostylis sp.																							
Pterostylis sp. 1																							
Ptilotus drummondii																							
Ptilotus drummondii var. *drummondii*																							0.55
Ptilotus manglesii							0.01															1.70	
Pyrorchis nigricans		0.00																					
Ranunculus colonorum														0.10	0.14				0.05			0.10	0.28
Ranunculus muricatus																							
Restionaceae sp.																							
Rytidosperma acerosum																							
Rytidosperma caespitosum																							
Rytidosperma setaceum					0.00																		
Rytidosperma sp.																							
Scaevola calliptera	0.13		0.22	0.71	0.05	0.24	0.03	0.15	0.13	0.67	0.02	0.01	0.12	0.10	0.14				0.05			0.10	0.28
Scaevola sp.																							
Scaevola pilosa										0.02													
Senecio diaschides		0.03																					
Senecio hispidulus								0.04	0.00														
Senecio sp.																							

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Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Senecio sp.1																							
Senecio quadridentatus		0.00																					
* *Sonchus oleraceus*					0.00	0.00			0.00														
Sowerbaea laxiflora																							
Sphaerolobium linophyllum			0.00				0.07		0.01														
Sphaerolobium macranthum																							
Sphaerolobium medium	0.15																						
Sphaerolobium sp.																							
Stachystemon vermicularis																							
Stackhousia monogyna																						0.50	
Stirlingia latifolia																							
Stylidium amoenum					0.06			0.04	0.00		0.31			0.50		0.10	0.02	0.10	0.05				
Stylidium androsaceum																0.04						0.12	
Stylidium brunonianum																							
Stylidium bulbiferum					0.00												0.02		0.50				0.06
Stylidium calcaratum				0.01		0.00		0.00		0.01				0.10						0.10			
Stylidium ciliatum															0.05		0.05		0.09	0.02			
Stylidium crassifolium																							
Stylidium hirsutum																							
Stylidium junceum																		0.10					
Stylidium lateriticola					0.01			0.02				0.02											
Stylidium lineatum																	2.00						
Stylidium piliferum						0.00		0.02						0.10	0.41	0.04	0.63	0.10	0.19	0.65		0.20	0.10
Stylidium recurvum																							
Stylidium repens																							
Stylidium rhynchocarpum																							
Stylidium scabridum																							
Stylidium scariosum																							
Stylidium schoenoides			0.01		0.01		0.01																
Stylidium spathulatum																							
Stylidium thesioides																							

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Stylidium hispidum	0.06	0.02					0.20	0.07	0.09														
Stylidium sp.																							
Stylidium sp. 1																							
Styphelia discolor		0.15	0.11	0.02		0.01				0.40									1.30			0.20	
Styphelia erubescens																							
Styphelia hispida																		0.20					0.20
Styphelia nitens			0.18				0.31							10.00	1.35		4.35						
Styphelia pallida											0.22	0.07	0.06										
Styphelia propinqua	0.60	0.01	0.10	0.24		0.00	0.06					0.03	0.01	1.00	1.00		0.50	0.33	1.50				1.00
Styphelia tenuiflora	0.02						0.01					0.04			2.24	0.50			2.00		0.65		
Synaphea sp.																							
Taxandria linearifolia																							
Tetraria capillaris	0.13	0.03	0.98	0.75	0.31	0.08	0.09	0.15	0.02	6.07	2.90	1.11	1.54										
Tetraria octandra						0.42	1.89	0.03				0.40											
Tetraria sp. Jarrah Forest (R. Davis 7391)														2.61	0.63	1.29	4.43	1.82	2.25	1.39	2.17	1.37	1.67
Tetrarrhena laevis	0.03	0.09	0.61	0.52	0.29	0.19	0.06	0.14	0.12	0.94	0.60	0.39	0.88	0.50	0.27	0.31	0.52	0.36	1.50		0.96	0.35	
Tetratheca hirsuta	1.09		0.29	0.00	0.57					0.05	0.17	0.06	0.03	0.13	0.17		1.00	0.22	0.55		0.10	0.50	0.13
Thelymitra antennifera																							
Thelymitra crinita	0.01		0.01	0.01	0.01	0.06	0.00	0.02	0.05	0.07	0.04	0.03	0.02										
Thelymitra macrophylla								0.00		0.00	0.00												
Thelymitra sp.																	0.05						
Thomasia paniculata																							
Thomasia pauciflora																							
Thysanotus anceps																							
Thysanotus dichotomus									0.17			0.95			0.75	1.00				0.50			
Thysanotus fastigiatus														0.55	0.34	0.10	0.20	0.20		0.40		0.50	0.25
Thysanotus gracilis																							
Thysanotus manglesianus															2.50								
Thysanotus multiflorus	0.02	0.05	0.02	0.07	0.20	0.12	0.08	0.09	0.07	0.01	0.00	0.03	0.14		0.68	0.17	0.20	0.75	0.50	0.17			0.30
Thysanotus patersonii		0.01								0.03													
Thysanotus ? scaber																							

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Species	JD134	JD135	JD78	JD79	JD80	JD81	JD82	JD83	JD84	JD85	JD86	JD87	JD88	FMP001	FMP002	FMP003	FMP004	FMP005	FMP006	FMP007	FMP008	FMP009	FMP010
Thysanotus sp.																							
Thysanotus sp.1																							
Thysnaotus sparteus												0.11											
Thysanotus tenellus																							
Thysanotus thyrsoideus	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.01	0.03	0.01	0.01	0.00	0.01	0.05	0.20	0.14		0.37		0.18		0.08	0.24
Trachymene pilosa	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00			0.00			0.25						0.69	0.10
Trichocline spathulata			0.01		0.09			0.22	0.18	0.03	0.22	0.12		0.09	0.11	0.22	0.10	0.21	0.08	0.20		0.75	0.15
Tricoryne elatior							0.01		0.08				0.01										
Tricoryne humilis						0.03	0.02					0.03											
Tripterococcus brunonis																							0.08
* *Trifolium dubium*																							
Tripterococcus brunonis																							
Trymalium ledifolium	6.58	0.00			0.02				0.53					0.30	1.69		1.74	1.08				0.98	5.46
Trymalium odoratissimum																							
Trymalium odoratissimum subsp. *odoratissimum*			0.01							3.95													
Trymalium spatulatum																							
Utricularia multifida																							
Viminaria juncea																							
* *Vulpia myuros*										0.01		0.04	0.09										
Wahlenbergia preissii																							
Wurmbea dioica																							
Xanthorrhoea gracilis	0.18	4.30	9.01	2.03	0.76	0.18	4.37	5.75	2.74	8.93	0.03	5.02	2.98		8.76		3.92				7.10		
Xanthorrhoea preissii	14.82	26.80		19.66	16.15	9.48	11.15	2.28		0.10	39.65			19.84	6.00	3.50	5.54		18.89		42.50		
Xanthosia atkinsoniana					0.01		0.05	0.04	0.01			0.03			0.15				1.23		0.10		1.67
Xanthosia candida	0.10	0.00		0.03	0.23	0.16	0.08	0.15	0.21	1.40		0.03	0.67	0.06	0.10						0.18	3.95	0.44
Xanthosia ciliata						0.10																	
Xanthosia huegelii	0.01					0.00	0.01	0.01	0.00		0.00												0.20
Xanthosia singuliflora																							
Xylomelum occidentale																							

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Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Acacia alata																		1.05				0.01
Acacia applanata			0.04																			
Acacia barbinervis														0.35	0.23			0.17				
Acacia browniana																						
Acacia celastrifolia																						
Acacia divergens											4.50											
Acacia drummondii														2.00								
Acacia drummondii subsp. *candolleana*																	5.17			0.20		0.10
Acacia extensa			0.35													3.00				4.00		
Acacia incrassata																						
Acacia lateriticola														0.50								
Acacia nervosa																						
Acacia preissiana																						
Acacia pulchella			19.25		0.07	0.16					0.16					5.24	1.45			6.89		
Acacia saligna				3.51																		
Acacia stenoptera														0.51	0.10							
Acacia urophylla			1.49			0.05	0.01					0.02					1.17			0.88		
Acacia varia																						
Acacia willdenowiana																						
Acacia sp.																						
Adenanthos barbiger	2.55	1.95	3.57		2.48	1.83		1.93	1.47			2.91	2.34	1.09	2.17		2.30					1.39
Agrostocrinum scabrum																						
* *Aira caryophyllea*																			0.27			
Allocasuarina fraseriana		14.23							9.96	19.78		5.00	25.92		38.09			1.75				21.63
Amphipogon amphipogonoides														1.00	0.20				0.05		0.27	0.21
Amphipogon laguroides																						
Andersonia latiflora																						
Andersonia lehmanniana																0.51						
Anigozanthos manglesii				0.10															1.24			
Aotus cordifolia											0.04											
Aphelia cyperoides				0.46																		

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Astartea scoparia				3.00							11.50					8.50			2.00			
* Asteraceae sp.				0.01																		
Austrostipa elegantissima																						
Austrostipa mollis																0.50						
Austrostipa sp.						0.01																
* *Avena fatua*																						
Babingtonia camphorosmae																						
Banksia bipinnatifida																					2.25	
Banksia dallanneyi subsp. *dallanneyi* var. *da*	7.66	2.60				13.84	1.50	0.80	0.69	0.15	2.53	1.43			1.88	4.78	1.15	1.90	3.16	4.00	4.76	0.74
Banksia fraseri																						
Banksia grandis		2.74	3.56		14.08	7.03		8.20	4.43	25.00			1.05		6.33		2.25	7.53		20.00		
Banksia grandis (seedling)	0.01	2.50			5.17				0.02													
Banksia littoralis											60.00											
Banksia sessilis	0.54	1.00						2.00														
Banksia sphaerocarpa																						
Baumea juncea																						
Billardiera floribunda											25.00				25.00							
Billardiera variifolia							75.00	575.00														
Billardiera fraseri																						
Billardiera fusiformis										0.05												
Billardiera sp.1															0.30							
Boronia crenulata											12.66											
Boronia crenulata subsp. *viminea*											7.10											
Boronia fastigiata	0.06	0.44	0.08		0.28			0.10	0.53	0.06		0.05	0.01	0.01			0.92	1.02			0.50	0.05
Boronia molloyae																						
Bossiaea aquifolium									0.06			0.05										
Bossiaea ornata		0.01	0.62		0.30	0.01		0.14	0.02	0.02		0.02	0.06	0.63	0.24	0.10		0.49		0.53	0.31	0.43
Bossiaea eriocarpa																						
Bossiaea spinescens																						1.20
Brachyscome pusilla																			0.95			
* *Briza minor*																0.10						

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Bulbine semibarbata																						
Burchardia congesta																						
Caladenia flava	0.02																0.40		0.17			
Caladenia macrostylis																						
Caladenia reptans																						
Caladenia sp.	0.01				0.01			0.02	0.01	0.01		0.01										
Caladenia sp. 1	0.01																					
Calothamnus quadrifidus																						
Calothamnus sp.																			5.00			
Cassytha glabella																						
Cassytha racemosa																						
Cassytha sp.											0.75											
Caustis dioica							0.69															
* *Centaurium erythraea*																						
Centella asiatica																						
Centrolepis drummondiana																						
Centrolepis aristata				1.27															0.01			
Chamaescilla corymbosa	0.05	0.26					0.35								0.18	1.00		0.10	0.02		0.16	0.06
Chorizema cordatum						0.03	0.20	0.10	0.05			0.05										
Chorizema ilicifolium																						
Chorizema rhombeum	0.40																					
Clematis pubescens						0.04											1.48			0.92	0.10	
Comesperma calymega																						
Comesperma virgatum													0.02									
Comesperma sp.		0.02																				
Conospermum capitatum																						
Conospermum scaposum																			0.50			
Conostylis aculeata																						
Conostylis setigera	0.03	0.12			0.04	0.05	0.15	0.03	0.03	0.10	0.30	0.09						0.20				0.26
Conostylis setosa	0.31	0.19						0.10		0.07		0.12			0.70							1.09
Conostylis pusilla																0.63	0.50		1.13	0.20	0.50	

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Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Conostylis serrulata					0.29	0.02		0.14	0.35	0.35	0.77	0.17					1.25	0.30		1.20		
Corymbia calophylla	19.01		7.05			9.60	15.75	1.06			7.50	4.22		18.50		50.00		26.00	33.40	40.00	5.50	
Corymbia calophylla (seedling)	0.03		0.03		0.01	0.01	13.00					1.50										
Craspedia variabilis										0.11									0.42			
Cryptandra arbutiflora var. *arbutiflora*																0.21						
Cryptostylis ovata																						
Cyanicula sericea																						
Cyathochaeta avenacea			0.30	4.00	0.66	0.02		2.05	1.67		7.49	1.15	0.01	8.67			2.55	1.00			3.33	2.83
* *Cyperus rotundus*																						
Cyperaceae sp.																						
Cyrtostylis robusta																						
Dampiera alata				0.02			0.04							0.03		0.63					0.02	
Dampiera hederacea											0.20											
Dampiera linearis			0.15	0.02	0.01		0.04	0.04	0.03		0.01	0.01		0.50						0.24	0.10	0.12
Dampiera pedunculata																						
Dasypogon bromeliifolius						0.80																
Daucus glochidiatus																						
Daviesia decurrens								0.01														0.10
Daviesia horrida							2.20															
Daviesia physodes																						
Daviesia preissii																						
Daviesia rhombifolia																						
Desmocladus fasciculatus							0.04				0.04					0.12			0.89	1.07	0.31	
Desmocladus flexuosus	0.22	0.16	0.12			0.02	0.01		0.04	0.51		0.07	0.09	1.92						0.50	0.02	
Dianella revoluta						0.20																
Dichopogon capillipes																						
* *Disa bracteata*																					5.00	
Diuris longifolia																						
Drosera bulbosa																						
Drosera erythrorhiza	0.01	0.03																			0.17	
Drosera macrantha																						

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Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Drosera microphylla																					0.01	
Drosera pallida																				0.01	0.05	
Drosera platystigma						0.01		0.01	0.20													
Drosera pulchella	0.02		0.17	0.05	0.04		0.04		0.02					0.10	0.15	0.18		0.13	0.10			0.01
Drosera sp.				0.02	0.01		0.04	0.01			0.03					0.30	0.16		0.24		0.13	0.01
Drosera sp. (climbing)															0.21	0.31	0.30	0.31	0.15		0.11	
Drosera sp. 1							0.06															
Drosera sp. 2																						
Drosera stolonifera																						
Elythranthera brunonis																						
Empodisma gracillimum																						
* *Erigeron sumatrensis*																						
Eriochilus dilatatus																						
Eriochilus scaber																						
Eriochilus tenuis																						
Eucalyptus marginata	7.17	14.28	35.40		17.56	18.88	3.93	23.82	35.07	6.66	23.75	34.94	0.47	27.30	24.78		31.01	20.55	40.00	15.20	32.97	
Eucalyptus marginata (seedling)	0.01	0.52	0.02		1.27	1.03	11.00	0.97	3.01	0.72	1.30	1.75										
Eucalyptus megacarpa																						
Eucalyptus patens											37.50											
Eucalyptus patens (seedling)											0.06											
Eucalyptus rudis																						
Eucalyptus sp.																						
Euchiton sphaericus																						
Gahnia decomposita											10.00											
Gastrolobium ebracteolatum																						
Gastrolobium spinosum																						0.48
Gastrolobium villosum																						0.60
Glischrocaryon aureum																						0.80
Gompholobium capitatum																						
Gompholobium cyaninum																						
Gompholobium knightianum	0.03		0.10		0.01	0.01		0.16	0.02													

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Gompholobium marginatum	0.03	0.02	0.02		0.03		0.05	0.04	0.04	0.02	0.04	0.01				0.44	3.13	3.16	1.24		0.67	0.17
Gompholobium polymorphum							0.01							0.12	0.50		0.10	0.02	0.01		0.20	
Gompholobium preissii			0.96		0.04			0.09	0.22	0.01					0.33		0.59	1.10	0.15	1.75	1.37	3.72
Gompholobium tomentosum								0.20		0.01												
Gompholobium sp.																						
Gompholobium sp.1														0.10								
Gonocarpus benthamii																						
Gonocarpus cordiger																						
Gonocarpus sp.																						
Goodenia sp.1							0.05															
Goodenia trinervis				0.32												0.61						
Grevillea bipinnatifida							31.67															
Grevillea pulchella																2.00						0.93
Grevillea quercifolia																						
Grevillea synapheae																						
Grevillea variifolia																						
Grevillea wilsonii		1.53			6.00		0.20	3.72	7.84				0.05			2.00		4.00				15.00
Haemodorum laxum																						0.13
Haemodocum spicatum																						
Haemodorum sp.		0.02		0.11	0.02		0.05	0.01			0.01	0.02	0.01		0.10							1.00
Haemodorum sp. 1				0.03			0.07					0.04			0.20	0.30						1.50
Haemodorum sp. 2																0.10						
Haemodoraceae sp.																						
Hakea amplexicaulis																						
Hakea cyclocarpa							8.25	10.00														
Hakea lissocarpha							1.00	1.10	0.10							3.50						2.30
Hakea prostrata																16.64						
Hakea ruscifolia																			0.40			
Hakea varia				11.19															0.50			
Hemiandra pungens									0.04							0.92					0.50	
Hemigenia pritzelii								0.01														

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Hibbertia acerosa	0.02									0.03		0.02									0.25	
Hibbertia amplexicaulis	0.05	0.02	0.31		0.08	0.05	0.02	0.04		0.06		0.10	0.02				0.78		0.67	0.55	0.50	
Hibbertia commutata		0.80	0.78		0.03	0.05	1.77	0.16	0.46	0.04		0.01	0.33	0.01			0.63	1.27	4.32	0.53		
Hibbertia commutata (seedling)								0.01														
Hibbertia diamesogenos																						
Hibbertia huegelii				0.13								0.21									12.50	
Hibbertia hypericoides	0.04		0.10				1.61	11.66							4.15				1.97	4.47	7.50	4.19
Hibbertia lasiopus			0.14																			
Hibbertia lineata							6.50															
Hibbertia ovata																						
Hibbertia perfoliata			0.20										0.20				1.09		2.00	0.80	1.30	
Hibbertia quadricolor		1.53																				
Hibbertia racemosa																						
Hibbertia sp.										0.02												
Hibbertia striata												0.05										
Hovea chorizemifolia	0.03		0.20		0.03			0.04	0.02	0.02		0.02	0.05	0.34	0.30			0.18				
Hovea trisperma							0.02			0.01			0.06									
Hyalosperma cotula				1.72																0.05	0.08	
Hybanthus calycinus																						
Hybanthus debilissimus																						
Hybanthus floribundus						0.01	0.01								0.02			0.20				
Hybanthus floribundus subsp. *floribundus*														0.40	0.36						0.10	
Hydrocotyle callicarpa																						
Hypocalymma angustifolium				5.67	0.02		5.32			0.10		0.07				3.40	0.50		1.00	0.25	4.00	
Hypocalymma cordifolium																						
* *Hypochaeris glabra*			0.20	0.01							0.10	0.01							0.55	0.56		
Hypolaena exsulca							5.51				15.29											
Isolepis marginata																				0.21		
Isotoma hypocrateriformis																						
Isotropis cuneifolia				0.03												0.10						
Jacksonia alata																0.80						

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
* *Juncus bufonius*																						
Juncus planifolius																						
Juncus subsecundus																						
Kennedia coccinea			0.66		0.02	0.01		0.37	0.05				0.03	2.34	0.01		0.69	1.23		0.30	1.25	0.50
Kennedia prostrata			0.36												0.20	0.11		1.35	2.32	1.36		
Kingia australis							5.10															
Kunzea glabrescens							5.00															
Kunzea recurva							13.60															
Labichea punctata	0.02	0.01								0.01		0.05					0.80					
Lachnagrostis filiformis																						
Lagenophora huegelii			0.01			0.01											0.15	0.15	0.10	0.36	0.43	0.30
Lasiopetalum floribundum		0.10			0.37	0.34				10.56	19.02	0.01	0.50	8.07	0.20		0.50					0.35
Lasiopetalum glabratum								0.02														0.30
Lasiopetalum glutinosum																						
Laxmannia squarrosa																0.09			0.10			
Lechenaultia biloba	0.02				0.03	0.01	0.03	0.01	0.02		0.01			0.20	0.50	1.43		0.09			0.10	0.05
Lepidobolus preissianus subsp. *preissianus*																5.00						
Lepidosperma gracile																						
Lepidosperma leptostachyum																						
Lepidosperma longitudinale											2.00											
Lepidosperma pubisquameum			0.20	0.53				0.02														0.35
Lepidosperma squamatum							0.40			0.20				2.25	0.32	1.50	0.20		0.30		1.00	0.45
Lepidosperma tenue	1.23						0.02	0.08	0.06	0.02												
Lepidosperma tetraquetrum																						
Lepidosperma sp.				5.10								0.30									0.10	1.00
Lepidosperma sp.1			0.30			0.06									0.17							0.10
Leporella fimbriata																						
Leptocarpus coangustatus																						
Leptomeria cunninghamii														0.30	0.20							
Leptospermum erubescens																		1.47	0.03			
Leucopogon australis																						

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Leucopogon capitellatus	0.20		7.32		0.06	0.01	0.01													4.00		
Leucopogon hirsutus																						
Leucopogon parviflorus											0.76											
Leucopogon sprengelioides																0.50						
Leucopogon verticillatus	0.02					0.01								4.00				0.01				
Levenhookia pusilla				0.04			0.05		0.01												0.02	
Levenhookia stipitata																						
Lindsaea linearis							0.01															
Liparophyllum capitatum																						
Lobelia gibbosa																						
Lobelia sp.											0.03											
Lomandra brittanii						0.02	0.01		0.02													
Lomandra caespitosa			0.83		0.10	0.51	0.02			0.08			0.02	0.10				0.92	0.74		3.00	3.17
Lomandra drummondii																					0.50	
Lomandra hermaphrodita	0.02	0.20	0.01	0.14	0.04	0.05	0.08	0.03	0.05	0.09		0.02	0.01	0.36	0.59		0.61	0.50	0.13		0.26	0.34
Lomandra integra																						
Lomandra micrantha	0.02					0.04	0.04	0.05	0.02	0.03				1.75						1.00		
Lomandra micrantha subsp. *micrantha*														6.50								
Lomandra nigricans						0.05											3.00	0.50		2.50		
Lomandra odora														0.20								
Lomandra preissii						0.02	0.05	0.03	1.50	0.18		0.03	0.01	0.10							4.00	0.76
Lomandra purpurea																						
Lomandra sericea																						
Lomandra sonderi	0.01	1.08	2.15		2.67	0.56		1.00	1.30	2.40		1.47	2.10	1.66			2.53	1.60	2.00		0.30	
Lomandra sp.	0.02	0.01	0.01	0.01			0.02			0.02										4.17		
Lomandra sp.1															0.10							
Lomandra spartea	0.06	0.35			0.03	0.06	0.07	0.01	0.02	0.26		0.12	0.74	0.53	0.34	0.15	0.30				0.61	0.78
Loxocarya cinerea						0.01			0.10	0.13	0.65	0.10	0.23	0.43								
Lyperanthus serratus																						
Lysimachia arvensis																2.25						
Macrozamia riedlei		5.00	10.51		17.88	9.70				3.01	4.15		5.43	20.40				2.65	0.25	9.10	1.00	

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Macrozamia riedlei (seedling)						0.01																
Marianthus drummondianus																						
Melaleuca incana																						
Melaleuca parviceps																17.56						
Melaleuca preissiana				15.00																		
Melaleuca viminea				0.37																		
Melaleuca viminea (seedling)				0.32																		
Mesomelaena graciliceps																					0.40	
Mesomelaena stygia				2.50																		
Mesomelaena tetragona				2.50																		
Microtis media																						
Millotia tenuifolia																0.44			0.26	0.29		
Mirbelia dilatata						0.25	2.00				0.11											
Monotaxis grandiflora																						
Monotaxis grandiflora var. *grandiflora*									0.02						0.10						1.00	0.23
Monotaxis occidentalis																						
Neurachne alopecuroidea	0.02		0.08	0.03	0.02	0.04	0.31			0.04	0.11	0.02	0.10	1.20	0.25	0.32	0.40	0.11	0.08		0.10	0.20
Olax benthamiana																						
Opercularia apiciflora																						
Opercularia echinocephala			0.24	0.01	0.03	0.10	0.04	0.01	0.04	0.03	0.01				0.28		1.76	1.10	0.77	2.28	0.05	0.50
Opercularia hispidula																						
Opercularia vaginata																						
Opercularia sp.										0.01	0.02											
Orchidaceae sp.														0.01								
Orchidaceae sp. 1														0.08								
Orchidaceae sp. 2																0.10						
Orianthera serpyllifolia																						
* *Oxalis compressa*																						
* *Oxalis corniculata*																						
Paraserianthes lophantha																						
Paspalidium sp.?															0.20							

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Note: if cover is 0.00 then value is <0.01

Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Patersonia babianoides			0.02		0.01	0.01	0.01	0.02	0.02	0.03		0.01	0.02		0.14			0.28	0.10			0.07
Patersonia juncea				2.84																		0.35
Patersonia occidentalis			0.80	0.20			0.48	0.98	0.74					0.65		0.01	0.26		1.68	0.80		1.30
Patersonia pygmaea				4.00			0.04					0.05				0.18						0.30
Patersonia rudis							0.13	0.71	0.50			0.08					1.75					
Pentapeltis peltigera	0.01	0.09	0.50		0.01	0.02	0.04	0.02	0.03	0.03	0.03	0.05		0.64			0.38	0.15	0.28		0.23	0.38
Pericalymma ellipticum				0.22			1.70		3.00							17.25						
Persoonia elliptica																						
Persoonia longifolia			1.50		2.00	1.25				0.50										0.73	1.50	
Persoonia longifolia (seedling)		1.00				1.00																
Persoonia sp.																						
Petrophile macrostachya																						0.60
Pheladenia deformis																						
Philotheca spicata							0.24												2.50			
Philydrella drummondii				0.05																		
Philydrella pygmaea																						
Phyllangium paradoxum																						
Phyllanthus calycinus	4.81	0.01			3.04	4.00				7.65		1.12				0.01	3.59	2.25		4.56		
Pimelea ciliata							0.05									1.96	0.10					
Pimelea lehmanniana																						
Pimelea suaveolens	0.01						0.09								0.20	0.05	0.57		1.50		2.00	0.10
Pimelea sp.																0.10						
Plantago lanceolata																						
Platysace commutata																						
Platysace compressa	0.36	0.02	0.48		0.15	0.27	0.02		0.01	0.01		0.10					0.27	0.40		7.02		0.10
Platysace filiformis																						
Platysace tenuissima																						
Poaceae sp.																						
Podolepis capillaris				0.05																		
Podotheca angustifolia																			0.08			0.03
Podotheca gnaphalioides																0.10						

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Poranthera microphylla																					0.11	0.03
Prasophyllum brownii																						
Prasophyllum elatum																						
Prasophyllum sp.															0.10							
Prasophyllum sp.1					0.01			0.01														
Pseudognaphalium luteoalbum																						
Pteridium esculentum						6.98					1.70			7.26						5.00		
Pterochaeta paniculata									0.08												0.05	0.02
Pterostylis barbata																						
Pterostylis pyramidalis																						
Pterostylis recurva																						
Pterostylis vittata																						
Pterostylis sp.	0.01	0.01																				
Pterostylis sp. 1														0.01	0.10							
Ptilotus drummondii																						
Ptilotus drummondii var. *drummondii*																						
Ptilotus manglesii									0.03	0.10					0.24	0.18						0.45
Pyrorchis nigricans																						
Ranunculus colonorum																						
Ranunculus muricatus																						
Restionaceae sp.																1.20						
Rytidosperma acerosum																				0.37		
Rytidosperma caespitosum		0.02		0.02	0.10		0.01															0.10
Rytidosperma setaceum																						
Rytidosperma sp.							0.02															
Scaevola calliptera	0.02					0.03	0.02	0.11	0.50	0.01		0.02		0.36		0.20	0.75			0.19	0.66	0.85
Scaevola sp.			0.11			0.02																
Scaevola pilosa																						
Senecio diaschides																		0.06	0.53	1.00		
Senecio hispidulus																						
Senecio sp.				0.10															0.55	2.00		

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Senecio sp.1																			1.00			
Senecio quadridentatus																						
* *Sonchus oleraceus*																						
Sowerbaea laxiflora			0.02	0.06		0.01				0.01		0.01										
Sphaerolobium linophyllum							0.50															
Sphaerolobium macranthum			0.10			0.10	0.11							0.10							0.10	0.29
Sphaerolobium medium							0.03			0.01		0.01										
Sphaerolobium sp.																						
Stachystemon vermicularis																						
Stackhousia monogyna												0.01										
Stirlingia latifolia									10.68													
Stylidium amoenum		0.01	0.30		0.04			0.06					0.03	0.14				0.19			0.05	0.01
Stylidium androsaceum					0.01	0.02						0.01								0.21		0.03
Stylidium brunonianum							0.02															
Stylidium bulbiferum																						
Stylidium calcaratum															0.20							
Stylidium ciliatum							0.01														0.17	
Stylidium crassifolium																						
Stylidium hirsutum															0.01			0.18			0.59	
Stylidium junceum																						
Stylidium lateriticola																						
Stylidium lineatum																						
Stylidium piliferum	0.01	0.02	0.01		0.02	0.03		0.04	0.04						0.01	0.06	0.51	0.58	0.30	0.06	0.20	0.13
Stylidium recurvum				0.20																		
Stylidium repens																0.33					0.20	
Stylidium rhynchocarpum														0.35								
Stylidium scabridum					0.02		0.12	0.04		0.02	0.13										0.30	0.45
Stylidium scariosum																					6.73	0.48
Stylidium schoenoides										0.01				0.10	0.01			0.15			0.07	
Stylidium spathulatum																						
Stylidium thesioides																						

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Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Stylidium hispidum								0.10						0.10		0.35	0.55	0.25		0.10		
Stylidium sp.				0.08				0.01	0.01													
Stylidium sp. 1								0.01														
Styphelia discolor					0.10		0.60															
Styphelia erubescens																						
Styphelia hispida																						
Styphelia nitens	2.45							0.10														
Styphelia pallida												0.05										
Styphelia propinqua	2.35						0.50	1.00		0.22	0.08		2.65					0.30		0.38		
Styphelia tenuiflora							0.02	0.50						0.10					6.00			
Synaphea sp.							0.05															
Taxandria linearifolia											38.56											
Tetraria capillaris			0.02		0.71	0.02	0.03	0.45	0.02	0.47		0.31	1.33									
Tetraria octandra			1.20			0.21	0.11	0.03	0.03		0.02	0.05	0.03		0.10	0.30	0.20		0.33		0.51	0.53
Tetraria sp. Jarrah Forest (R. Davis 7391)	1.84	2.26	0.02		0.07	0.40	0.57	0.09	0.31	0.48		0.03	0.55	0.23	1.10	1.46	1.28	0.56	1.63	0.65	1.28	2.05
Tetrarrhena laevis	0.01	0.01	0.03		0.03	0.02	0.03		0.02	0.03	0.03	0.04	0.03	1.10		0.10	0.10	0.10		0.11	0.10	
Tetratheca hirsuta			0.14		0.04			0.02		0.04		0.01	0.01	0.27	0.10			0.16			0.15	0.20
Thelymitra antennifera																						
Thelymitra crinita										0.02	0.03	0.01										
Thelymitra macrophylla																						
Thelymitra sp.								0.02		0.01	0.01											
Thomasia paniculata								0.02			0.86											
Thomasia pauciflora																						
Thysanotus anceps																						
Thysanotus dichotomus								0.01	0.06								0.05					
Thysanotus fastigiatus						0.03							0.05			0.20						
Thysanotus gracilis																						
Thysanotus manglesianus																				0.13		
Thysanotus multiflorus			0.03		0.01	0.27	0.07		0.03	0.09	0.03			0.60	0.39	0.40	0.84	0.40	0.20	0.52	0.20	0.98
Thysanotus patersonii						0.01		0.01														
Thysanotus ? scaber																						0.30

APPENDIX J2: SUMMARY OF FOLIAGE COVER ON PERMANENT PLOTS IN MYARA NORTH SURVEY AREA AND NEARBY MYARA REGION

Note: if cover is 0.00 then value is <0.01

Species	MY001	MY002	MY003	MY004	MY005	MY006	MY007	MY008	MY009	MY010	MY011	MY012	MY013	MY014	MY015	MY016	MY017	MY018	MY019	MY020	MY021	MY022
Thysanotus sp.						0.01			0.01									0.01				
Thysanotus sp.1					0.01			0.01		0.01					0.10	0.53			0.20			0.06
Thysnaotus sparteus																						
Thysanotus tenellus																						
Thysanotus thyrsoideus								0.03	0.01	0.01										0.06	0.10	
Trachymene pilosa		0.01				0.01										0.01			0.16	0.08	0.05	
Trichocline spathulata	0.02	0.03		0.01	0.02	0.02		0.02	0.02	0.03		0.10	0.06	0.06	0.04	1.87	0.07	0.13			0.23	0.05
Tricoryne elatior			1.54	0.02	0.04	0.37					0.01	0.04									0.14	
Tricoryne humilis																						0.14
Tripterococcus brunonis																0.08		0.10				0.73
* *Trifolium dubium*																						
Tripterococcus brunonis																						
Trymalium ledifolium																						
Trymalium odoratissimum	2.63					0.01		0.95	0.02	0.23					0.01	2.75						
Trymalium odoratissimum subsp. *odoratissim*	0.01						0.30															
Trymalium spatulatum																						
Utricularia multifida				0.04																		
Viminaria juncea																						
* *Vulpia myuros*																						
Wahlenbergia preissii																				0.02		
Wurmbea dioica																						
Xanthorrhoea gracilis	2.66	2.83			3.09	3.29		2.54	1.20	2.81	2.17	2.46	0.13	13.95			9.50	2.00	12.00		4.31	4.00
Xanthorrhoea preissii				25.57			10.72	1.00	2.00	3.50	16.33	15.27	27.11	16.20		3.50			17.17		23.01	6.10
Xanthosia atkinsoniana	0.01	0.01			0.03	0.02			0.05	0.03	0.01	0.01					0.36	0.94		0.30	0.10	
Xanthosia candida	0.01				0.03		0.08	0.05	0.07	0.08			0.03	0.47	0.08	0.13	0.74	0.17		0.22	0.44	0.18
Xanthosia ciliata																						
Xanthosia huegelii				0.10		0.02	0.03	0.01								0.03	0.50		1.94	0.37	0.25	
Xanthosia singuliflora																						
Xylomelum occidentale			6.00																20.49			

Appendix 3 – Myara North Pre-Clearance Surveys 2022 (WEPL, 2023)

WESTERN
ENVIRONMENTAL

Myara North Pre-Clearance Surveys 2022

Threatened and Priority Flora
Targeted Search

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Myara North Pre-Clearance Surveys 2022

Threatened and Priority Flora Targeted Search

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WEPL will not be liable to update or revise this report to take into account any events or circumstances or facts becoming apparent after the date of this report.

Executive Summary

Alcoa of Australia (Alcoa) proposes to transition to the new mine region of Myara North (MN) as part of its Huntly mining operations. The MN mine region is currently under assessment by the Environmental Protection Authority (EPA). Alcoa engaged Western Environmental Pty Ltd (WEPL) to undertake targeted pre-clearance Threatened and Priority flora surveys to support a preliminary or minor works application as part of the Part IV EPA approvals process.

The overall Survey Area comprised eight packages of work, most with partially overlapping boundaries, summarised in Table A below.

Table A: Survey Areas

Survey Area	Description of Survey Area	Area Approximate (ha)
Water Pipeline Alignment	Approx. 9 km long by 40m wide. Runs north from Serpentine Dam (4 km) then east along Balmoral Rd (3.5 km).	65 ha
Power Corridor Alignment	Approx. 8 km long by 40m wide. Centred on Balmoral Rd and unnamed forestry track. Shared alignment on Balmoral Rd with Water Pipeline Alignment.	
Frollet Road Intersection and Additional Frollet Road	Running east west along Jarrahdale Rd and covering the Jarrahdale Rd and Frollet Rd intersection.	15 ha
Albany Highway Intersection	Covering intersection of Jarrahdale Rd and Albany highway and verges of Albany Hwy running north south.	40 ha
MN Facilities Area	Facilities area, magazine and magazine access track. Centred on Balmoral Rd..	50 ha
HUNG_G_000473-000_B_Frollet Rd and Additional Survey Road	Access road corridor 8.2 km wide and 20-80 m wide. Running north south along Frollet Rd and Balmoral Rd between Jarrahdale Rd and the MN Facilities Area	35 ha
Total		**204.9 ha (exact)**

The Survey Area falls within the previous survey extent of the Mattiske (2021) *Alcoa of Limited Australia: Pinjarra Alumina Refinery Revised Proposal Detailed Flora and Vegetation Survey for Huntley Mine – Myara North Surveys.* This report, and other available desktop/background information was reviewed prior to the field survey.

No Threatened or Priority flora were identified as previously recorded within the Survey Area from Mattiske (2021) or Department of Biodiversity Conservation and Attractions (DBCA) database records. A pre-survey likelihood of occurrence assessment specific to the eight packages of work within the Survey Area was undertaken. The assessment identified that three species have a high likelihood of occurrence, 14 species a medium likelihood of occurrence and 22 species a low likelihood of occurrence. No Threatened species had a high or medium likelihood of occurrence.

The targeted searches were conducted across 25 person days from 7–30 November 2022 by the WEPL ecology team. Searches were undertaken as 20 m spaced grid searches. Due to generally open understory 20 m spacings were considered suitable. Where target species have specific micro habitat preferences, these receive a higher intensity of search effort. No significant limitations or constraints were encountered while undertaking the targeted searches.

No Commonwealth E*nvironment Protection and Biodiversity Conservation Act 1999* (EPBC) listed, or State Biodiversity Conservation (BC) Act listed Threatened flora or DBCA listed Priority flora were recorded in the Survey Area.

Following suitable targeted search effort, the likelihood of occurrence for all Threatened and Priority flora species identified by the desktop was reassessed as low. This assessment was reached considering:

- The results of the pre-survey likelihood of occurrence assessments, both by WEPL for the specific Survey Area and Mattiske (2021) for the MY project area.
- Having undertaken suitable targeted search efforts during the primary spring survey season and within the flowering period for the majority of species. For four species with flowering periods outside the survey period, three can be identified without flowering material.
- The absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).
- Disturbance to the understory in many areas through vehicle access for firewood collection and clearing of access tracks.
- The alignment of much of the Survey Area on existing disturbed areas, roads and forestry tracks.

The absence of Threatened and Priority flora was not an unexpected survey outcome considering the dominance of habitat with *Eucalyptus marginata* and *Corymbia calophylla* forest over laterite and the absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).

Acronyms and Abbreviations

Abbreviation	Full Title
°C	Degree Celsius
BoM	*Bureau of Meteorology*
BC Act	*Biodiversity Conservation Act 2016*
CR	Critically Endangered
DBCA	Department of Biodiversity, Conservation and Attractions
EIA	Environmental Impact Assessment
EN	Endangered
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection Biodiversity and Conservation Act 1999*
ESA	Environmentally Sensitive Area
GPS	Global Positioning System
ha	Hectare
IUCN	International Union for Conservation of Nature
km	Kilometres
m	Metres
MN	Myara North
MNES	Matters of National Environmental Significance
P	Priority
PF	Priority Flora
PMST	Protected Matters Search Tool
SVT	Site Vegetation Types
T	Threatened
TPFL	Threatened and Priority Flora Database
VU	Vulnerable
WA	Western Australia
WAH	Western Australian Herbarium
WEPL	Western Environmental Pty Ltd

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1. Introduction

1.1 Project Background

Alcoa proposes to transition to the new MN mine region as part of its Huntly mining operations. The MN mine region is currently under assessment by the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (Assessment No. 2253).

The Survey Area falls within the previous survey extent of the Mattiske (2021) *Alcoa of Australia Limited: Pinjarra Alumina Refinery Revised Proposal Detailed Flora and Vegetation Survey for Huntley Mine – MN Surveys.*

Alcoa engaged WEPL to undertake targeted pre-clearance Threatened and Priority flora surveys to support a preliminary or minor works application as part of the Part IV EPA approvals process.

1.2 Location

The overall Survey Area comprised eight packages of work, most with partially overlapping boundaries. The total Survey Area was 204.9 ha. See Figure 1 for Survey Area overview and Table 1 for descriptions.

Table 1: Location of the Survey Areas

Survey Area	Description of Survey Area	Area Approximate (ha)
Water Pipeline Alignment	Approx. 9 km long by 40m wide. Runs north from Serpentine Dam (4 km) then east along Balmoral Rd (3.5 km). Eastern portion centred on Balmoral Rd. Eastern portion overlaps with Power Corridor for parts.	65 ha
Power Corridor Alignment	Approx. 8 km long by 40m wide. Larger polygon of 150x800 m at west end. Centred on Balmoral Rd and unnamed forestry track. Eastern portion overlaps with Water Corridor for parts.	
Frollet Road Intersection and Additional Frollet Road	Running east west along Jarrahdale Rd and covering the Jarrahdale Rd and Frollet Rd intersection. Overlaps in parts	15 ha
Albany Highway Intersection	Covering intersection of Jarrahdale Rd and Albany highway and verges of Albany Hwy running north south.	40 ha
MN Facilities Area	Facilities area, magazine and magazine access track. Centred on Balmoral Rd. Overlaps in parts.	50 ha
HUNG_G_000473-000_B_Frollet Rd and Additional Survey Road	Access road corridor 8.2 km wide and 20-80 m wide. Running north south along Frollet Rd and Balmoral Rd between Jarrahdale Rd and the MN Facilities Area. Also additional road option polygon near the MN Facilities Area. Overlaps in parts.	35 ha
Total		**204.9 ha**

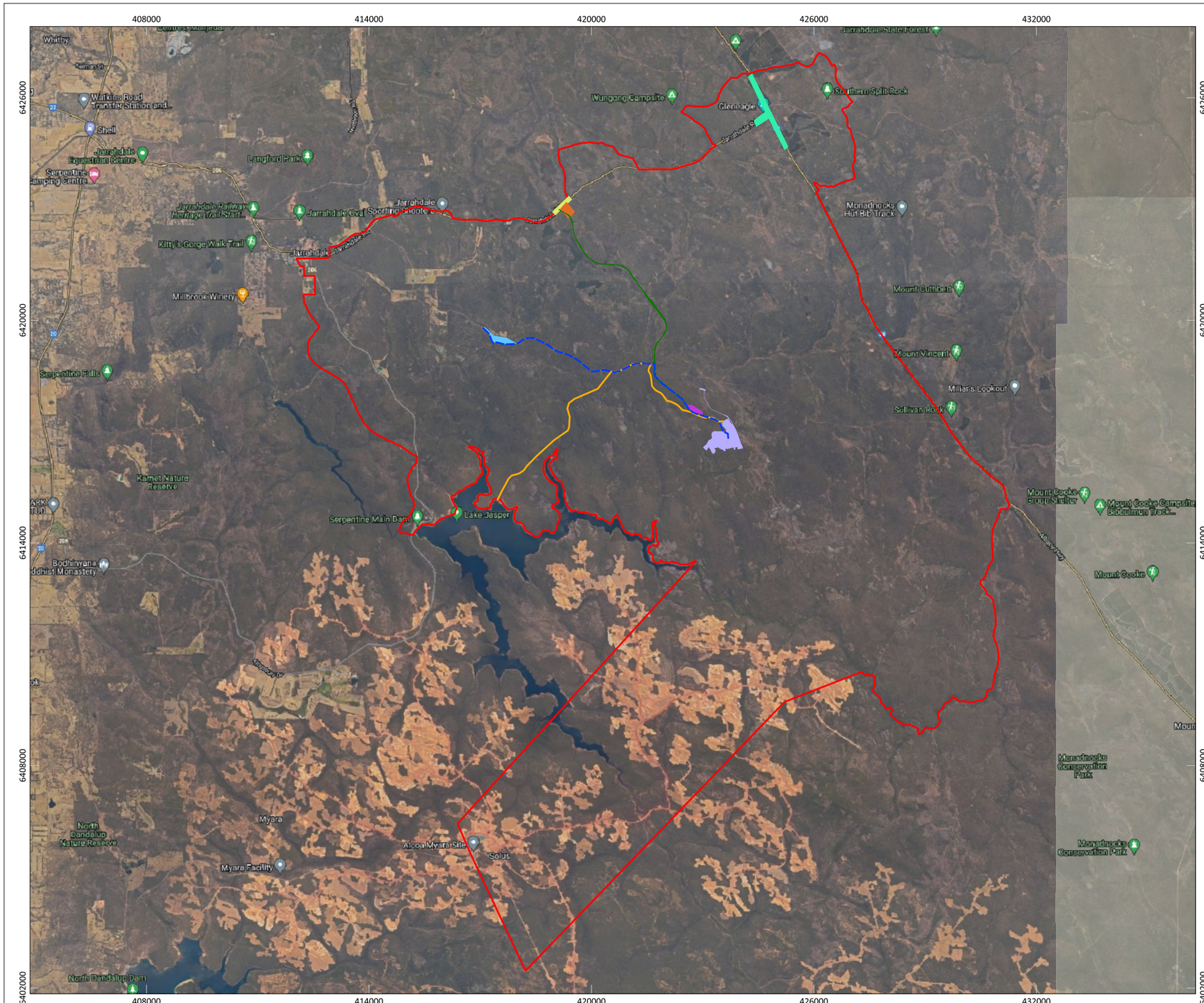
1.3 Scope and Objectives

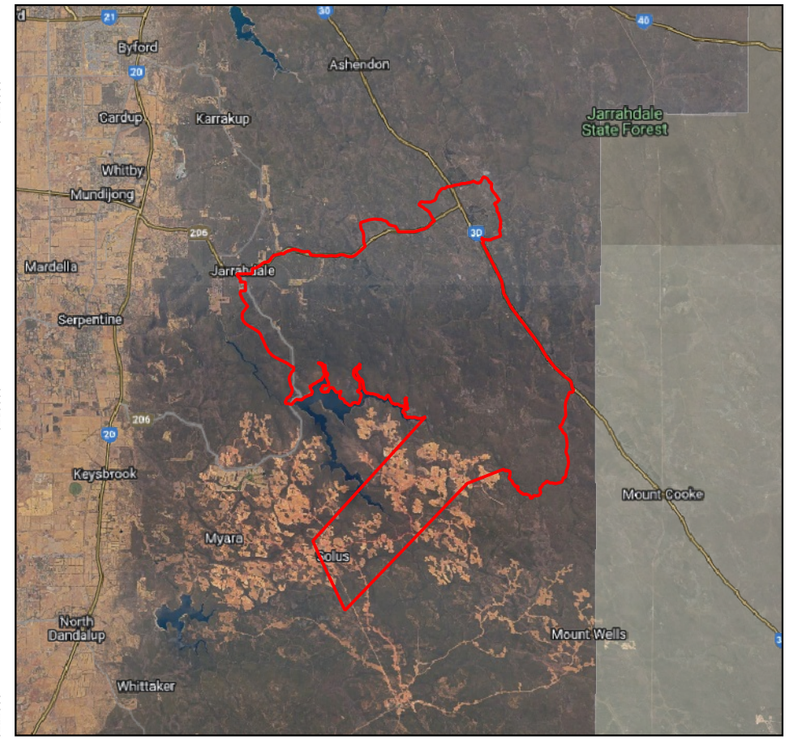
The objective of the survey was to identify the presence or likelihood of occurrence for Threatened and Priority flora.

The scope of works included:

- Desktop assessment of existing records and previous flora and vegetation studies.
- Undertake a likelihood of occurrence assessment based on desktop information.
- Conduct targeted Threatened and Priority flora searches.
- Preparation of a technical report, maps and supporting spatial data; suitable for submission to the EPA to support a preliminary or minor works application.

This report presents the results of the desktop and field survey undertaken to support the above objective.





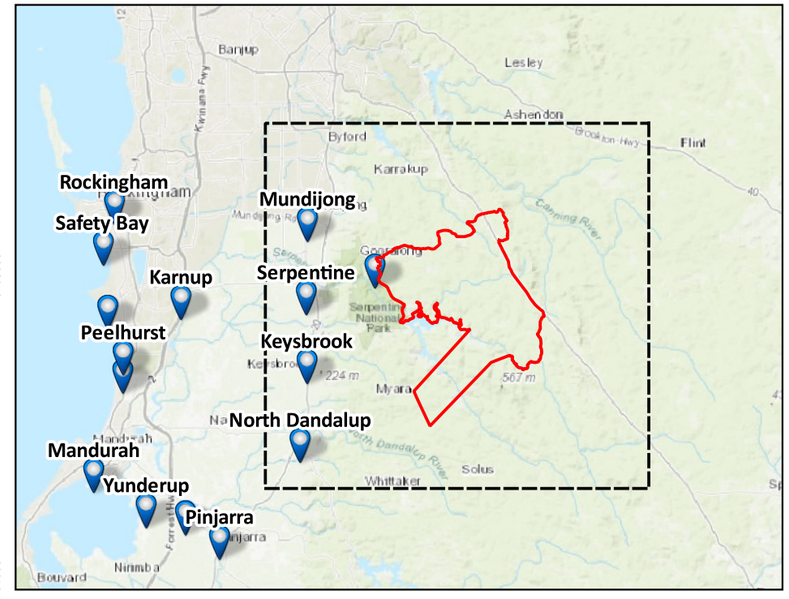


Figure 1: Survey Area

N 0 1 2 3 4 km

SCALE: 1:120,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT: Alcoa of Australia Limited

PROJECT NUMBER	VERSION
A22.055	0
DRAWN BY / REVIEWED BY: MD / LT	DATE: 9/3/2023

Legend

- Myara North Development Envelope
- Additional Frollett Road Survey Area
- Additional Survey Road
- Albany Hwy Intersectoin
- Frollet Road Intersection
- HUNG_G_000473-000_B_Frollet Rd
- Myara North Facilities
- Power Alignment
- Water Alignment
- Power Alignment

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	9/3/2023

NOTES:
Cadastral boundary (LGATE-002). Base map ESRI Topo. Townsites (LGATE-248).

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G:\GIS\Project Data\A22.055\A22.055.qgs

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1.4 Legislation and Guidance

This environmental assessment was conducted in accordance with Commonwealth and State legislation, guidelines and advice:

- *Environment Protection and Biodiversity Conservation Act 1999.* (EPBC Act) (Cth).
- *Environmental Protection Act 1986.* (EP Act) (WA).
- *Biodiversity Conservation Act 2016.* (BC Act) (WA).
- Biodiversity Conservation Regulations 2018 (WA).
- EPA. (2016). *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.* Known herein as the 'Flora and Vegetation Technical Guidance' (WA).
- Commonwealth of Australia. (2013). *Survey Guidelines for Australia's Threatened Orchids* (Cth).

Brief descriptions of relevant Commonwealth and State legislation is provided in Appendix A. While definitions and criteria for Commonwealth and State conservation codes is provided in Appendix B.

2. Existing Environment

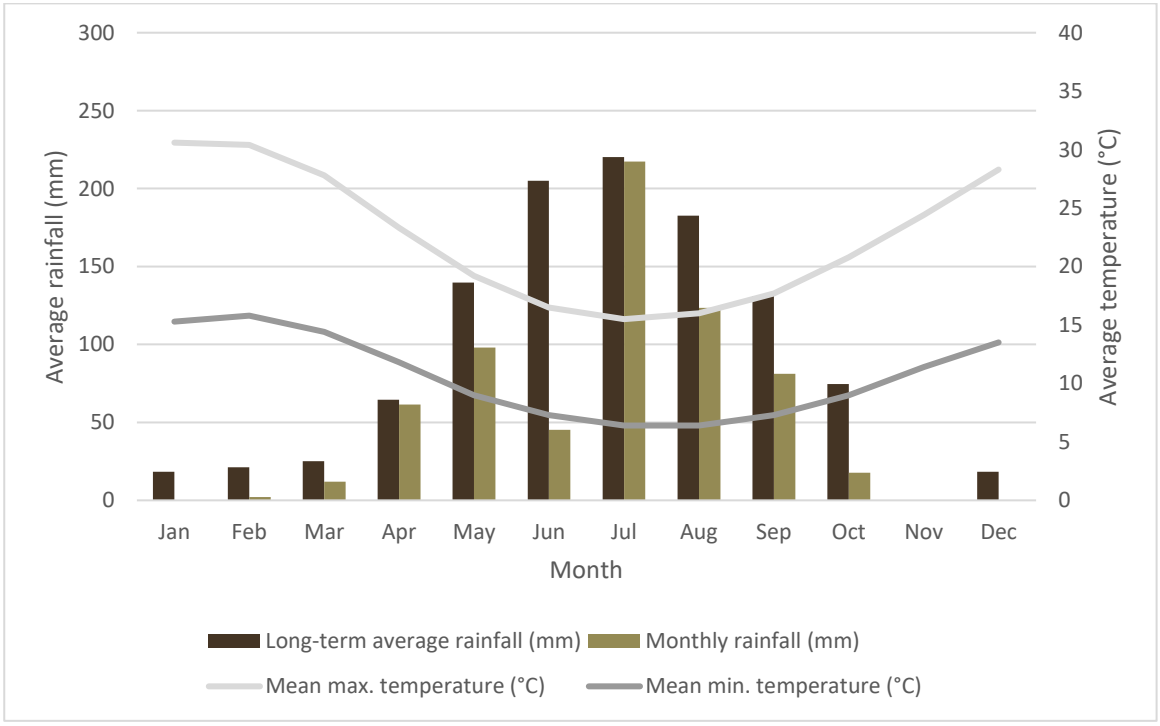
2.1 Climate and Pre-Survey Rainfall

The closest long-term Bureau of Meteorology (BoM) weather station with a complete dataset is Karnet WA (Station 009111), located approximately 14 km south-west of the Survey Area.

Climate statistics were calculated utilising data from the most current climate normal, which is defined as a 30-year interval (BoM, 2007), where possible. A climate normal is a period long enough to include year-to-year variations while avoiding the influence of longer-term changes in climate.

The long-term mean minimum temperature for Karnet ranges from 6.4˚C (July and August) to 15.8˚C (February) (1991 to 2022) and the long-term mean maximum temperature ranges from 15.5˚C (July) to 30.6˚C (January) (Graph 1) (BoM, 2022).

Karnet weather station recorded 668.1 mm of rain in the eleven months prior to the survey (December 2021 – October 2022), which is 432.9 mm below the long-term average of 1101.6 mm in the same period (BoM, 2022). Conditions during winter 2022 showed considerably below average rainfall in June (45.3 mm in 2022 compared to 205.1 mm) and slightly below average rainfall in July (217.4 in 2022 mm compared to 220.3 mm) and August (123.4 mm in 2022 compared to 182.7 mm) (BoM 2022). In the three months prior to the survey (August to October 2022), 222.3 mm of rainfall was recorded, which is 166.2 mm below the long-term average at 388.5 mm (BoM, 2022).



Graph 1: Long Term and Monthly Total Rainfall, Maximum and Minimum Temperatures for Karnet WA (009111) (BoM, 2022)

3. Methodology

3.1 Desktop Assessment

3.1.1 Literature Review

Background information on the Survey Area and surrounds was reviewed prior to the field survey. The Mattiske (2021) detailed flora and vegetation survey report was reviewed in detail, the full report is provided as Appendix C.

Previous locations of Priority flora identified by Mattiske (2021) were provided by Alcoa.

3.1.2 Database Searches

The results of the Mattiske (2021) desktop assessment database searches were reapplied to identify potentially occurring Threated and Priority Flora. The database searches and dates are summarised below in (Table 2).

Table 2: Database Searches of the Survey Area

Database Name	Date	Search Type	Search Area
NatureMap (DBCA)	2021	Threatened and Priority Taxa	20 km buffer of point -32° 21' 54" S, 116° 10' 23" E.
Protected Matters Search Tool (PMST) (Department of Climate Change, Energy, the Environment and Water)	2021	Commonwealth listed Threatened flora and fauna and TECs	20 km buffer around the MN Project Area
Threatened and Priority Flora (TPFL) database search (Department of Biodiversity Conservation and Attractions)	2020	Threatened and Priority Flora	
Western Australian Herbarium (WAHerb) flora database search (Department of Biodiversity Conservation and Attractions)	2020	Threatened and Priority Flora	

3.1.3 Likelihood of Occurrence

A pre-survey likelihood of occurrence assessment, specific to the eight packages of work within Survey Area was undertaken. This was updated following survey to provide a post-survey likelihood of occurrence.

To identify potential habitat suitability the pre-survey likelihood of occurrence assessment considered:

- Intersection of Survey Area with Mattiske and Havel (1998) vegetation complexes. This was compared to the table listing relationship between locations of previous records and vegetation complex the records occurred in (Refer to *Table 6: Summary of Potential Threatened and Priority Flora Recorded in The MN Survey Area By Vegetation Complexes, And Dominant Landform And Soil Groupings* in Mattiske [2021]).

- Intersection with Site Vegetation Types (SVT) and Dominant Landform and Soil Groupings (Refer to *Table 11: Summary of Site-vegetation Types (SVT) on the Myara North Survey Area* in Mattiske [2021]).

- Review of aerial imagery to identify features such as granite outcrops, wetlands or sandy patches.

Further contextual information was gained through assessment of:

- Proximity of previous records from the Mattiske (2021) surveys.

- Proximity of previous records from DBCA database records.

- The findings of the previous likelihood of occurrence assessment (Refer to *Table 6: Summary of Potential Threatened and Priority Flora Recorded In The Myara North Survey Area By Vegetation Complexes, and Dominant Landform And Soil Groupings* in Mattiske [2021]).

The criteria presented in Table 3 were applied to determine final pre-survey likelihood of occurence.

Only species either recorded within the MN project area or considered as having a high or medium likelihood of occurrence under the Mattiske (2021) were included in the likelihood of occurrence assessment. Species classified by WEPL as having a low likelihood of occurrence will not be discussed unless a justification for this classification is required.

Table 3: Likelihood of Occurrence Criteria

Likelihood	Criteria
Recorded	Recorded in the Survey Area from database searches (if confident record is accurate), previous survey by others or by current survey.
High	Suitable habitat occurs within the Survey Area; and • Records of flora species <5 km from the Survey Area. With record <30 years old.
Medium	Suitable or marginally suitable habitat occurs within the Survey Area; and • Records of flora species <5 km from the Survey Area with record >30 years old. • Records 5-20 km from the Survey Area. • Species is strongly linked to a specific habitat, which occurs within the Survey Area and records are present >20 km from the Survey Area.
Low	• Records are >20km from the Survey Area • The species has a well understood and specific habitat preference/ requirements, which is absent from the Survey Area. • Records are historical only, or are pre mapping procedures (e.g. records assigned to towns or place names). • Suitable habitat is present, but there are no existing records of the species from the region despite reasonable previous search effort.

3.2 Field Survey

3.2.1 Field Survey Timing and Survey Team

The targeted field survey was conducted across 25 person days from 7–30 November 2022 by WEPL ecology team as summarised in Table 4.

Table 4: Survey Team and Effort According to Location

Survey Area and Date	Name	Position and years of Experience	DBCA Licence No.
The Water/Power Alignments 7-10 November 2022	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2
	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468
Frollett Road intersection and additional Frollett Road survey area 17-18 November 2022	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2
	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468
Albany Highway Intersection Survey 21-23 November 2022	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2
	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468
MN Facilities	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2

Survey Area and Date	Name	Position and years of Experience	DBCA Licence No.
24, 29 & 30 November 2022	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468
HUNG_G_000473-000_B_Frollet Rd and Additional Survey Road	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2
23, 28 & 29 November 2022	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468

3.2.2 Targeted Searches

Threatened and Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted. Searches were undertaken as 20 m spaced grid searches. In some locations narrowed to 10-15 m where necessary. Due to open understory 20 m spacing were typical applied. Where target species have specific micro habitat preferences these receive a higher intensity of search effort.

The locations of any records were marked using a handheld GPS with the following data recorded:

- Observer, date, and time.
- Local abundance/population size and/or population boundary.
- Representative photos of each species and habitat.
- Collection of representative specimens.
- Notes on habitat and vegetation type.

3.2.3 Flora Taxonomy and Lodgement of Specimens

A pre-field survey identification guide was prepared from plant descriptions and images and by inspection of relevant species from Western Australian Herbarium (WAH) reference collection.

Where field identification of plant taxa was not possible, specimens were collected for identification using resources of the WAH. Identification of flora collections was primarily completed by senior ecologist Andrew Fry with suspected or potential conservation significant flora species submitted to the WAH for identification by Mike Hislop.

3.3 Survey Limitations and Constraints

Limitations and constraints of the targeted searches as outlined in the Flora and Vegetation Technical Guidance are detailed below in Table 5.

Table 5: Limitations and Constraints

Possible Limitation	Degree of Limitation (Significant, Moderate or Negligible)	Potential Constraints on Survey Outcomes
Survey Level/ Scope	Negligible	Targeted pre-clearance searches following a detailed flora and vegetation survey was undertaken at a sufficient level of detail and in accordance with the *EPA Flora and Vegetation Technical Guidance.* Is considered appropriate to support approvals applications and EIA processes.
Availability of contextual information at a regional and local scale	Negligible	All data required to complete the scope of works including regional and local contextual information was available. Previous detailed surveys have been undertaken by Mattiske (2021) across the MN area. As part of that project, lower intensity targeted searched have been undertaken providing good contextual information. Available literature was reviewed, and publicly available databases were also searched. Contextual information is therefore not considered to be a limiting factor for this study.
Site Access	Negligible	The Survey Area was readily accessible by foot, and the entire the Survey Area was traversed.
Survey Intensity and Extent	Negligible	The entire Survey Area was traversed by foot to search to conservation significant flora. Sufficient time was allocated to survey, given the size and complexity of the Survey Area. The survey effort was considered adequate to assess values of the Survey Area and provide information required to support approvals applications.
Experience	Negligible	The field survey team and leading scientist (Andrew Fry) has suitable experience in conducting flora and vegetation surveys in the southwest. All flora collections of potential conservation significant species were submitted to the WAH for identification.
Timing, weather, season	Negligible	The recommended primary survey period for flora and vegetation surveys for the region as per the EPA Technical Guidance occurs during Spring (September through November). The survey was completed in November, after below average rainfall in July and August 2022 (see Graph 1). Observed conditions were good with many species in fruit and flower and annuals present. Survey period aligned with the flowering period for majority of the species but outside of flowering period for four species, three of which can be identified without flowering material. This limitation is discussed in Section 4.2 and was considered negligible
Mapping Reliability	Negligible	The entire of the Survey Area was traversed by foot and mapping reliability is considered high.
Disturbances (fire, flood etc.)	Moderate	Areas of disturbance associated with access tracks, previous clearing and weeds were recorded but were not a constraint on the results of the survey. There was recent fire (<2 years ago) at Albany Highway Intersection Survey Area, about 15% of the survey area affected. This represents a minor constraint for the specific Survey Area.

4. Results

4.1 Desktop Assessment

Previous records identified by the desktop search are shown in Figure 2. As discussed in Mattiske (2021) the use of a 20 km radius results in species that are restricted to the Swan Coastal Plain or occurring in areas on granite outcrops (e.g. Mt Cooke, Mr Windsor and Mt Wells), or species restricted to the eastern Jarrah forest being included.

The Mattiske (2021) desktop assessment identified 39 Threatened or Priority species as being previously recorded or having a high or moderate likelihood of occurrence, see Table 7.

Previous Records Mattiske (2021)

Mattiske (2021) undertook a detailed survey of the MN project area. The survey which ran across 302 person days included 6121 recording sites on a 120 m x 120 m grid system, 22 permanent quadrats, targeted searches throughout the area and mapping vegetation, soils and condition.

The Mattiske (2021) Threatened and Priority flora search area overlays the Survey Area for this project. No previous records of Threatened or Priority flora were identified as present. In the broader MN project area, no Threatened flora species and four new Priority flora locations were recorded. Species recorded are shown in the likelihood of occurrence assessment (Table 7) and in Figure 2.

Mattiske (2021) reported their results reflected the importance of granite outcrop areas and the sandier and sandy gravel soils, with many species associated with these. Fewer species occur on the gravellier laterite soils. It was also identified that a higher concentration of Priority flora species occurred on the eastern fringes of the MN area which supports species that are more tolerant of sandier soils and outcrops.

Previous Records DBCA Database

Ten Priority flora species as listed by DBCA have been recorded in the MN Survey Area and 25 Threatened or Priority species within the 20 km desktop search area, see Table 7. The remaining four species were only recorded from the PMST search.

Pre-Survey Likelihood of Occurrence Assessment

The pre-survey likelihood of occurrence assessment specific to the eight packages of work within the Survey Area is presented below in Table 7. The intersection with Mattiske and Havel (1998) vegetation complexes, which was used to understand habitat present is presented in Table 6.

The likelihood of occurrence assessment identified that three species have a high likelihood of occurrence, 14 species a medium likelihood of occurrence and 22 species a low likelihood of occurrence. No Threatened species had a high or medium likelihood of occurrence. The species assed as having a low likelihood or occurrence were typically associated with granites, drainage lines, wetlands or sandy habitats. These were identified as not occurring or having marginal/ restricted occurrences within the Survey Area.

Table 6: Vegetation Complexes Within the MN Survey Area

Vegetation Complex	Description	Water Pipeline Alignment	Power Corridor Alignment	Frollett Road Intersection and Additional Frollett Road	Albany Highway Intersection	MN Facilites	HUNG_G_000473-000_B_Frollett Rd and Additional Survey Road
Dwellingup 1	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.	x	x			x	x
Dwellingup 2	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.	x	x	x	x		
Goonaping	Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata* (humid zones) and *Eucalyptus marginata* subsp. *thalassica* (semiarid to periarid zones) on the sandy gravels, low woodland of *Banksia attenuata* on the drier sandier sites (humid to periarid zones) with some *Banksia menziesii* (northern arid and periarid zones) and low open woodland of *Melaleuca preissiana – Banksia littoralis* on the moister sandy soils (humid to periarid zones).		x				
Murray 1	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.	x					
Pindalup	Open forest of *Eucalyptus marginata* subsp*. thalassica – Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones.						
Swamp	Mosaic of low open woodland of *Melaleuca preissiana – Banksia littoralis*, closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.	x	x		x		x
Yarragil 1	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.	x				x	
Yarragil 2	Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on slopes, woodland of *Eucalyptus patens – Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors.	x	x	x	x	x	x

Table 7: Pre-Survey Likelihood of Occurrence

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
Anthocercis gracilis	T	V	Low	Not recorded within MN area previously or during 2020 and earlier studies. Recorded in Dwellingup 1 in wider Jarrah Forest.	Sandy or loamy soils. Granite outcrops. Mainly near granites (Florabase records) and less likely in lateritic gravels.	Sep to Oct	Previous records >20km and preferred habitat not present.
Diuris drummondii	T	V	Low	Not recorded within MN area previously or during 2020 and earlier studies.	Low-lying depressions, swamps. Not likely in lateritic soils.	Nov to Dec or Jan	Previous records >20km and preferred habitat not present.
Diuris micrantha	T	V	Low	Not recorded within MN area previously or during 2020 and earlier studies.	Brown loamy clay. Winter-wet swamps, in shallow water. Not likely in lateritic soils.	Sep to Oct	Previous records >20km and preferred habitat not present.
Eleocharis keigheryi	T	V	Low	Not recorded within MN area previously or during 2020 and earlier studies.	Clay, sandy loam. Emergent in freshwater: creeks, claypans. Not likely in lateritic soils.	Aug to Nov	Previous records >20km and preferred habitat not present.
Grevillea flexuosa	T	V	Low	Recorded in Cooke in wider Jarrah Forest.	Red-brown sand with laterite & gravel, sand over granite. Ridgetop plateau & associated breakaways.	Jul to Oct	Preferred habitat not present. Previously recorded in a vegetation complex that was not within the Survey Areas.
Lasiopetalum pterocarpum	T	E	Low	Recorded on Darling Scarp, Murray 1 and Helena 1 so may extend to granite outcrops. Not in lateritic soils.	Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines.	Aug to Dec	Preferred habitat not present. Previously recorded in a vegetation complex that was not within the Survey Areas.
Verticordia fimbrilepis* subsp. *fimbrilepis	T	E	Low	Recorded in Swamps in wider Jarrah Forest. Some potential in lateritic soils.	Gravelly sandy or clayey soils. Flats, road verges.	Oct to Dec or Jan	Preferred habitat not present. Previously recorded in a vegetation complex that was not within the Survey Areas.
Verticordia plumosa* var. *ananeotes	T	E	Low	Not recorded within MN area North previously or during 2020 and earlier studies. Not likely in lateritic soils.	Sandy loam. Seasonally inundated plains.	Nov to Dec	Records 15 km west at base of scarp. Preferred habitat not present.

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
[2]***Andersonia* sp. Saxatilis (F. & J. Hort 3324)**	P1		Low	Recorded on Dwellingup, and Cooke.	Dry, brown loam, clay over granite. Slope, outcrops, granite.	Jan or Sep-Oct	Preferred habitat (granites) not present. Previously recorded in a vegetation complex that was not within the Survey Areas.
Calytrix simplex* subsp. *simplex	P1		Low	Recorded in Dwellingup 2 within wider Jarrah Forest. Potential in lateritic soils.	On sandplain. With *Eucalyptus tetragona*, etc.	Oct to Nov	Preferred habitat is not present within Survey Areas. The closest recording was 8.5 km away within Swamp complex with grey clay and loamy soil (WA Herb). This habitat was not present within the Survey Area.
Paracaleana gracilicordata	P1		Low	Not likely in lateritic soils as associated mainly with outcrops (may be localised small occurrences in Dwellingup 2, Pindalup) but more likely in Cooke	Growing on moss mats, granite.	Oct-Nov	Closest recording is 1.1 km from the Survey area (WA herb), however has strong association with moss mats on granite which was not present.
[2]***Paracaleana granitica***	P1		Low	Mainly on granite outcrops, not in lateritic soils, may be in other complexes if small, localised outcrops that are small in size Recorded on Dwellingup 2, Pindalup and Murray 1.	Growing on moss mats, granite.	Oct-Dec	Closest recording is 750 m from the Survey Area (WA herb), however habitat not present in Survey Areas.
Banksia recurvistylis	P2		Low	Recorded in Cooke and Dwellingup 2 within wider Jarrah Forest. Less likely in deeper lateritic soils.	Shallow, lateritic soils associated with granite outcrops.	Nov to Dec	Closest recording is 7.8 km from the Survey Area (WA herb), however preferred habitat (granites) not present.
Grevillea crowleyae	P2		Medium	Not recorded within MN previously or during 2020 and earlier studies. East of area in Dwellingup 2	Gravel. In gravel pit.	Aug to Nov	Previous record >5 km from the Survey Area (WA herb). Potentially suitable habitat present.
[2]***Grevillea manglesii* subsp. *ornithopoda***	P2		Low	Recorded in Dwellingup 1 and Murray 1. Less likely in deeper lateritic soils.	Loam, loam over clay, clay. Edge of riverbank and creek, dunes.	Sep-Nov	Vegetation complexes species previously recorded in present. Closest record 2.4 km from the Survey Area. However, the record is from 1901 (WA herb). Considered that preferred habitat is not present.
Millotia tenuifolia* var. *laevis	P2		Medium	Recorded in Dwellingup. Potential in lateritic and granite soils.	Granite or laterite soils.	Sep to Oct	Vegetation complexes previously recorded in present. Preferred habitat is present throughout the Survey Area. Previous recordings >10 km from the Survey Area (WA herb; TPFL).

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
Tetratheca phoenix	P2		Low	Recorded in mainly Cooke and occasionally in Dwellingup 4 in wider Jarrah Forest area. Most likely on granite. Not likely in deeper lateritic soils.	Brown gravelly loam over granite. Mid-upper slopes, often near large rock outcrops.		Preferred habitat (granites) not present. Previously recorded in a vegetation complex not within the Survey Area.
[1]***Acacia drummondii*** **subsp. *affinis***	P3		High	Potential in lateritic soils. Recorded in Yarragil 1 and Dwellingup 1 on soils associated with Dwellingup 2, Cooke and Yarragil 2 within wider Jarrah Forest. Recorded by Mattiske (2021) in Dwellingup 2, Cooke and Yarragil 2.	Lateritic gravelly soils.	Jul-Aug	Recorded within 2 km. Vegetation complexes association, soils and preferred habitat present.
[1]***Acacia horridula***	P3		High	Recorded in Dwellingup 2, Swamp, Yarragil 1 and Darling Scarp in wider Jarrah Forest. Potential in lateritic soils.	Gravelly soils over granite, sand. Rocky hillslopes.	May-Aug	Recent records <5 km from the Survey Area, within a vegetation complex (Swamp) that was present.
Acacia oncinophylla **subsp. *oncinophylla***	P3		Low	Recorded in Dwellingup 1 in wider Jarrah Forest. More likely on granites (Florabase, WAH 1998-).	Granitic soils.	Aug to Oct	Previously recorded in habitats associated with granite outcrops (WA herb) which was not present.
[2]***Andersonia*** **sp. Audax (F. Hort, B. Hort & J. Hort 3179)**	P3		Low	Recorded on Dwellingup 1, Dwellingup 2, Dwellingup 4, Yarragil 2, Swamp, Yarragil 2, and Cooke.	Loam, clay, sand, gravel. Granite slopes and drainage lines.	Oct-Nov	Previously recorded in habitats associated with granite outcrops (WA herb) which was not present.
[1]***Conospermum scaposum***	P3		Medium	Recorded in Yarragil 2. Not likely in lateritic soils.	White-grey sand, sandy clay. Low swampy areas, road verges.	Oct to Dec or Jan to Feb	Previously recorded 5.5 km from the Survey Area, within a vegetation complex that had minor coverage within the Survey Area. The preferred habitat was present in small patches of the Survey Area.
Grevillea manglesii **subsp. *dissectifolia***	P3		Medium	Recorded in in Dwellingup, Murray 1, Cooke and Pindalup. Potential in lateritic soils.	Gravelly loam, moist. Roadsides.	Jun or Sep or Nov	Previously recorded 7km east of Survey Area within a vegetation complex present in Survey Area.

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
Halgania corymbosa	P3		Medium	Recorded in Darling Scarp 2. Potential in lateritic soils.	Gravelly soils, soils over granite.	Aug to Nov	Previous records >10 km from Survey Area and >30 years old (WA herb) in a vegetation complex that was not present within the Survey Area. Potentially suitable habitat present.
Lasiopetalum glutinosum* subsp. *glutinosum	P3		Medium	Recorded in Dwellingup 1, Darling Scarp 2, and Murray 1, in wider area. Potential in lateritic soils.	Grows in open woodland and low scrub, mostly on the Darling Scarp near the Avon Wheatbelt, Jarrah Forest, Swan Coastal Plain.		Previous records >10 km from Survey Area and >20 years old (WA herb) in vegetation complexes present within the Survey Area.
Petrophile filifolia* subsp. *laxa	P3		Low	Recorded in Yarragil 1 in wider area. Not likely in lateritic soils.	White gritty sand, brown, red, yellow, white or grey sand, brown-yellow sandy clay. Winter-wet sites, flats, slopes, swamps, drainage lines.	Nov to Jan	Previous recording >10 km from Survey Area (WA herb). The preferred habitat was not present.
Pithocarpa corymbulosa	P3		Low	Recorded in Yarragil 2, Dwellingup 2 and Swamp. Not likely in deeper lateritic soils.	Gravelly or sandy loam. Amongst granite outcrops.	Jan to Apr	Previous records >10 km away from Survey area (WA herb) and in vegetation complexes that are within the Survey Area. Preferred habitat (granites) not present.
[2]***Stackhousia* sp. Redblotched corolla (A. Markey 911)**	P3		Medium	Recorded north of MN in Dwellingup 2 in wider Jarrah Forest. Potential for occurrence in lateritic soils.	Brown loamy sand clayey sand over laterite, white sandy clay over granite, grey clay. Slopes.	Sep-Nov	Previous records 1.9 km from the Survey Area, record is > 30 years old (WA herb). Vegetation complex association present within the Survey Area.
Synaphea pandurata	P3		Medium	Recorded in Pindalup, Swamp and Dwellingup 2 in wider Jarrah Forest and earlier studies.	Yellow-grey, yellow-brown, yellow-red sands and sandy loams, dark brown loam, laterite gravel, granite. In undulating areas.		Previous records >9 km from the Survey Area (WA herb) and within vegetation complexes present within the Survey Area.
Thysanotus anceps	P3		Medium	Recorded in Murray 1 and Dwellingup in wider Jarrah Forest. Potential for occurrence in lateritic soils.	White or grey sand, lateritic gravel, laterite.	Oct to Dec	Previous records in vegetation complexes present in Survey Area. Previous records >10 km from the Survey area and are >20 years old (WA herb). Preferred habitat was present in patches.

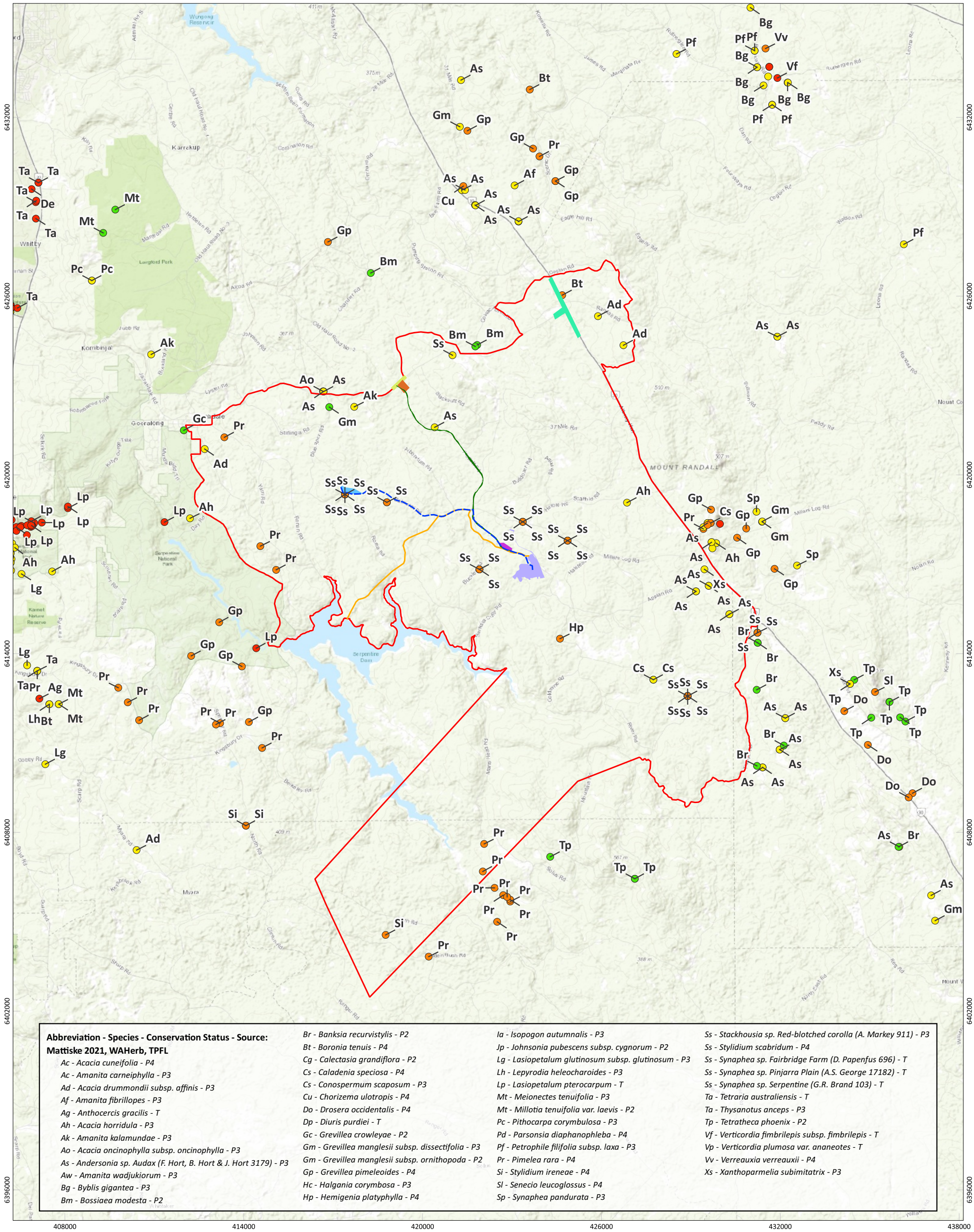
Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
[2]*Boronia tenuis*	P4		Medium	Recorded in Dwellingup 2, Yarragil 1 and Murray 1 in wider Jarrah Forest. Potential in lateritic soils in valleys and on granite outcrops.	Laterite, stony soils, granite.	Aug-Nov	Previous records located <1 km from Survey Area, however >30 years old and listed as from Turtle Pool (WA herb). Likely inaccurate location. Vegetation complex association present within the Survey Area.
Chorizema ulotropis	P4		Medium	Recorded in Dwellingup 1 and Dwellingup 2 within wider Jarrah Forest. Potential in lateritic soils.	Moist to dry soils, white sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats.	Jul to Sep	Previous records in vegetation complexes present within the Survey Area. Record is 5 km from the Survey Area (WA herb) and the preferred habitat is marginally suitable within the wider Survey Area.
Grevillea pimeleoides	P4		Medium	Recorded in Murray 1 Dwellingup 1, Dwellingup 2, Pindalup and Cooke in wider Jarrah Forest.	Gravelly soils over granite. Rocky hillsides. Although on outcrops, there is potential in lateritic soils.	May to Nov	Several records 5-10 km from Survey Area. Majority of records >30 years old (WA herb). Records <30 years old within vegetation complexes not present. Potentially suitable habitat considered present.
[2]*Hemigenia platyphylla*	P4		Medium	Recorded in Dwellingup 1. Less likely in deeper lateritic soils. Potential in sandy gravels.	Sandy and loamy soils. Granite rocks, slopes.	Sep-Nov	Previous records within vegetation complex present in the Survey Area. Record is >5 km away (WA herb). Habitat present marginally suitable.
Lasiopetalum cardiophyllum	P4		Low	Recorded on sandy gravels and further east in wider Jarrah Forest. May occur in lateritic soils.	Lateritic gravelly soils, sandy clay. Flats, hillslopes.	Aug to Dec or Jan	Previously records >20 km from Survey Area. Potentially suitable habitat present (WA herb).
Parsonsia diaphanophleba	P4		Low	Recorded in Murray 1 and Yarragil 1 in wider Jarrah Forest. Less likely in lateritic soils.	Alluvial soils. Along rivers.	Jan to Feb or Apr to Jun or Sep	Previous records either >30 years old or >20 km from the Survey Area, all records in association with riverbank (WA herb). Vegetation complexes that associated with previous records present, however preferred habitat not present.
[2]*Pimelea rara*	P4		Medium	Recorded in Dwellingup 1, Dwellingup 2, Murray 1, Yarragil 1, Yarragil 2 and to a lesser degree Cooke in wider Jarrah Forest. Potential to occur in lateritic soils.	Lateritic soils.	Dec-Jan	Vegetation complexes and preferred habitat present. Closest previous record 6.3 km from the Survey Area (WA herb).

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
[2]***Stylidium ireneae***	P4		Low	Recorded in Yarragil 1 and Yarragil 2 in wider Jarrah Forest.	Sandy loam. Valleys near creek lines. Not likely in lateritic soils.	Oct-Dec	Previous records in vegetation complexes that cover smaller areas of the Survey Area. Previous records >8 km (WA herb) from the Survey Area and preferred habitat not present.
[1]***Stylidium scabridum***	P4		High	Less likely in lateritic soils, although was recorded in Dwellingup complexes. Recorded on Dwellingup 1, Dwellingup 2, Yarragil 2, Goonaping in range of soils and site conditions.	Sand. Open woodland or heath.	Sep-Nov	Records in five locations <2 km, within vegetation complexes that are common across the Survey Area. Preferred habitat was present in some patches.

[1]-Recorded by Mattiske 2021.

[2]-DBCA database.

This table based on *Table 6: Summary of Potential Threatened and Priority Flora Recorded In The Myara North Survey Area* in Mattiske (2021). Preferred habitat and flowering period from Florabase (WAH, 2022).


408000
414000
420000
426000
432000
438000
6432000
6426000
6420000
6414000
6408000
6402000
6396000
Wungong Reservoir
Karrakup
Whitby
Langford Park
Korribinjal
Gooralong
Serpentine National Park
Kamet Nature Reserve
Serpentine Dam
MOUNT RANDALL
Mount Co
Myara
Ta Ta Ta De Ta Ta
Mt Mt
Pc Pc
Ta
Ak
Ad
Lp Lp Lp Lp Lp Lp Lp Lp Lp
Ah Ah Lg
Gp Gp Gp Gp
Lg Ta TaPr Ag Mt LhBt Mt Lg
Pr Pr Pr Pr Pr Pr Pr Pr Pr Pr
Si Si Si
Ad
As
Bm
Gp
Ao As Ak As Gm Gc Pr Ad
Ss Ss Ss Ss Ss Ss Ss Ss Ss Ss
Lp Ah Pr Pr
Gm Gp
As As Cu As As As As
Gp Pr Af Gp Gp
Bt
Bm Bm Ss
Pf
Pf Pf Vv Bg Bg Vf Bg Bg Bg Bg Pf Pf
Ah
Gp Pr Cs Gp Sp Gm Gm As As Ah Gp Sp Gp
As As As Xs As As As Ss Ss Br Ss Br
Hp
Cs Cs Ss Ss Ss Ss Ss
Br As As Br As As
Xs Tp Sl Tp Tp Do Tp Tp Tp Tp Tp Do
Do Do
As Br
As Gm
Tp Tp Tp
Pf
As As
Ad
Ad
Br
Bt
Ra
Ra
Ra

4.2 Field Survey Results

Threatened and Priority Flora

No Commonwealth EPBC Act listed, or State BC Act listed Threatened flora or DBCA listed Priority flora were recorded in the Survey Area. The absence of Threatened and Priority flora was not an unexpected outcome considering the absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).

Thirty-five collections were made in the field for identification to check for potential threaten and priority species. Five collections (four *Acacia* and one *Pimelea*) were subsequently submitted to the WAH to confirm identifications. It was confirmed that none of the collections were Priority species.

The survey was undertaken outside of the flowering period of four species assessed as having a high or medium likelihood of occurrence. This potentially limits the ability to detect or confirm identification. These are discussed below.

- *Acacia drummondii* subsp. *affinis* (P3) flowers Jul-Aug: Medium size perennial shrub, is identifiable in the field without flowers by pinnae dimensions and hair structures. Four collections were submitted to the WA herbarium for confirmation. All were identified as other *Acacia* sp. Not considered a survey limitation.

- *Acacia horridula* (P3) flowers May-Aug: Perennial shrub, is identifiable in the field without flowers by robust, harsh single stemmed form. Not considered a survey limitation.

- *Chorizema ulotropis* (P4) flowers Jul-Sep: Flowers required for positive identification. No suspected occurrence was identified. All *Chorizema* collections were positively identified as common species. Due to form as a spawning or twining shrub detection may be more difficult if not in flower. May represent minor survey limitation.

- *Pimelea rara* (P4) flowers Dec-Jan: Likely identifiable by having concolorous dull leaves and small (<40 cm) size vs common species present which have sheen an adaxial leaf surface and are larger. One collection was submitted to the WA herbarium and was confirmed as not as Priority species.

Brief descriptions of survey effort, the habitats encountered and comments on vegetation condition and disturbance for the eight packages of work within the Survey Area are provided below.

Survey Area Descriptions

Water/Power Alignment

Eight person days of survey effort, see tracklogs in Figure 3a-3c and Figure 4a-4d. Follows Balmoral Rd or forestry tracks for majority of area. Water Corridor runs through bushland with limited disturbance in southern branch.

Geology throughout was lateritic with gravel and shallow loams. The vegetation was considered Good to Very Good with patches of Very Good to Excellent condition. Due to the activity of firewood harvesting along the edges of Balmoral Rd and the forestry tracks the ground stratum was sparse with vehicle disturbance present. The vegetation was consistent *Eucalyptus marginata* and *Corymbia calophylla* forest.

HUNG_G_000473-000_B_Frollet Rd and Additional Survey Road

Five person days of survey effort, see tracklogs in Figure 5a-5d. Survey Area follows Frollet Rd and Balmoral Rd verges. 1.6 km of the Survey Area intersected pine plantations, these were not traversed. Ground stratum was generally sparse with vehicle disturbance present.

Majority geology was lateritic gravel and shallow loams. Some lower lying areas with a more clay loam soil was present. On lateritic soils vegetation was comparable to the Power Alignment with *Eucalyptus marginata* and *Corymbia calophylla* forest. Where the soil type was associated with the Swamp vegetation complex *Melaleuca preissiana* and myrtaceous shrublands were present.

MN Facilities Area

Five person days of survey effort, see tracklogs in Figure 6a-6d. Extending north and south of Balmoral Rd and north along proposed magazine access track.

Majority of the area was associated with lateritic gravel and *Eucalyptus marginata* and *Corymbia calophylla* forest. The southwest corner was associated with a soil type of grey sand over laterite supporting myrtaceous shrubland. This area received additional focus as the desktop identified several species associated with this habitat type.

Vegetation was Very Good to Excellent condition with minor forestry tracks going through the area. Firewood collection disturbance was common around tracks.

Frollett Road Intersection and Additional Frollett Road Survey Area

Two person days of survey effort, see tracklogs in Figure 7. Survey Area followed verges and intersection of Jarrahdale Rd and Frollet Rd.

Geology throughout the was lateritic gravels with *Eucalyptus marginata* and *Corymbia calophylla* forest. The vegetation was in Good condition. The ground stratum was sparse with low species diversity. This is the main access road to a firewood harvesting block, hence the vegetation was disturbed from the high

concentration of vehicles and people accessing firewood. Additionally, a part of the area was historically cleared for a borrow pit which was revegetated.

Albany Highway Intersection Survey Area

Five person days of survey effort, see tracklogs in Figure 8. Follows the verges of Albany Highway and Jarrahdale Rd. Several sections of pine plantation were present, these were not traversed. The survey area along the northern side of Jarrahdale Road had recently burnt (<2 years prior) impacting around 15% of the Survey Area. Most of the mid and ground stratum had not re-established limiting ability to undertake searches. This is considered a minor limitation in the context of the overall survey effort.

Majority of the area was associated with the Dwellingup 2 complex with lateritic gravels but had pockets of the Swamp complex with clay loam soils and Yarragil 2 complex also with clay loam soils. In the clay loam areas dense thickets of myrtaceous shrubland were present. In the southern corner a moderate size drainage line was present with flowing water. In this area the soil type was loamy. This area received additional focus as the desktop identified several species associated with this habitat type.

The vegetation along Albany Highway was disturbed with partial clearing present for access tracks and pine plantations. Outside of clearing impacts vegetation Good to Very Good condition.

Post Survey Likelihood of Occurrence Assessment

Following suitable targeted search effort, the likelihood of occurrence for all Threatened and Priority flora species identified by the desktop was reassessed as low. This assessment is discussed further in Section 5.

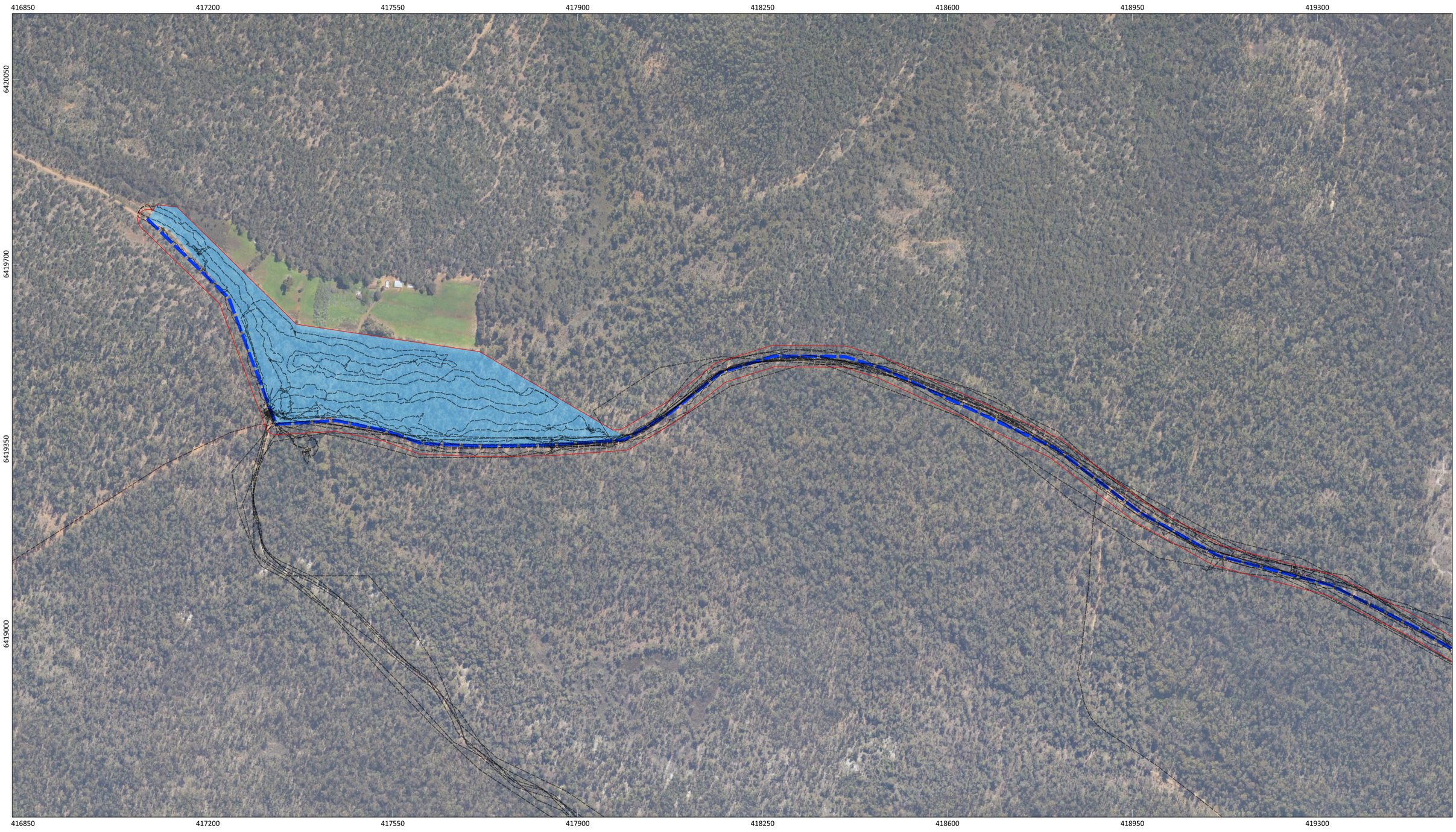


Figure 3a: Survey effort: Power Alignment

N

0 100 200 300 400 m

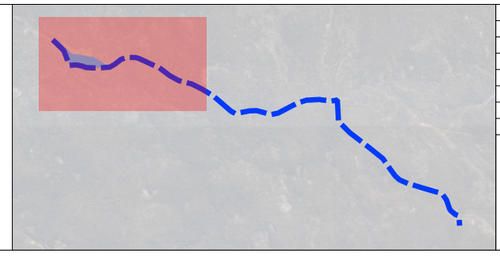
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DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: MD / LT / DATE: 13/3/2023

PROJECT/REPORT NAME
Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT
Alcoa of Australia Limited

Legend

- Survey Area
- Power Alignment
- Power Alignment
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:
Cadastral boundary from LANDGATE 2022

WESTERN ENVIRONMENTAL
Western Environmental Pty Ltd
08 6244 2310 | enquiries@westenv.com.au
Level 3/25 Prowse St, West Perth WA 6005
westenv.com.au

G:\GIS\Project Data\A22.055\A22.055.qgs

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Designed and Automated by AC



Figure 3b: Survey effort: Power Alignment

N

0 100 200 300 400 m

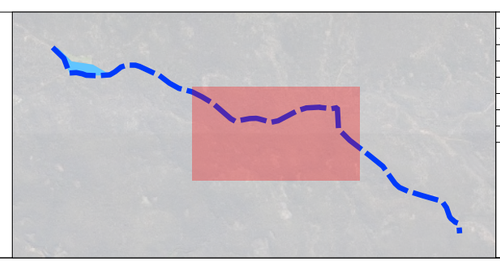
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DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: MD / LT / DATE: 13/3/2023

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT: Alcoa of Australia Limited

Legend

- Survey Area
- Power Alignment
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:

Cadastral boundary from LANDGATE 2022

WESTERN ENVIRONMENTAL

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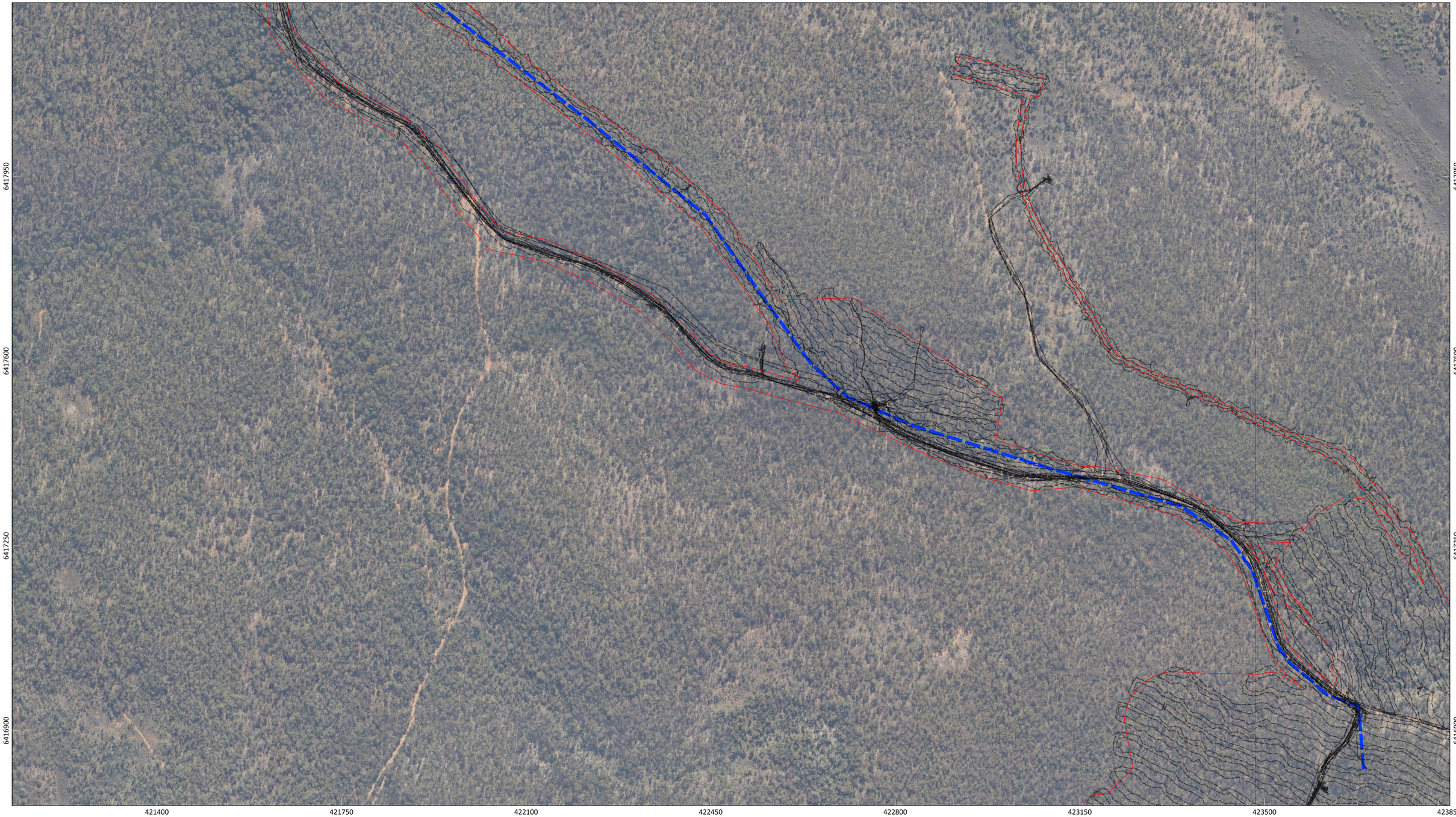


Figure 3c: Survey effort: Power Alignment

N

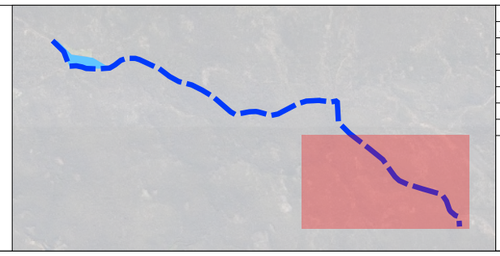
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SCALE: 1:7,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
CLIENT: Alcoa of Australia Limited		
PROJECT NUMBER: A22.055	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023	

Legend

- Survey Area
- Power Alignment
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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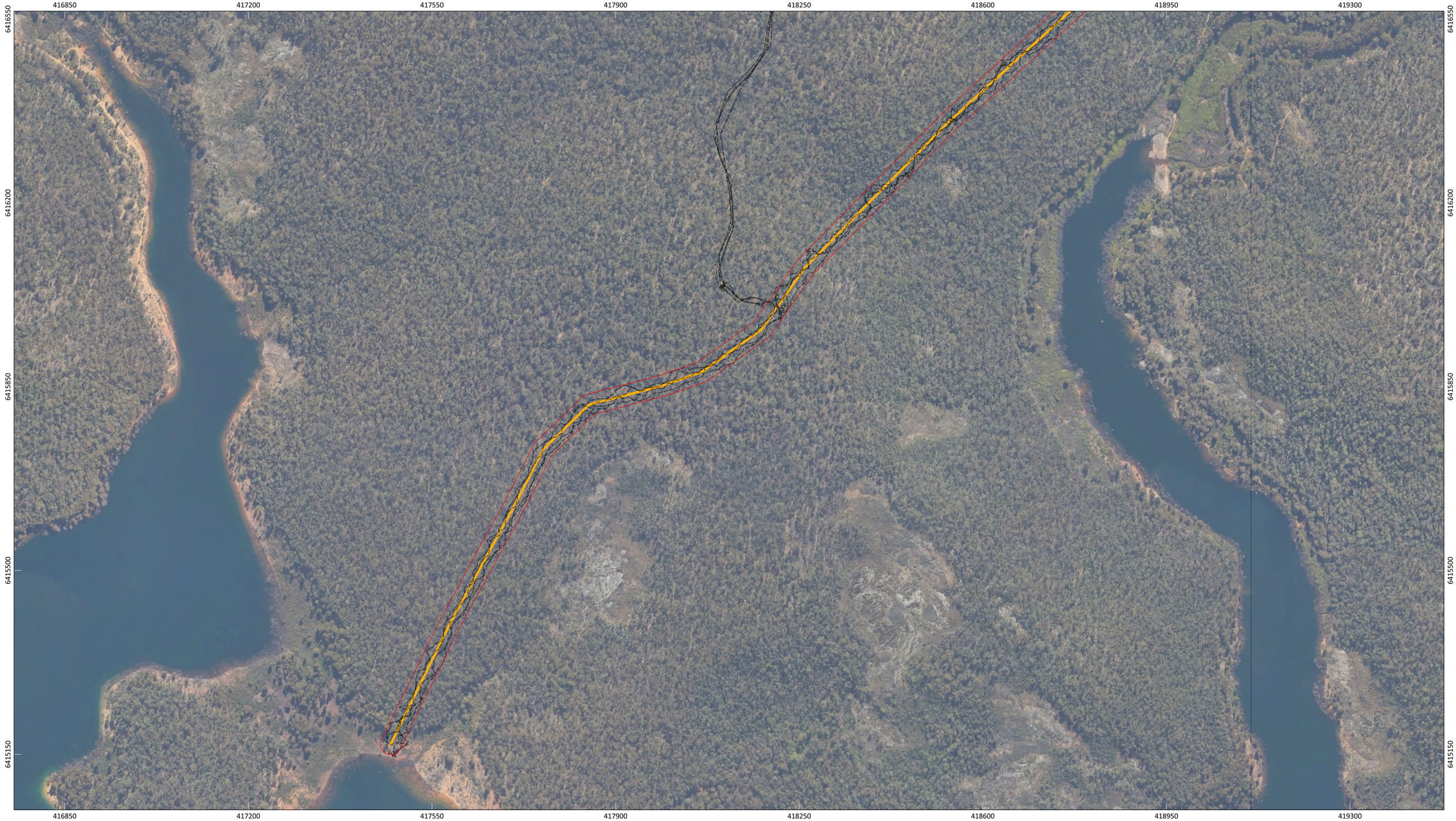


Figure 4a: Survey effort: Water Alignment

N

0 100 200 300 400 m

SCALE: 1:7,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT: Alcoa of Australia Limited

PROJECT NUMBER	VERSION
A22.055	0
DRAWN BY / REVIEWED BY	DATE
MD / LT	13/3/2023

Legend

- Survey Area
- Water Alignment
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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Figure 4b: Survey effort: Water Alignment

N

0 100 200 300 400 m

SCALE: 1:7,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

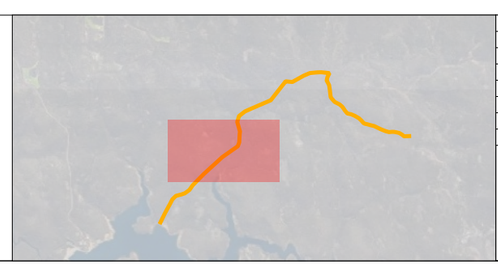
PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT: Alcoa of Australia Limited

PROJECT NUMBER	VERSION
A22.055	0
DRAWN BY / REVIEWED BY	**DATE**
MD / LT	13/3/2023

Legend

- Survey Area
- Water Alignment
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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Figure 4c: Water Alignment

N

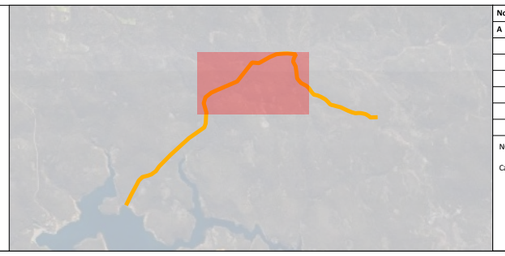
0 100 200 300 400 m

SCALE: 1:7,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
CLIENT: Alcoa of Australia Limited		
PROJECT NUMBER: A22.055	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023	

Legend

- Survey Area
- Water Alignment
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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421400 421750 422100 422450 422800 423150 423500 423850

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6417950
6417600
6417250

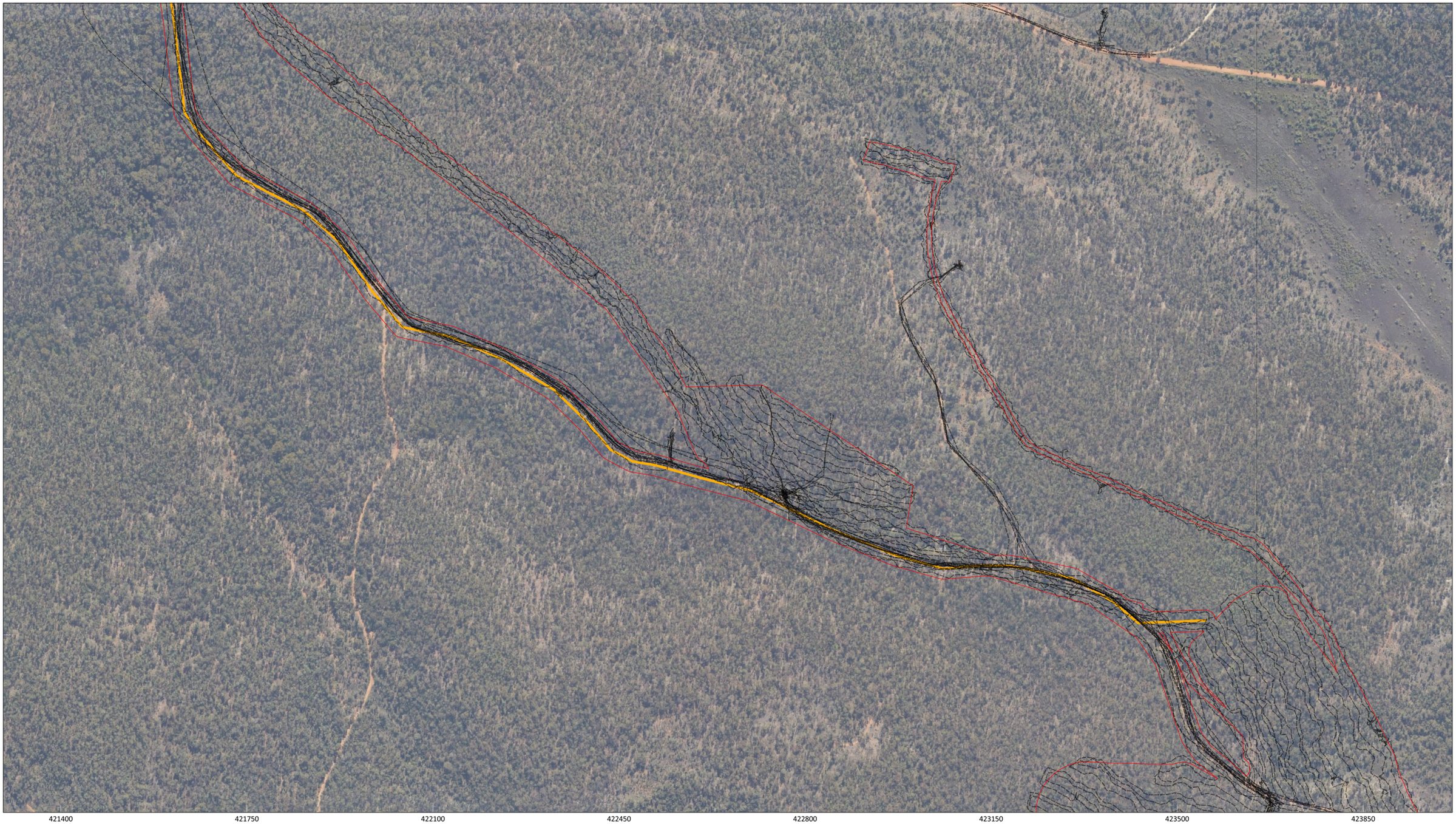


Figure 4d: Water Alignment

N

0 100 200 300 400 m

SCALE: 1:7,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

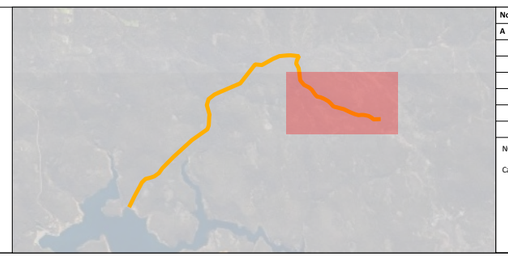
PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT: Alcoa of Australia Limited

PROJECT NUMBER	VERSION
A22.055	0
DRAWN BY / REVIEWED BY	**DATE**
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Legend

- Survey Area
- Water Alignment
- Track Log



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A	Original issue	MD	LT	13/3/2023

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Figure 5a: Survey Effort: HUNG_G_000473-000_B_Frollet Rd and Additional Survey Area

N

0 100 200 300 400 m

PROJECT/REPORT NAME	Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North
SCALE	1:7,000
SHEET SIZE	A3 COLOUR
CLIENT	Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A22.055
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY 2022
DRAWN BY / REVIEWED BY	MD / LT
DATE	13/3/2023

Legend

- Survey Area
- HUNG_G_000473-000_B_Frollet Rd
- Track Log

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:

Cadastral boundary from LANDGATE 2022

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Figure 5b: Survey Effort: HUNG_G_000473-000_B_Frollet Rd and Additional Survey Area

N

0 100 200 300 400 m

SCALE: 1:7,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
CLIENT: Alcoa of Australia Limited		
PROJECT NUMBER: A22.055	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023	

Legend

- Survey Area
- HUNG_G_000473-000_B_Frollet Rd
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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Figure 5c: Survey Effort: HUNG_G_000473-000_B_Frollet Rd and Additional Survey Area

N

0 100 200 300 400 m

PROJECT/REPORT NAME	Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North
SCALE	1:7,000
SHEET SIZE	A3 COLOUR
CLIENT	Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A22.055
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY 2022
DRAWN BY / REVIEWED BY	MD / LT
DATE	13/3/2023

Legend

- Survey Area
- HUNG_G_000473-000_B_Frollet Rd
- Track Log

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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Figure 5d: Survey Effort: HUNG_G_000473-000_B_Frollet Rd and Additional Survey Area

N

0 100 200 300 400 m

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
SCALE: 1:7,000	SHEET SIZE: A3 COLOUR	CLIENT: Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A22.055	VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023

Legend

- Survey Area
- HUNG_G_000473-000_B_Frollet Rd
- Additional Survey Area
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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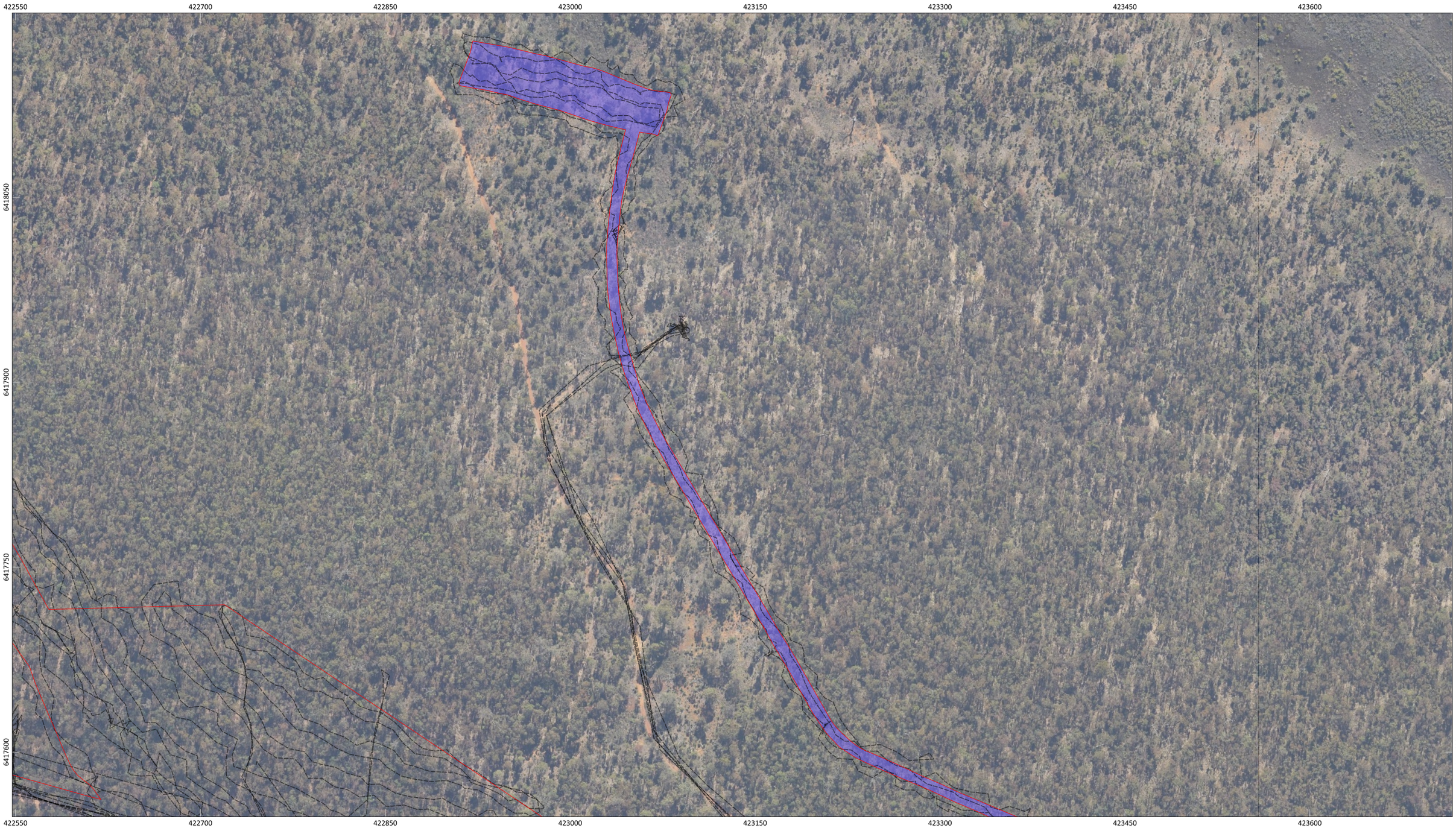


Figure 6a: Survey Effort: Myara North Facilities

N

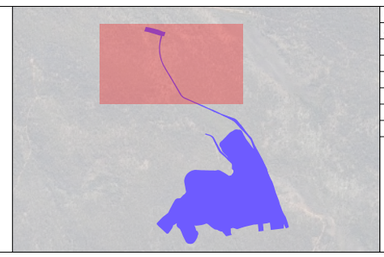
0 40 80 120 160 m

SCALE: 1:3,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
CLIENT: Alcoa of Australia Limited		
PROJECT NUMBER: A22.055	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023	

Legend

- Survey Area
- Myara North Facilities
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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Figure 6b: Survey Effort: Myara North Facilities

N

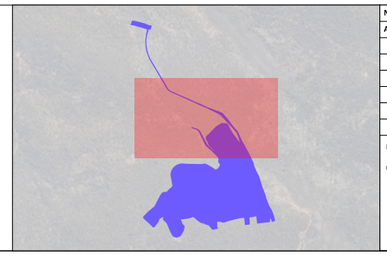
0 40 80 120 160 m

SCALE: 1:3,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
CLIENT: Alcoa of Australia Limited		
PROJECT NUMBER: A22.055	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023	

Legend

- Survey Area
- Myara North Facilities
- Track Log



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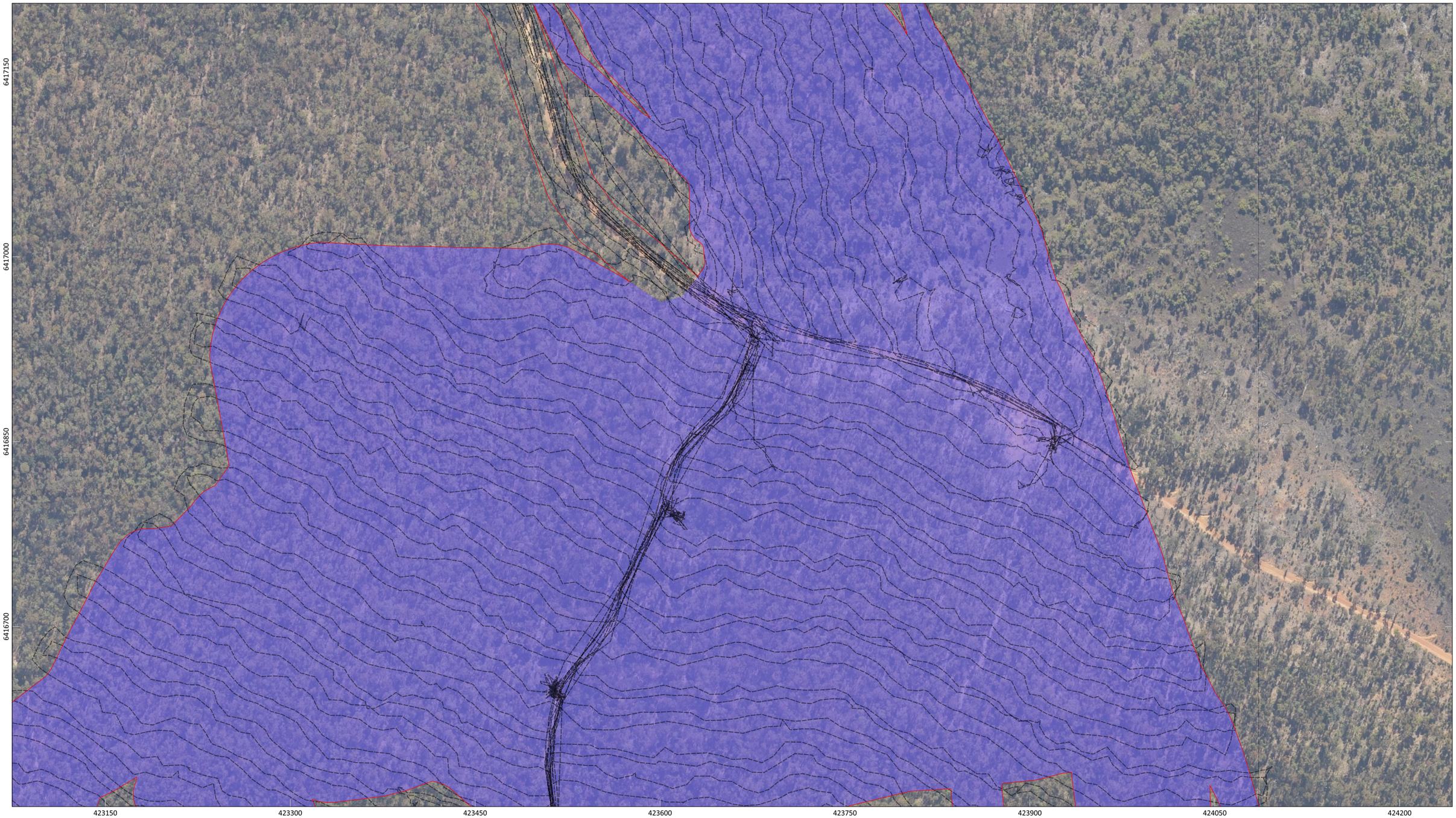


Figure 6c: Survey Effort: Myara North Facilities

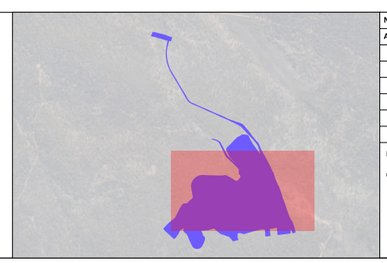
N

0 40 80 120 160 m

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
SCALE: 1:3,000	SHEET SIZE: A3 COLOUR	CLIENT: Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A22.055	VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023

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- Survey Area
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- Track Log



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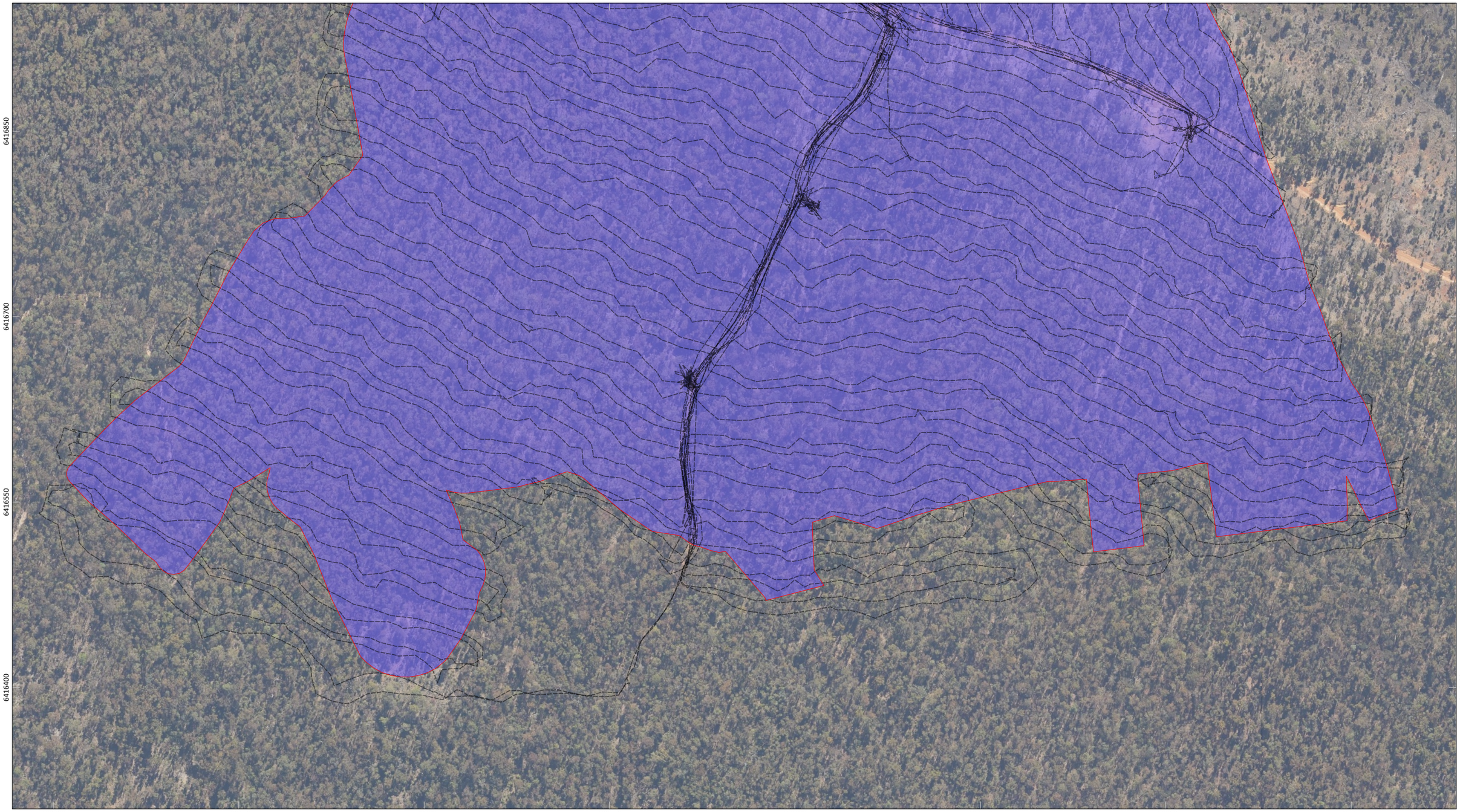


Figure 6d: Survey Effort: Myara North Facilities

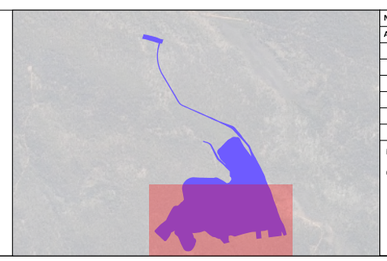
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0 40 80 120 160 m

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
SCALE: 1:3,000	SHEET SIZE: A3 COLOUR	CLIENT: Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A22.055	VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023

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- Survey Area
- Myara North Facilities
- Track Log



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A	Original issue	MD	LT	13/3/2023

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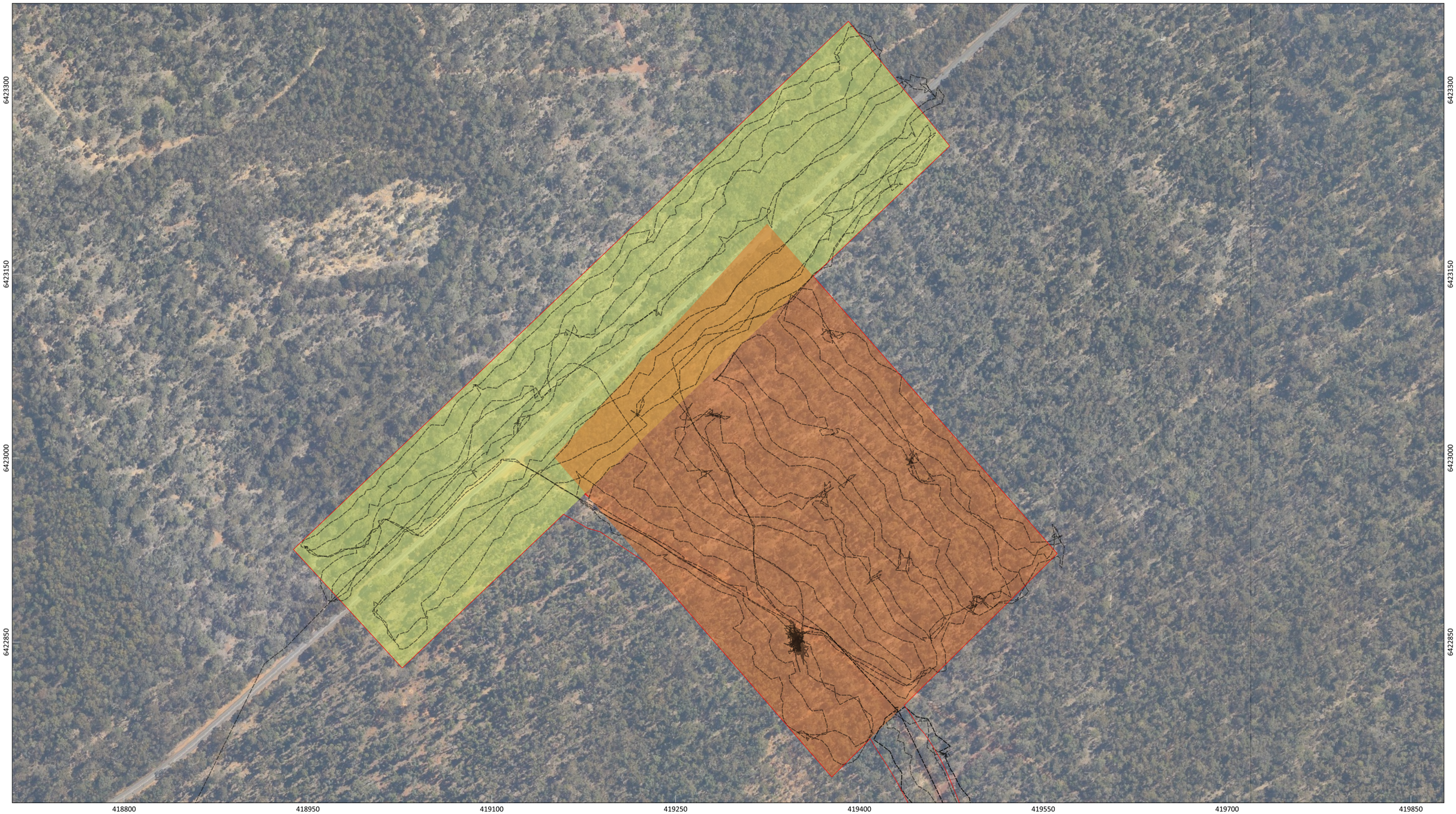


Figure 7: Survey effort: Frollett Road Intersection and Additional Frollett Road Survey Area

N

0 40 80 120 160 m

SCALE: 1:3,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT: Alcoa of Australia Limited

PROJECT NUMBER	VERSION
A22.055	0
DRAWN BY / REVIEWED BY	DATE
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Legend

- Survey Area
- Additional Frollett Road Survey Area
- Frollet Road Intersection
- Track Log

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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Figure 8: Survey Effort - Albany Highway Intersection

0 50 100 150 200 m

N

PROJECT/REPORT NAME	Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North
SCALE	1:7,000
SHEET SIZE	A3 COLOUR
CLIENT	Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A22.055
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY 2022
DRAWN BY / REVIEWED BY	MD / LT
DATE	13/3/2023

Legend

- Survey Area
- Albany Hwy Intersectoin
- Track Log

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:

Cadastral boundary (LGATE-002)

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5. Discussion

No Commonwealth EPBC Act listed, or State BC Act listed Threatened flora or DBCA listed Priority flora were recorded in the Survey Area.

The pre-survey likelihood of occurrence assessment identified three species as having a high likelihood of occurrence, 14 species medium and 22 species low. No Threatened species had a high or medium likelihood of occurrence. The species assed as having a low likelihood of occurrence were typically associated with granites, drainage lines, wetlands or sandy habitats. These were identified as not occurring or having marginal/ restricted occurrences within the Survey Area.

Following suitable targeted search effort, the likelihood of occurrence for all Threatened and Priority flora species identified by the desktop was reassessed as low. This assessment has been reached considering:

- The results of the pre-survey likelihood of occurrence assessments, both by WEPL for the specific Survey Area and Mattiske (2021) for the MY project area.
- Having undertaken suitable targeted search efforts during the primary spring survey season and within the flowering period of the majority of species. For the four species with flowering periods outside the survey period, three can likely be identified without flowering material.
- The absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).
- Disturbance to the understory in many areas through vehicle access for firewood collection and clearing of access tracks.
- The alignment of much of the Survey Area on existing disturbed areas, roads and forestry tracks.

The absence of Threatened and Priority flora was not an unexpected survey outcome considering the dominance of habitat with *Eucalyptus marginata* and *Corymbia calophylla* forest over laterite and the absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).

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Appendix A
Legislation

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act aims to protect matters of national environmental significance (MNES). Under the EPBC Act, the Commonwealth Department of Climate Change, Energy and the Environment lists Threatened species and communities in categories determined by criteria set out in the EPBC Act.

Projects likely to cause a significant impact on MNES should be referred to the DCCEEW for assessment under the EPBC Act.

Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 aims to conserve and protect biodiversity and biodiversity components within the State and to promote ecologically sustainable use of biodiversity components in the State.

Environmental Protection Act 1986

Declared Rare Flora (DRF) and Threatened Ecological Communities (TECs) are given special consideration in environmental impact assessments and have special status as Environmentally Sensitive Areas (ESAs) under the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Exemptions for a clearing permit do not apply in an ESA. In addition, habitat necessary for the maintenance of indigenous fauna is considered in the clearing principles and assessed during consideration of applications for a clearing permit.

Biosecurity and Agricultural Management Act 2007

Plants may be 'Declared' by the Minister for Agriculture and Food under the BAM Act. The Western Australian Organism List contains information on the area(s) in which a plant is declared and the control and keeping categories to which it has been assigned in Western Australia. A declaration may apply to the whole State, to districts, individual properties or even to single paddocks. If a plant is 'Declared', landholders are obliged to control that plant on their properties.

Weeds of National Significance

The Australian Government along with the State and Territory governments has endorsed 32 WoNS. Four major criteria were used in determining WoNS:

- The invasiveness of a weed species.
- A weed's impacts.
- The potential for spread of a weed.
- Socio-economic and environmental values.

Each WoNS has a national strategy and a national coordinator, responsible for implementing the strategy. WoNS are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts.

Department of Biodiversity, Conservation and Attractions Priority Lists

DBCA lists 'Priority' flora and fauna that have not been assigned statutory protection as "Threatened" under the BC Act and are under consideration for declaration as Threatened. Flora and fauna assessed as Priority 1-3 are considered to be in urgent need of further survey. Priority 4 flora requires monitoring every 5 -10 years.

DBCA maintains a list of Priority Ecological Communities (PECs) which identifies plant communities that require further investigation before possible nomination for TEC status. Once listed, a community becomes a PEC and, when endorsed by the WA Minister for Environment, becomes a TEC and protected as an ESA under Environmental Protection (Clearing of Native Vegetation) Regulations 2004.

Informal Recognition of Flora and Fauna

Certain populations or communities of flora and/or fauna may be of local significance or interest because of their patterns of distribution and abundance. For example, specific locations of flora and may be locally significant because they are range extensions to the previously known distribution, or are newly discovered taxa (and have the potential to be of more than local significance). In addition, many species are in decline as a result of threatening processes (land clearing, grazing, and changed fire regimes) and relict populations of such species assume local importance for DBCA. It is not uncommon for DBCA to make comment on these species of interest.

Appendix B
Definitions and Criteria

EPBC Act Categories for Flora, Fauna and Ecological Communities

Category	Threatened Species	Threatened Ecological Communities
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.	N/A.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.	N/A.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish. (ii) the species is the focus of a plan of	N/A.

Category	Threatened Species	Threatened Ecological Communities
	management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised. (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory. (iv) cessation of the plan of management would adversely affect the conservation status of the species.	

Conservation Codes for Western Australian Flora and Fauna (DBCA)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, Threatened, extinct or in need of special protection, and have been gazetted as such. **The Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** **Categories of Threatened, Extinct and Specially Protected fauna and flora are:**	
T	**Threatened species** Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as Threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using International Union for Conservation of Nature (IUCN) Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
EN	**Endangered species** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare

Conservation Codes for Western Australian Flora and Fauna	
	Flora) Notice 2018 for endangered flora.
VU	**Vulnerable species** Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct species **Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.**	
EX	**Extinct species** Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
EW	**Extinct in the wild species** Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no Threatened fauna or Threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species **Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.** **Species that are listed as Threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.**	
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Conservation Codes for Western Australian Flora and Fauna	
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as Threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
P	**Priority species** Possibly Threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of Priority for survey and evaluation of conservation status so that consideration can be given to their declaration as Threatened fauna or flora. Species that are adequately known, are rare but not Threatened, or meet criteria for near Threatened, or that have been recently removed from the Threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority 1: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	**Priority 2: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	**Priority 3: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Conservation Codes for Western Australian Flora and Fauna	
4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently Threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of Threatened species during the past five years for reasons other than taxonomy.

[1] The definition of flora includes algae, fungi and lichens.

DBCA Definitions and Criteria for TECs and PECs

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years). ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years). ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes.

Criteria	Definition
	iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short-term future (within approximately 20 years). ii. modification throughout its range is continuing such that in the short-term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short-term future (within approximately 20 years). ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes. iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few

Criteria	Definition
	locations. C. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority Ecological Communities	
Priority One	**Poorly known ecological communities** Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	**Poorly known ecological communities** Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three	**Poorly known ecological communities** i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or. ii. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or. iii. Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities, but do not meet adequacy of survey requirements and / or are not well defined, and known threatening processes exist that could affect them.
Priority Four	**Ecological communities that are adequately known, rare but not Threatened or meet criteria for Near Threatened, or that have been recently removed from the Threatened list**. These communities require regular monitoring. i. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently Threatened or in need of special protection, but could be if present circumstances change These communities are usually represented on conservation lands. ii. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii. Ecological communities that have been removed from the list of Threatened communities during the past five years.

Criteria	Definition
Priority Five	**Conservation Dependent Ecological Communities** Ecological Communities that are not Threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming Threatened within five years.

Appendix C
Mattiske (2021) Detailed Flora and Vegetation Survey for Huntly Mine – Myara North

Appendix 4 – Myara North Targeted Flora Survey (AECOM, 2024)

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14 February 2024

Commercial-in-Confidence

Miranda Ludlow
Approvals Manager - Major Capital Projects Australia
Alcoa of Australia

Dear Miranda

Myara North Targeted Flora Survey

1.0 Introduction

ALCOA of Australia (ALCOA) engaged AECOM Australia Pty Ltd (AECOM) to undertake a targeted flora survey for the Myara North Project. The survey area includes a Geotechnical Pre-clearance Survey Area as well as a Boundary Pre-clearance Survey Area (Figure 1).

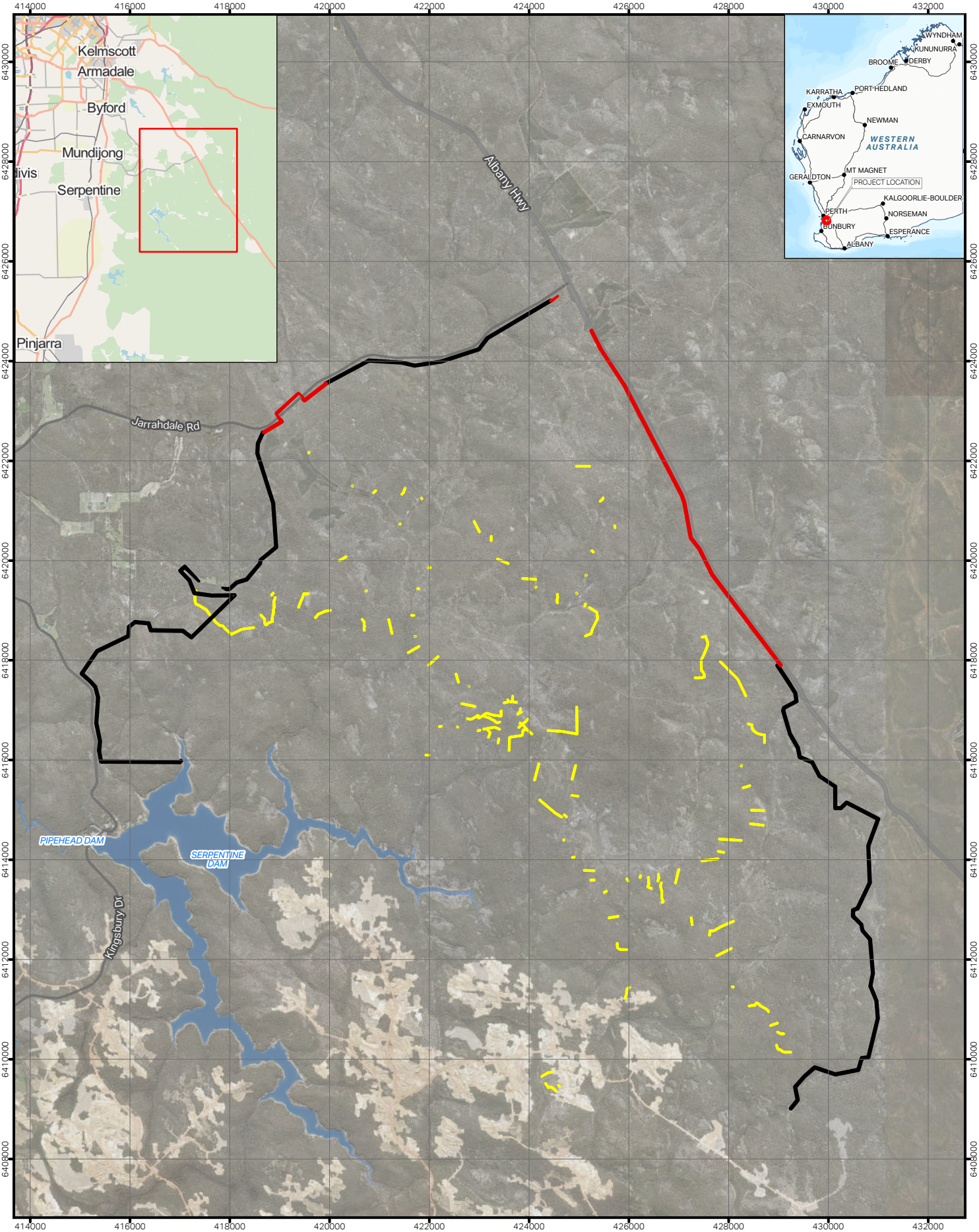
This letter document briefly outlines the objective, methods, and results of the targeted flora survey.

2.0 Objective

The objective of the program was to determine the presence of significant flora species within 20 m of the survey area to support a preliminary or minor works approval for submission to the Environmental Protection Authority (EPA). The scope included:

- A desktop assessment including a review of available literature and results from previous surveys and associated desktop study results undertaken from the Myara Project.
- Targeted flora searches within a 20 m corridor along 39.46 km across the Geotechnical Pre-clearance survey area, and a portion of the Boundary survey area. This involved collection of all suspected significant flora to be verified by a WA Herbarium taxonomist.
- A targeted flora survey report documenting survey results to-date and associated spatial data package in IBSA format.

AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.



AECOM Delivering a better world

PROJECT ID	60720686	**CREATED BY**	WYATTK2
DATE MODIFIED	13 FEB 2024	**APPROVED BY**	C. SEPKUS

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(when printed at A4)

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km

GDA2020 MGA ZONE 50

DATA SOURCES Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010)

Service Layer Credits: World Topographic Map: Esri, TomTom, FAO, NOAA, USGS,OpenStreetMap: Map data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its affiliates, Esri Community Maps contributors, Map layer by Esri,WMS: World Hillshade: Esri, USGS

LEGEND

- Boundary 1
- Boundary 2
- Geotech Pre-clearance Survey Area

Survey Area

ALCOA OF AUSTRALIA

MYARA NORTH
TARGETED FLORA SURVEY

Figure

1

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3.0 Climate

The survey area is situated approximately 45 km southwest of Perth Central Business District (CBD). The climate is warm Mediterranean with mild wet winters and hot dry summers. Precipitation occurs predominantly during the winter months, with the possibility of some summer storms.

Rainfall data was obtained from Jarrahdale Station (station number 009023), located less than 1 km to the north-east of the survey area. Temperature data was obtained from Karnet station (station number 009111), located approximately 5.7 km south of the southern point of the survey area. The long-term rainfall and temperature data is compared against the December 2022 to November 2023 data in Figure 2 (BoM, 2024) to determine if climatic conditions posed a constraint to the survey.

The survey was undertaken from 28 to 30 November 2023 following a year of below average rainfall. In the twelve months preceding the survey, 889.2 mm was recorded, a reduction of 265.9 mm per annum compared to the long-term average. Rainfall was particularly low across the late winter, spring and summer months (August 2023 – November 2023).

Both minimum and maximum temperatures were higher than average across eight of the 12 preceding months, with both temperatures consistently above the mean for the three months immediately prior to the survey.

The notably warm and dry conditions leading up to the survey is a limitation for the survey, with lack of material for annual and cryptic species where flower/fruit material is essential for confident identification.

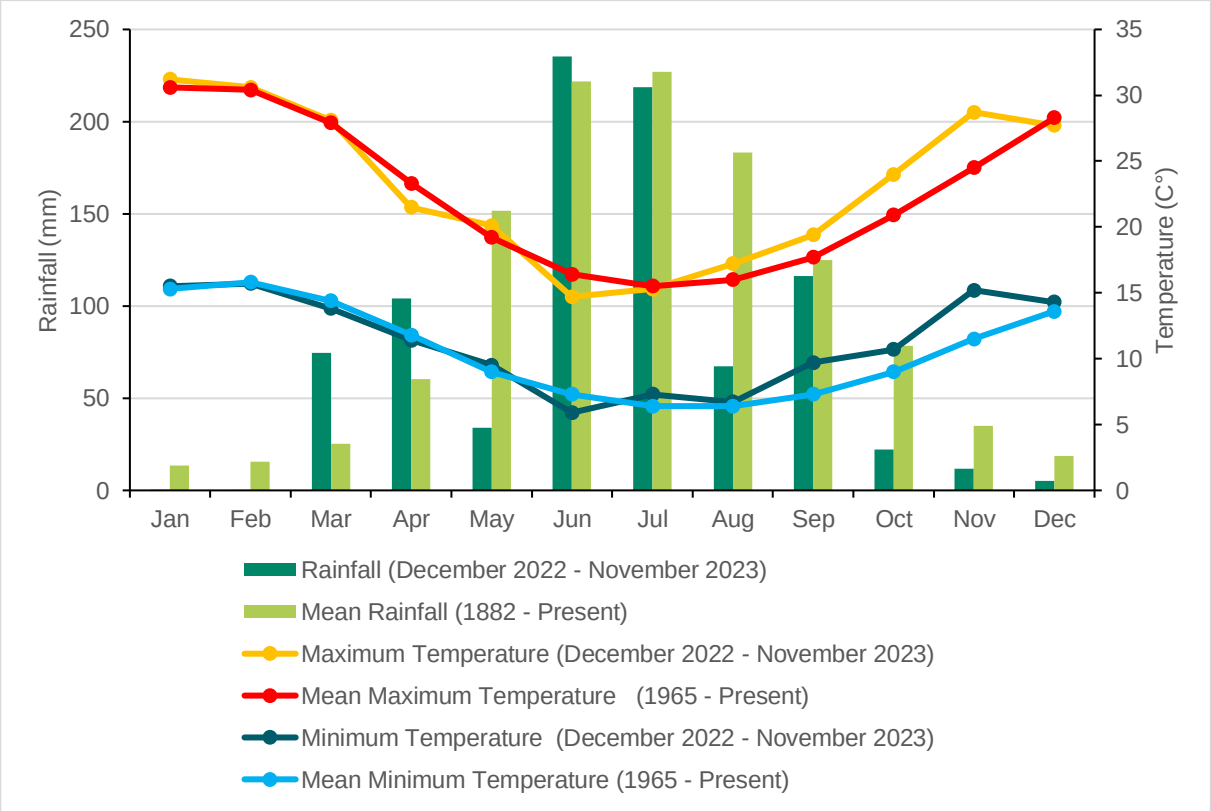


Figure 2 Long-term and current climatic data from Jarrahdale Station (station number 009023) (BoM, 2024).

4.0 Methods

4.1 Desktop Assessment

A comprehensive desktop assessment was undertaken prior to completing the field surveys. The objective was to define the existing environment and determine the significant species that may occur. The desktop assessment included:

- Department of Biodiversity, Conservation and Attractions (DBCA) Threatened Species and Communities database, including Threatened and Priority flora species with a 50 km buffer.
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) with a 20 km buffer from a central coordinate
- Previous surveys conducted for the Project (Western Environmental, 2023)
- Alcoa data (Alcoa, 2023a; 2023b).

The likelihood of occurrence for all significant flora was determined based on the categories the categories outlined in Table 1. The score is informed by:

- known occurrences of species in the vicinity scored as a 0 or 1, where 1 represents the presence of records within 5 km
- date of records scored as 0 or 1, where 1 represents records less than 20 years old
- habitat suitability scored between 0 and 2, where 0 represents no habitat present, 1 represents marginal habitat (i.e. some elements of preferred habitat are present), and 2 represents suitable habitat for that species.

Table 1 Likelihood categories for species

Likelihood of Occurrence	Score	Definition
Known	6	Species is known to occur in the survey area
High (Likely)	5	There are records within close proximity and suitable habitat for the species is known to be, or likely to be, present.
Moderate (Possible)	4 (if suitable habitat is known to be, or likely to be present) 3 (if suitable habitat may be present within the survey area)	There are records in close proximity of the survey area AND/OR recent records OR records within the LGA and suitable habitat for the species is known to be, or likely to be present OR There are records in close proximity of the survey area AND recent records AND records within the LGA, and suitable habitat for the species may be present (marginal habitat)
Low (Unlikely)	2,3	Not known to occur within the survey area but there are records in close proximity OR within the LGA OR suitable habitat for the species may be present (marginal habitat)
Negligible (Suitable Habitat not Present)	1,2,3	No suitable habitat is present within the survey area.

4.1.1 Targeted Flora Searches

Targeted searches were undertaken for all significant flora species considered to have a high likelihood of occurrence. All 'likely' species were compiled into a field guide which include photographs and describing morphological features that would assist in identifying the species. Linear traverses were conducted 20 m either side of the proposed Geotech locations, and up to 20 m inside of the proposed Boundary line.

Significant flora species were recorded using the Field Maps application on hand-held devices. A sample was collected for formal identification at the Western Australian Herbarium, as well as photographs and number of individuals recorded.

5.0 Results

5.1 Desktop Results

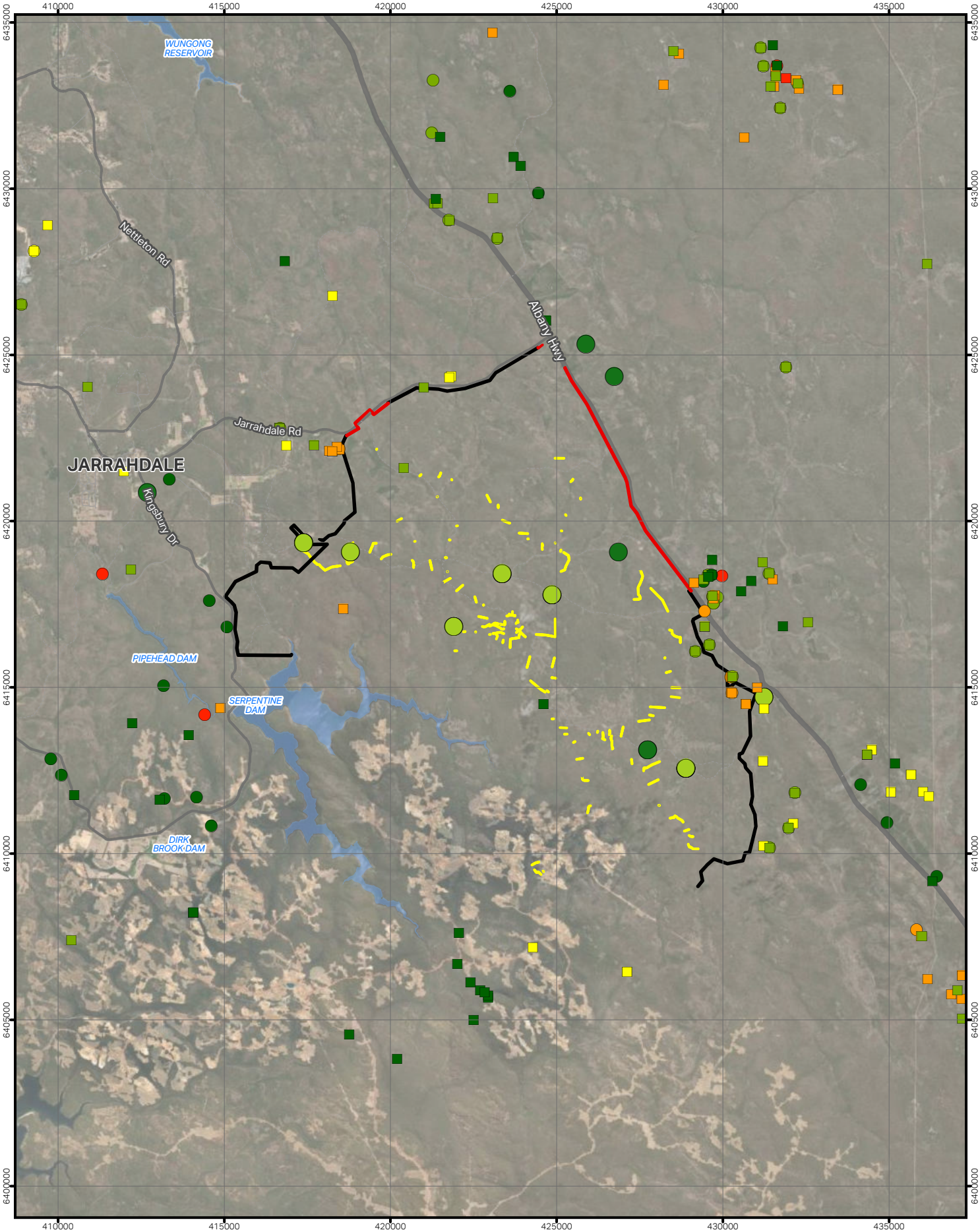
A total of 66 significant vascular flora species were identified from the desktop assessment as potentially occurring within the survey area (Figure 3, Appendix A). This includes 12 species listed as Threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Biodiversity Conservation Act 2016* (BC Act), and 54 Priority species listed by the Department of Biodiversity, Conservation and Attractions (DBCA). Based on the desktop assessment of specimen records and preferred habitat, it has been determined that 13 species have a high likelihood of occurrence. These species are described in Table 2 below. The comprehensive desktop assessment is presented in Appendix A.

Table 2 Significant species considered to have a 'high' likelihood of occurrence for Myara North

Taxon	Conservation Code (BC Act / DBCA)[1]	Habitat[2]
Acacia oncinophylla subsp. *oncinophylla*	P3	Granitic soils.
Andersonia sp. Audax (F. Hort, B. Hort & J. Hort 3179)	P3	Loam, clay, sand, gravel, granite outcrops, drainage lines (Alcoa, 2023).
Andersonia sp. Saxatilis (F. & J. Hort 3324)	CR	Gravelly clay, granite (Alcoa, 2023).
Bossiaea modesta	P2	Soils derived from granite. Damp areas close to stream.
Darwinia hortiorum	P1	Shallow granitic soils, loam or loam/clay associated with laterite. Granite outcrops, drainage lines (Alcoa, 2023).
Grevillea dissectifolia	P3	Grows in Eucalypt forest in moist situations or depressions in gravelly soils recorded as brown or yellow sand, loam or clay, sometimes in heavy laterite with exposed granite sheet or outcrops.
Grevillea pimeleoides	P4	Gravelly soils over granite. Rocky hillsides.
Hemigenia platyphylla	P4	Sandy & loamy soils. Granite rocks, slopes.
Paracaleana gracilicordata	P1	Growing on moss mats, granite. Outcrops.
Paracaleana granitica	P1	Growing on moss mats, granite. Outcrops.
Pimelea rara	P4	Lateritic soils.
Synaphea pandurata	P3	Yellow-grey, yellow-brown, yellow-red sands and sandy loams, dark brown loam, laterite gravel, granite. In undulating areas.
Tetratheca phoenix	P2	Brown gravelly loam over granite. Mid-upper slopes, often near large rock outcrops.

1. BC Act: CR Critically Endangered, DBCA: P Priority
2. Habitat descriptions derived from WAH (1998-) unless otherwise stated.

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LEGEND

- Boundary 1
- Boundary 2
- Geotech Pre-clearance Survey Area

Threatened and Priority Flora database (TPFL)
- Threatened
- P1
- P2
- P3
- P4

WA Herbarium database (WAHERB)
- Threatened
- P1
- P2
- P3
- P4

Myara Holyoakes MCPL Flora
- P3
- P4

Desktop Significant Flora

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MYARA NORTH TARGETED FLORA SURVEY

Figure 3

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5.2 Field Survey Results

One significant flora species, *Thysanotus anceps* listed as Priority 3 by the DBCA was recorded. *T. anceps* is a perennial leafless herb, that grows on white or grey sand, lateritic gravel or laterite (WAH, 1998-) (Plate 1). A total of 13 individuals were recorded across the survey area, these locations are depicted on Figure 4. This species was considered to have a moderate likelihood of occurrence in the desktop assessment, primarily due to the nearest verified population occurring 11.74 km from the survey area.



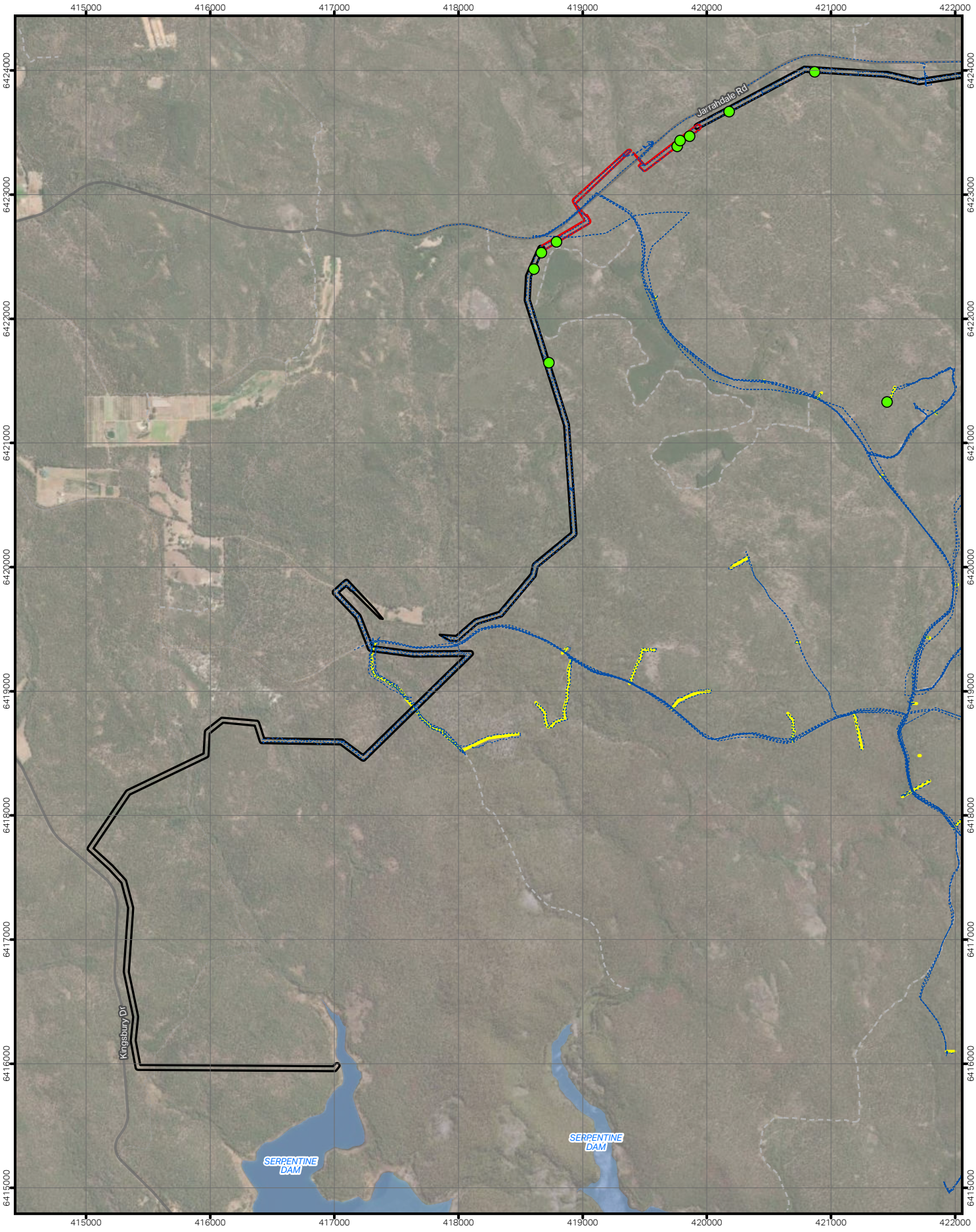
Plate 1 *Thysanotus anceps* (P3) recorded in the survey area

Flora species considered to have a high likelihood of occurrence in the desktop assessment were reviewed following the field survey and a post-survey likelihood was provided. This likelihood reflects the habitat observed in the field survey, and the survey effort implemented. All 13 species have been downgraded to a low likelihood of occurrence as they represented perennial species, many of which are associated with unique landforms such as granite outcrops, that were not recorded during the survey.

Three limitations were recognised that may have influenced the survey results:

- the detectability of annual and cryptic species may be compromised during the Spring 2023 survey due to unusually warm and dry conditions experienced in the 12 months preceding the survey.
- access was restricted to areas outside of the active mining footprint, where pre-clearance areas branch off existing tracks. Eleven pre-clearance areas were unable to be surveyed due to lack of access (Figure 4).
- fire has passed through portions of the survey area within the 12 months preceding the survey. This was identified to impact two pre-clearance survey areas in their entirety. Due to the recency of the fire, these areas were not subjected to targeted searches.

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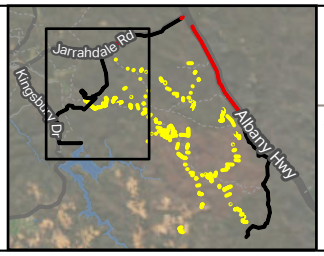
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LEGEND

- Boundary 1
- Boundary 2
- Geotech Pre-clearance Survey Area
- Tracklogs
- Significant Flora
  - *Thysanotus anceps* (P3)



Survey Effort and Significant Flora Locations

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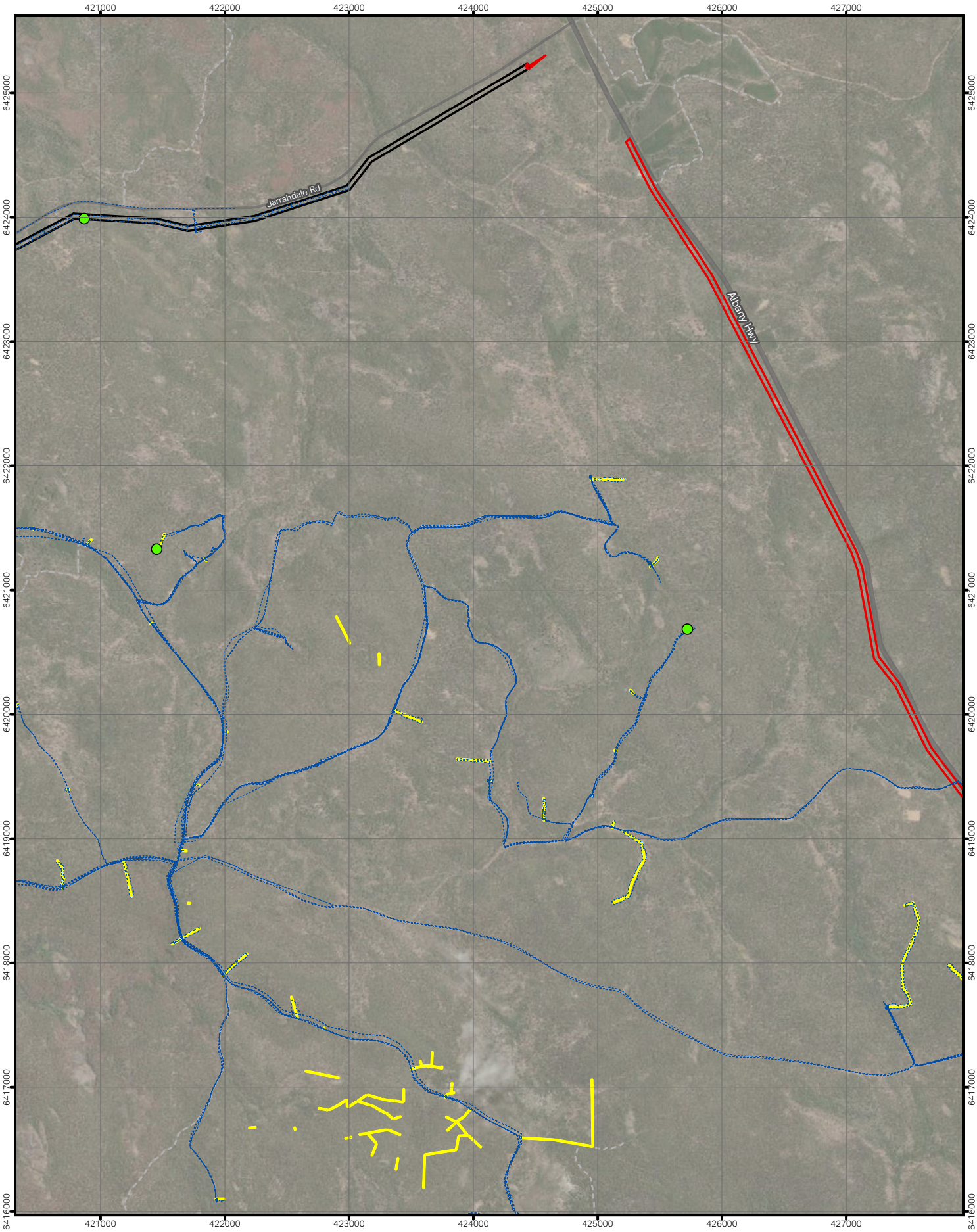
MYARA NORTH TARGETED FLORA SURVEY

Figure 4.1

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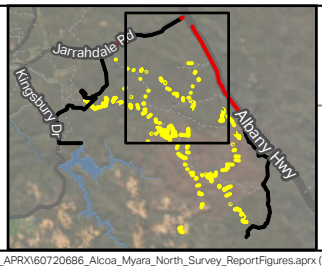
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LEGEND

- Boundary 1
- Boundary 2
- Geotech Pre-clearance Survey Area
- Tracklogs
- Significant Flora
- *Thysanotus anceps* (P3)



Survey Effort and Significant Flora Locations

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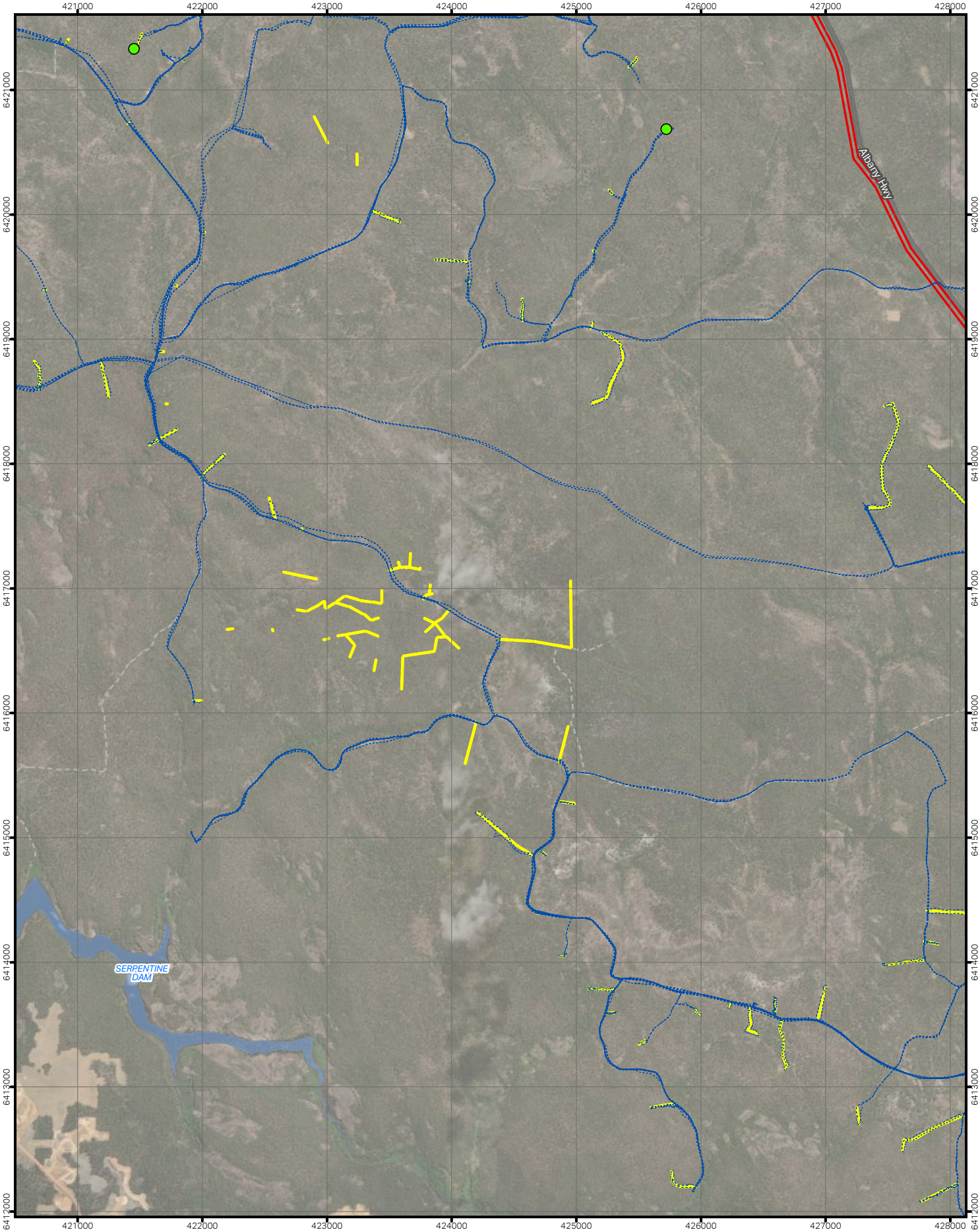
MYARA NORTH TARGETED FLORA SURVEY

Figure 4.2

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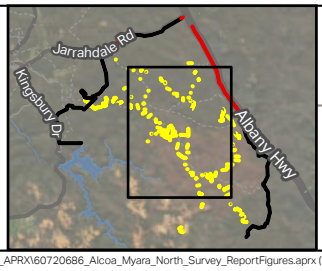
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LEGEND

- Boundary 2
- Geotech Pre-clearance Survey Area
- Tracklogs
- Significant Flora
  - *Thysanotus anceps* (P3)



Survey Effort and Significant Flora Locations

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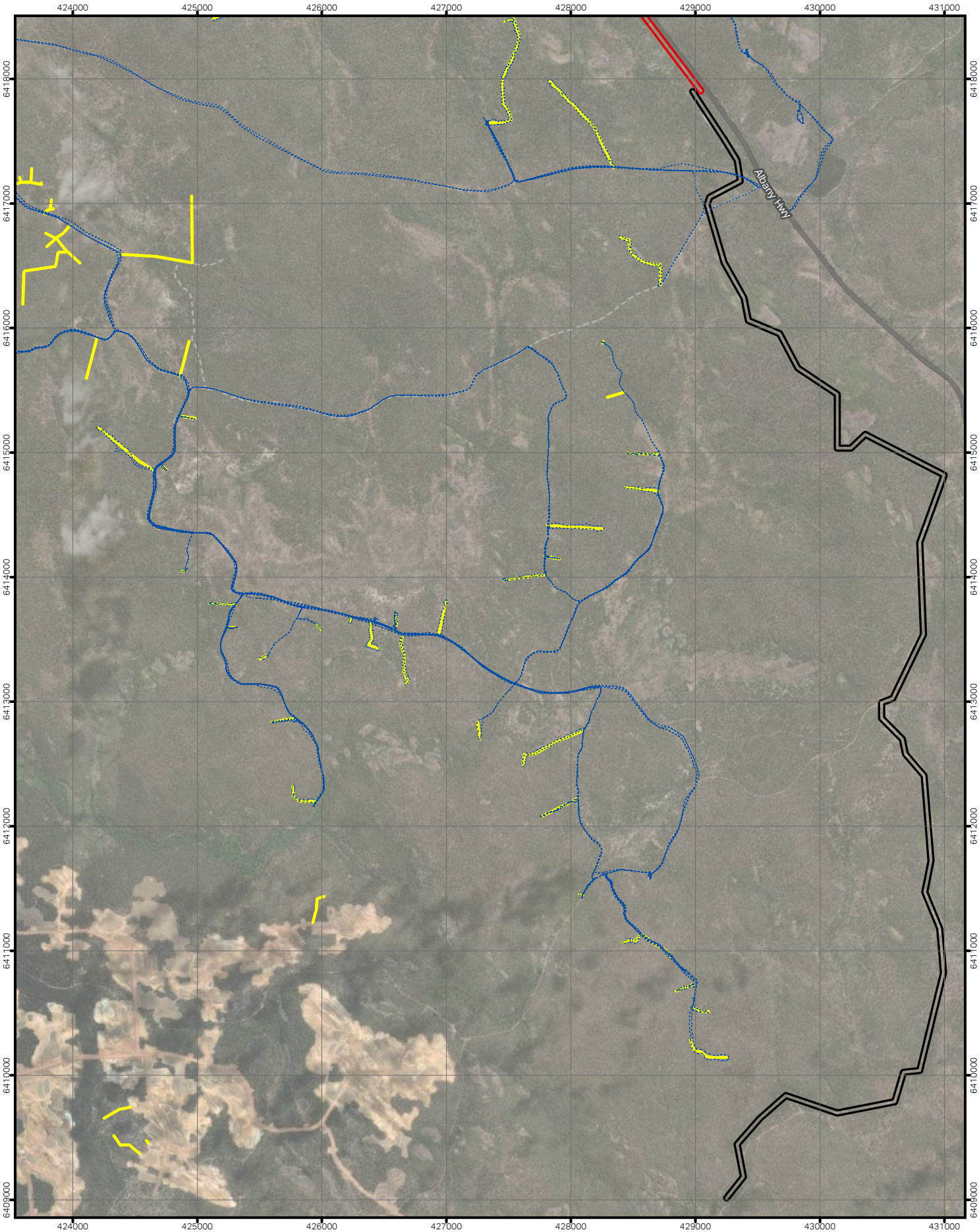
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Figure 4.3

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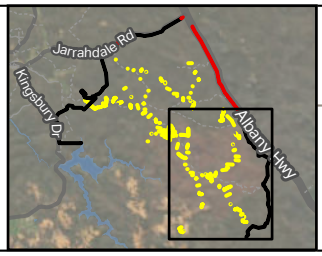
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LEGEND

- Boundary 1
- Boundary 2
- Geotech Pre-clearance Survey Area
- Tracklogs



Survey Effort and Significant Flora Locations

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MYARA NORTH TARGETED FLORA SURVEY

Figure

4.4

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Yours faithfully



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Appendix A

Desktop Assessment

Taxon	Habitat[1]	Cons. Code		Distance (km)		Date		Alcoa (2023b) Distance (km)	PMST	Likelihood Assessment					Total Score	Pre-survey Likelihood	Post-survey Likelihood	Comments
		EPBC	BC Act / DBCA	WA HERB	TPFL	WA HERB	TPFL			Recorded in survey area	Known occurrence <5km	Recent Record <20 years	Known within LGA	Habitat suitability (0,1,2)				
Acacia cuneifolia	Sand, clay or loam over granite. Granite outcrops & hills, rocky watercourses.		P4	11.91	11.91	2005	2005			0	0	1	0	2	3	Moderate	Moderate	
Acacia drummondii subsp. *affinis*	Lateritic gravelly soils.		P3	13.49	13.49	2008	1900	10.21		0	0	1	0	2	3	Moderate	Moderate	
Acacia horridula	Gravelly soils over granite, sand. Rocky hillsides.		P3	5.15	1.56	1996	1996	3.85		0	1	0	1	2	4	Moderate	Moderate	
Acacia oncinophylla subsp. *oncinophylla*	Granitic soils.		P3	2.99	2.99	2013	1976			0	1	1	1	2	5	High	Low	Suitable habitat, perennial shrub not recorded.
Andersonia sp. Audax (F. Hort, B. Hort & J. Hort 3179)	Loam, clay, sand, gravel, granite outcrops, drainage lines (Alcoa, 2023a).		P3	0.11	0.11	2009	2008			0	1	1	1	2	5	High	Low	No outcrops detected. No suitable habitat. Perennial shrub not recorded.
Andersonia sp. Saxatilis (F. & J. Hort 3324)	Gravelly clay, granite (Alcoa, 2023a).		CR	1.42	1.40	2010	2010			0	1	1	1	2	5	High	Low	Suitable habitat, perennial shrub not recorded.
Anthocercis gracilis	The species (also known as the slender tailflower), grows on steep granite slopes along the Darling Scarp in shallow, humus-rich sandy or loamy soils along the Darling Scarp (DEWHA, 2008a).	V	VU	12.16	12.16	2002	1900			0	0	0	1	2	3	Moderate	Moderate	
Anthotium sp. Darling Range (F. Hort & B. Hort 2431)	Yellow, grey or brown clayey sand, loam. Slopes, low plains, drainage lines of swampy flats.		P1	11.62	11.62	2017	1900			0	0	1	0	2	3	Moderate	Moderate	
Banksia recurvistylis	This banksia grows in or near heath or heath patched in shallow lateritic soil near granite outcrops. It is only known from five populations in the Monadnocks Conservation Park and Wandering Conservation Park and is associated with the Jarrah-Marri forest. Characteristic associated species include *Allocasuarina humilis, Andersonia* spp., *Grevillea bipinnatifida* , *Hakea undulata* , *H. trifurcata* , *H. petiolaris* , *Isopogon dubius* , *Verticordia* spp. and *Xanthorrhoea preissii* (Thiele, 2009).		P2	1.97	1.97	2009	1900			0	1	1	0	1	3	Low	Low	
Bossiaea modesta	Soils derived from granite. Damp areas close to stream.		P2	2.87	2.87	2015	1998			0	1	1	1	2	5	High	Low	Suitable habitat, perennial shrub not recorded.
Byblis gigantea	Sandy-peat swamps. Seasonally wet areas.		P3	12.79	12.79	2008	2004			0	0	1	0	2	3	Moderate	Moderate	
Caladenia speciosa	The species grows in deep Bassendean and Karrakatta sands (typically white, grey or black sand), in Banksia woodland with scattered Jarrah, or in Tuart woodland. Flowers best after fire a (WAH 1998–, Hopper & Brown, 2001).		P4	1.66	1.66	2003	2005			0	1	1	0	0	2	Negligible	Negligible	
Calectasia grandiflora	White, grey or yellow sand, sandy clay, gravel, laterite, granite. Swampy areas, rock outcrops, flats, slopes, ridges.		P2	13.92	13.92	1982	1900			0	0	0	1	2	3	Moderate	Negligible	Restricted to the Swan Coastal Plain.
Calothamnus graniticus subsp. *leptophyllus*	Clay over granite, lateritic soils. Hillsides.		P4	31.97	31.97	2008	1900			0	0	1	0	2	3	Moderate	Moderate	
Calytrix simplex subsp. *simplex*	Flats and slopes on laterite, grey clay loam soil, red-brown gravelly loam. Swamp (Alcoa, 2023a).		P1	12.93	12.93	2004	1900			0	0	1	0	2	3	Moderate	Moderate	
Chordifex gracilior	Peaty sand. Swamps.		P3		28.53		1996			0	0	0	0	1	1	Negligible	Negligible	
Chorizema ulotropis	Moist to dry soils, white sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats.		P4	7.72	7.72	2002	1900			0	0	0	0	2	2	Low	Low	
Conospermum scaposum	White-grey sand, sandy clay. Low swampy areas, road verges.		P3					8.56		0	0	1	1	1	3	Moderate	Moderate	
Cyanothamnus tenuis	Laterite stony soils and granite. Darling Scarp between Dwellingup and Wannamal in the Jarrah Forest and SCP.		P4	4.14	4.14	2002	2002			0	1	0	0	2	3	Moderate	Moderate	
Darwinia hortiorum	Shallow granitic soils, loam or loam/clay associated with laterite. Granite outcrops, drainage lines (Alcoa, 2023a).		P1	3.27	3.27	2009	2016			0	1	1	0	2	4	High	Low	No outcrops detected. No suitable habitat. Perennial shrub not recorded.
Darwinia thymoides subsp. St Ronans (J.J. Alford & G.J. Keighery 64)	Low shrub, sandy or gravely clay-loam soils. Slopes or flats. Granite outcrops.		P4	29.58	29.58	1970	1900			0	0	0	0	2	2	Low	Low	
Diuris micrantha	This species is found in small populations, on dark, grey to blackish, sandy clay-loam substrates in winter-wet depressions or swamps. The species is distributed from east of Kwinana and south towards the Frankland area. The bases of the flowering plants are often covered with shallow water (DEWHA, 2008b).	V	VU						May	0	0	0	0	0	0	Negligible	Negligible	
Diuris purdiei	Grey-black sand, moist. Winter-wet swamps.		P4	14.56	14.56	1900	1900		May	0	0	0	1	1	2	Low	Low	Perennial herb.
Drakaea elastica	The species (also known as the glossy/warty-leafed Hammer Orchid), grows on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in banksia (*Banksia menziesii, B. attenuata* and *B. ilicifolia*) woodland or spearwood *(Kunzea glabrescens*) thicket vegetation. *D. elastica* often occurs with other orchid species such as *Drakaea glyptodon* , *D. livida* and *Paracaleana nigrita* . The increased rates of survival in sites with relatively little direct sun exposure indicate a requirement for shady canopy cover to be present (DEC, 2009).	E	CR		14.60		2013			0	0	1	1	0	2	Negligible	Negligible	
Drosera occidentalis	Sandy & clayey soils. Swamps & wet depressions.		P4	7.12	5.26	1990	1990			0	0	0	1	2	3	Moderate	Moderate	
Grevillea crowleyae	Gravel. In gravel pit.		P2	5.74	5.74	1992	1900			0	0	0	1	2	3	Moderate	Moderate	
Grevillea flexuosa	The species grows on sands of granite ridgetop plateaus and associated breakaways or lateritic sands and gravel on hilltops, slopes and in gullies. It grows in heath vegetation, among medium trees, low trees, or tall (sclerophyll) shrubland (DEWHA, 2008c).	V	VU		1.93		2000			0	1	0	0	2	3	Moderate	Moderate	
Grevillea dissectifolia	Grows in Eucalypt forest in moist situations or depressions in gravelly soils recorded as brown or yellow sand, loam or clay, sometimes in heavy laterite with exposed granite sheet or outcrops		P3	3.26	3.24	2015	2003			0	1	1	0	2	4	High	Low	No outcrops detected. No suitable habitat. Perennial shrub not recorded.
Grevillea ornithopoda	Loam, loam over clay, sand, clay. Edge of riverbank and creek (Alcoa, 2023a).		P2	2.71	2.71	2017	1900			0	1	1	1	1	4	Moderate	Moderate	
Grevillea pimeleoides	Gravelly soils over granite. Rocky hillsides.		P4	1.92	1.92	2008	1997			0	1	1	1	2	5	High	Low	Suitable habitat, perennial shrub not recorded.
Hakea oldfieldii	Red clay or sand over laterite. Seasonally wet flats.		P3	23.43	23.43	2001	1900			0	0	0	0	2	2	Low	Low	
Halgania corymbosa	Gravelly soils, soils over granite.		P3	12.93	12.93	1992	1900			0	0	0	1	2	3	Moderate	Moderate	
Hemigenia microphylla	Sandy clay, peaty clay, granite. Winter wet depressions.		P3	28.76	28.76	2001	2001	31.59		0	0	0	0	2	2	Low	Low	

Taxon	Habitat[1]	Cons. Code		Distance (km)		Date		Alcoa (2023b) Distance (km)	PMST	Likelihood Assessment					Total Score	Pre-survey Likelihood	Post-survey Likelihood	Comments
		EPBC	BC Act / DBCA	WA HERB	TPFL	WA HERB	TPFL			Recorded in survey area	Known occurrence <5km	Recent Record <20 years	Known within LGA	Habitat suitability (0,1,2)				
Hemigenia platyphylla	Sandy & loamy soils. Granite rocks, slopes.		P4	0.13	0.13	2007	1900			0	1	1	1	2	5	High	Low	Suitable habitat, collection taken at known DBCA location, not identified as the Priority species (ACC/10606/E)
Hibbertia acrotoma	Steep hillsides and slopes, brown loam, granite (Alcoa, 2023a).		P1	12.16	12.16	2002	1900			0	0	0	1	2	3	Moderate	Moderate	
Hibbertia hortiorum	Slopes, broad sandy gravels (Alcoa, 2023a).		P1	10.32	10.32	2016	1900			0	0	1	0	2	3	Moderate	Moderate	
Hibbertia polyancistra	Shallow soil over granite (Alcoa, 2023a).		P1	11.07	11.07	2005	1900			0	0	1	0	2	3	Moderate	Moderate	
Isopogon autumnalis	Sandy soils, often in Banksia woodlands.		P3	13.94	13.94	2003	1900			0	0	1	1	1	3	Moderate	Moderate	
Johnsonia pubescens subsp. *cygnorum*	Grey-white-yellow sand. Flats, seasonally-wet sites.		P2	13.75	13.62	1983	1983			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat. Associated with the SCP.
Lasiopetalum glutinosum subsp. *glutinosum*	Open woodland dominated by *Eucalyptus marginata, Corymbia calophylla, Banksia menziesii* and *B. attenuata* and in open, low scrub over heath, on steep slopes of lateritic gravel, clay or sandy loam near granite outcrops and creeklines (Shepherd and Wilkins, 2015).		P3	11.05	11.05	2002	1900			0	0	0	1	2	3	Moderate	Moderate	
Lasiopetalum membranaceum	Sand over limestone.		P3	31.86	31.86	1942	1900			0	0	0	0	0	0	Negligible	Negligible	No suitable habitat. Associated with the coast on the SCP.
Lasiopetalum pterocarpum	Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines.	E	CR	9.21	5.64	2016	2016			0	0	1	1	2	4	Moderate	Moderate	
Lepyrodia heleocharoides	Moist peaty sand. Dry or seasonally inundated heath or woodland, swamps.		P3	11.98	11.98	2003	1900			0	0	1	1	2	4	Moderate	Moderate	
Meionectes tenuifolia	Grey sand, clay. Winter-wet flats (Alcoa, 2023a).		P3	11.72	11.72	2002	2002			0	0	0	1	2	3	Moderate	Moderate	
Millotia tenuifolia var. *laevis*	Granite or laterite soils.		P2	11.87	11.87	2005	2005			0	0	1	1	2	4	Moderate	Moderate	
Paracaleana gracilicordata	Growing on moss mats, granite. Outcrops.		P1	1.11	1.11	2017	2004			0	1	1	1	2	5	High	Low	No outcrops detected. No suitable habitat.
Paracaleana granitica	Growing on moss mats, granite. Outcrops.		P1	0.80	0.80	2011	1986			0	1	1	1	2	5	High	Low	No outcrops detected. No suitable habitat.
Parsonsia diaphanophleba	Alluvial soils. Along rivers.		P4	13.29	13.29	2015	1996			0	0	1	1	1	3	Moderate	Moderate	
Petrophile filifolia subsp. *laxa*	White gritty sand, brown, red, yellow, white or grey sand, brown-yellow sandy clay. Winter-wet sites, flats, slopes, swamps, drainage lines.		P3	12.38	12.38	2007	2005			0	0	1	0	2	3	Moderate	Moderate	
Pimelea rara	Lateritic soils.		P4	1.54	1.35	2004	2000			0	1	1	1	2	5	High	Low	Suitable habitat. Multiple collections taken, not identified as the Priority species (ACC/10606/E).
Pithocarpa corymbulosa	Gravelly or sandy loam. Amongst granite outcrops.		P3	11.04	11.04	2005	2005			0	0	1	1	2	4	Moderate	Moderate	
Senecio leucoglossus	Gravelly lateritic or granitic soils. Granite outcrops, slopes.		P4	6.45	6.45	2004	1900	52.24		0	0	1	1	2	4	Moderate	Moderate	
Stackhousia sp. Red-blotched corolla (A. Markey 911)	Brown loamy sand, clayey sand over laterite, white sandy clay over granite, grey clay (Alcoa, 2023a).		P3	2.32	2.32	1993	1900			0	1	0	1	2	4	Moderate	Moderate	
Stylidium ireneae	Sandy loam. Valleys near creek lines, woodland, often with Agonis.		P4	7.45	7.45	2009	1900			0	0	1	0	2	3	Moderate	Moderate	
Stylidium scabridum	Sand. Open woodland or heath.		P4					9.82		0	0	1	1	1	3	Moderate	Moderate	
Synaphea odocoileops	Brown-orange loam and sandy clay, granite. Swamps, winter wet areas.		P1		13.68		1998			0	0	0	1	1	2	Low	Negligible	Associated with the SCP.
Synaphea pandurata	Yellow-grey, yellow-brown, yellow-red sands and sandy loams, dark brown loam, laterite gravel, granite. In undulating areas.		P3	3.21	3.21	2009	1900			0	1	1	0	2	4	High	Low	Suitable habitat, perennial shrub not recorded.
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	CE	CR	12.97	12.97	2003	2014			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat. Associated with the SCP.
Synaphea sp. Pinjarra Plain (A.S. George 17182)	Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains.	E	EN	13.52	13.50	2012	2014			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat. Associated with the SCP.
Synaphea sp. Serpentine (G.R. Brand 103)	The species occurs predominantly on flat terrain on grey-brown sandy loams to clay in seasonally wet areas within a warm Mediterranean climate. This includes within heath of *Pericalymma ellipticum, Xanthorrhoea preissii, Kunzea micrantha, Adenanthos meisneri*. Open Woodland to Very Open Woodland of *Corymbia calophylla* over Very Open Shrubland of *Xanthorrhoea preissii, Kingia australis, Adenanthos meisneri* over very open herbland of Tricoryne elatior and sedgeland of *Mesomelaena tetragona, Tetraria octandra* (TSSC, 2018).	CE	CR	12.97	12.97	2009	2014			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat. Associated with the SCP.
Morelotia australiensis	Flats, well-drained areas. Sand, sandy loam (Alcoa, 2023a).	V	VU	12.75	11.94	2011	2014			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat. Associated primarily with the SCP.
Tetratheca phoenix	Brown gravelly loam over granite. Mid-upper slopes, often near large rock outcrops.		P2	2.21	2.21	2016	1900			0	1	1	0	2	4	High	Low	No outcrops detected. No suitable habitat. Perennial shrub not recorded.
Thysanotus anceps	White or grey sand, lateritic gravel, laterite.		P3	11.74	11.74	2003	2003	28.70		0	0	1	1	2	4	Moderate	Known	13 Individuals recorded.
Goodenia verreauxii	Flats, white/grey or yellow sand (Alcoa, 2023a).		P4	13.43	13.43	2009	1900			0	0	1	0	0	1	Negligible	Negligible	
Verticordia fimbrilepis subsp. *fimbrilepis*	This species (also known as the shy feather flower), occurs within Shire Council Road Reserves, Conservation Reserves. The species grows in low-lying shallow grey sand and yellowish-white sandy loam over gravel, sometimes with clay. It is found in low heath and scrubland, as well as open *Eucalyptus wandoo* (Wandoo) woodland. Associated species include *Adenanthos cygnorum* subsp. *cygnorum*, *Banksia grandis, Banksia drummondii, Banksia nivea, Hakea trifurcata, Allocasuarina* sp. *Desmocladus fasciculatus, Callistemon phoeniceus, Verticordia densiflora*, *Verticordia huegelii*, among others (DAWE, 2021).	E	EN	13.24	13.24	2017	2009			0	0	1	0	0	1	Negligible	Negligible	
Verticordia plumosa var. *ananeotes*	Sandy loam. Seasonally inundated plains.	E	CR	13.91	13.91	1900	1900			0	0	0	1	1	2	Low	Low	

1. Habitat derived from WAH (1998-) unless otherwise stated.

Appendix 5 – Targeted Flora Search Myara North Region 2023 (WEPL, 2024)

WESTERN
ENVIRONMENTAL

Myara North Pre-Clearance Surveys 2022

Threatened and Priority Flora
Targeted Search

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Myara North Pre-Clearance Surveys 2022

Threatened and Priority Flora Targeted Search

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Executive Summary

Alcoa of Australia (Alcoa) proposes to transition to the new mine region of Myara North (MN) as part of its Huntly mining operations. The MN mine region is currently under assessment by the Environmental Protection Authority (EPA). Alcoa engaged Western Environmental Pty Ltd (WEPL) to undertake targeted pre-clearance Threatened and Priority flora surveys to support a preliminary or minor works application as part of the Part IV EPA approvals process.

The overall Survey Area comprised eight packages of work, most with partially overlapping boundaries, summarised in Table A below.

Table A: Survey Areas

Survey Area	Description of Survey Area	Area Approximate (ha)
Water Pipeline Alignment	Approx. 9 km long by 40m wide. Runs north from Serpentine Dam (4 km) then east along Balmoral Rd (3.5 km).	65 ha
Power Corridor Alignment	Approx. 8 km long by 40m wide. Centred on Balmoral Rd and unnamed forestry track. Shared alignment on Balmoral Rd with Water Pipeline Alignment.	
Frollet Road Intersection and Additional Frollet Road	Running east west along Jarrahdale Rd and covering the Jarrahdale Rd and Frollet Rd intersection.	15 ha
Albany Highway Intersection	Covering intersection of Jarrahdale Rd and Albany highway and verges of Albany Hwy running north south.	40 ha
MN Facilities Area	Facilities area, magazine and magazine access track. Centred on Balmoral Rd..	50 ha
HUNG_G_000473-000_B_Frollet Rd and Additional Survey Road	Access road corridor 8.2 km wide and 20-80 m wide. Running north south along Frollet Rd and Balmoral Rd between Jarrahdale Rd and the MN Facilities Area	35 ha
Total		**204.9 ha (exact)**

The Survey Area falls within the previous survey extent of the Mattiske (2021) *Alcoa of Limited Australia: Pinjarra Alumina Refinery Revised Proposal Detailed Flora and Vegetation Survey for Huntley Mine – Myara North Surveys.* This report, and other available desktop/background information was reviewed prior to the field survey.

No Threatened or Priority flora were identified as previously recorded within the Survey Area from Mattiske (2021) or Department of Biodiversity Conservation and Attractions (DBCA) database records. A pre-survey likelihood of occurrence assessment specific to the eight packages of work within the Survey Area was undertaken. The assessment identified that three species have a high likelihood of occurrence, 14 species a medium likelihood of occurrence and 22 species a low likelihood of occurrence. No Threatened species had a high or medium likelihood of occurrence.

The targeted searches were conducted across 25 person days from 7–30 November 2022 by the WEPL ecology team. Searches were undertaken as 20 m spaced grid searches. Due to generally open understory 20 m spacings were considered suitable. Where target species have specific micro habitat preferences, these receive a higher intensity of search effort. No significant limitations or constraints were encountered while undertaking the targeted searches.

No Commonwealth E*nvironment Protection and Biodiversity Conservation Act 1999* (EPBC) listed, or State Biodiversity Conservation (BC) Act listed Threatened flora or DBCA listed Priority flora were recorded in the Survey Area.

Following suitable targeted search effort, the likelihood of occurrence for all Threatened and Priority flora species identified by the desktop was reassessed as low. This assessment was reached considering:

- The results of the pre-survey likelihood of occurrence assessments, both by WEPL for the specific Survey Area and Mattiske (2021) for the MY project area.
- Having undertaken suitable targeted search efforts during the primary spring survey season and within the flowering period for the majority of species. For four species with flowering periods outside the survey period, three can be identified without flowering material.
- The absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).
- Disturbance to the understory in many areas through vehicle access for firewood collection and clearing of access tracks.
- The alignment of much of the Survey Area on existing disturbed areas, roads and forestry tracks.

The absence of Threatened and Priority flora was not an unexpected survey outcome considering the dominance of habitat with *Eucalyptus marginata* and *Corymbia calophylla* forest over laterite and the absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).

Acronyms and Abbreviations

Abbreviation	Full Title
°C	Degree Celsius
BoM	*Bureau of Meteorology*
BC Act	*Biodiversity Conservation Act 2016*
CR	Critically Endangered
DBCA	Department of Biodiversity, Conservation and Attractions
EIA	Environmental Impact Assessment
EN	Endangered
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection Biodiversity and Conservation Act 1999*
ESA	Environmentally Sensitive Area
GPS	Global Positioning System
ha	Hectare
IUCN	International Union for Conservation of Nature
km	Kilometres
m	Metres
MN	Myara North
MNES	Matters of National Environmental Significance
P	Priority
PF	Priority Flora
PMST	Protected Matters Search Tool
SVT	Site Vegetation Types
T	Threatened
TPFL	Threatened and Priority Flora Database
VU	Vulnerable
WA	Western Australia
WAH	Western Australian Herbarium
WEPL	Western Environmental Pty Ltd

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1. Introduction

1.1 Project Background

Alcoa proposes to transition to the new MN mine region as part of its Huntly mining operations. The MN mine region is currently under assessment by the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (Assessment No. 2253).

The Survey Area falls within the previous survey extent of the Mattiske (2021) *Alcoa of Australia Limited: Pinjarra Alumina Refinery Revised Proposal Detailed Flora and Vegetation Survey for Huntley Mine – MN Surveys.*

Alcoa engaged WEPL to undertake targeted pre-clearance Threatened and Priority flora surveys to support a preliminary or minor works application as part of the Part IV EPA approvals process.

1.2 Location

The overall Survey Area comprised eight packages of work, most with partially overlapping boundaries. The total Survey Area was 204.9 ha. See Figure 1 for Survey Area overview and Table 1 for descriptions.

Table 1: Location of the Survey Areas

Survey Area	Description of Survey Area	Area Approximate (ha)
Water Pipeline Alignment	Approx. 9 km long by 40m wide. Runs north from Serpentine Dam (4 km) then east along Balmoral Rd (3.5 km). Eastern portion centred on Balmoral Rd. Eastern portion overlaps with Power Corridor for parts.	65 ha
Power Corridor Alignment	Approx. 8 km long by 40m wide. Larger polygon of 150x800 m at west end. Centred on Balmoral Rd and unnamed forestry track. Eastern portion overlaps with Water Corridor for parts.	
Frollet Road Intersection and Additional Frollet Road	Running east west along Jarrahdale Rd and covering the Jarrahdale Rd and Frollet Rd intersection. Overlaps in parts	15 ha
Albany Highway Intersection	Covering intersection of Jarrahdale Rd and Albany highway and verges of Albany Hwy running north south.	40 ha
MN Facilities Area	Facilities area, magazine and magazine access track. Centred on Balmoral Rd. Overlaps in parts.	50 ha
HUNG_G_000473-000_B_Frollet Rd and Additional Survey Road	Access road corridor 8.2 km wide and 20-80 m wide. Running north south along Frollet Rd and Balmoral Rd between Jarrahdale Rd and the MN Facilities Area. Also additional road option polygon near the MN Facilities Area. Overlaps in parts.	35 ha
Total		**204.9 ha**

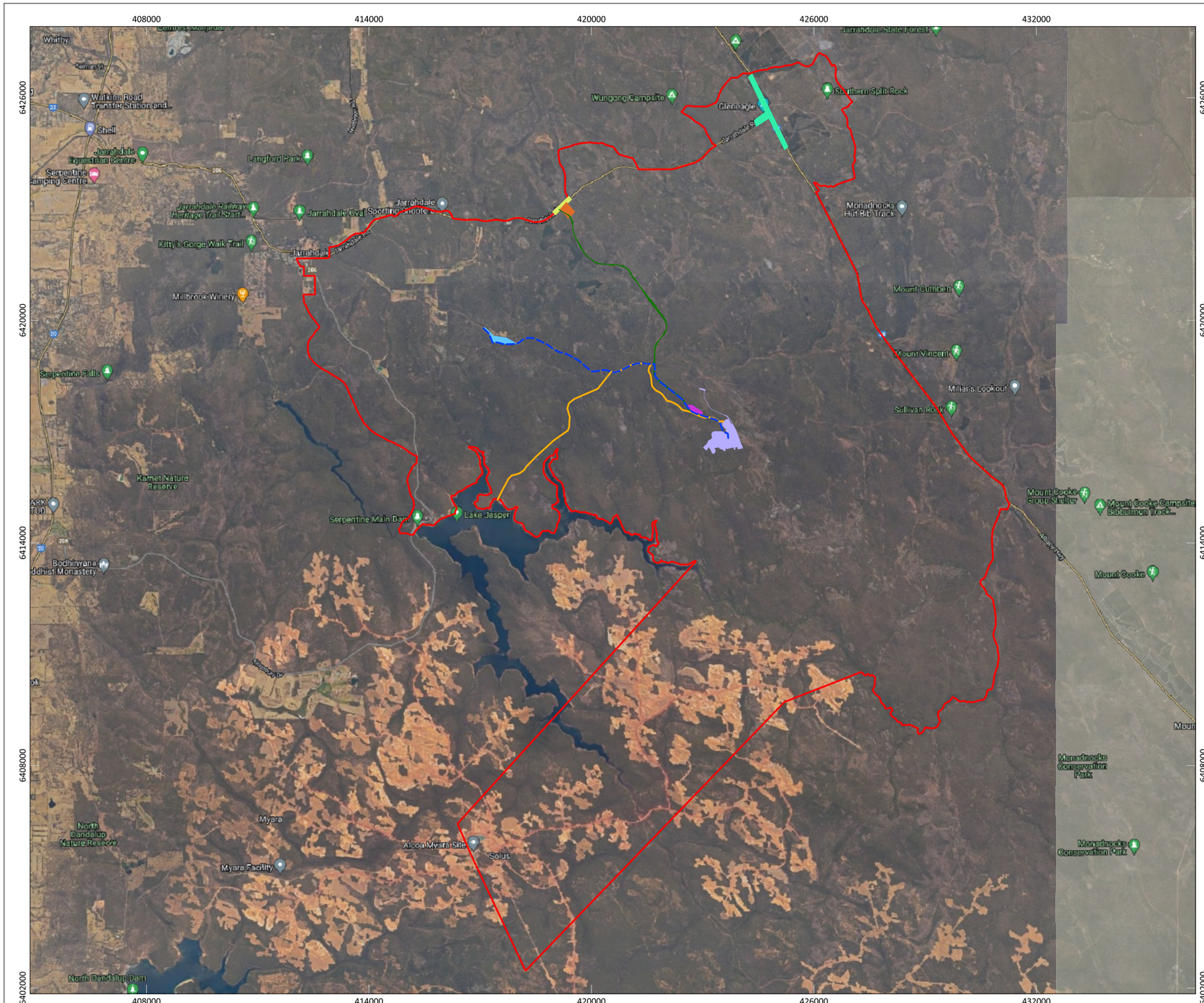
1.3 Scope and Objectives

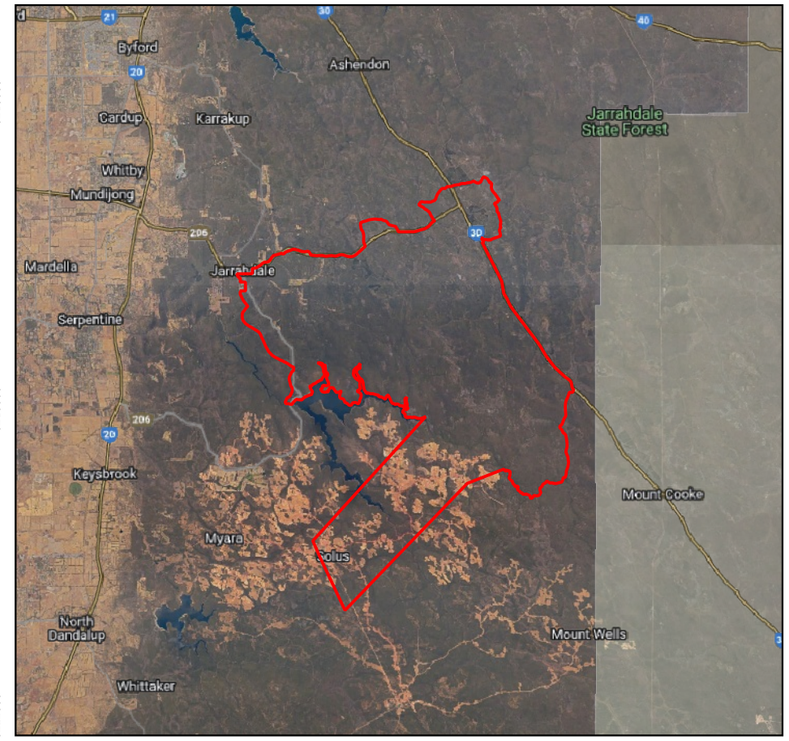
The objective of the survey was to identify the presence or likelihood of occurrence for Threatened and Priority flora.

The scope of works included:

- Desktop assessment of existing records and previous flora and vegetation studies.
- Undertake a likelihood of occurrence assessment based on desktop information.
- Conduct targeted Threatened and Priority flora searches.
- Preparation of a technical report, maps and supporting spatial data; suitable for submission to the EPA to support a preliminary or minor works application.

This report presents the results of the desktop and field survey undertaken to support the above objective.





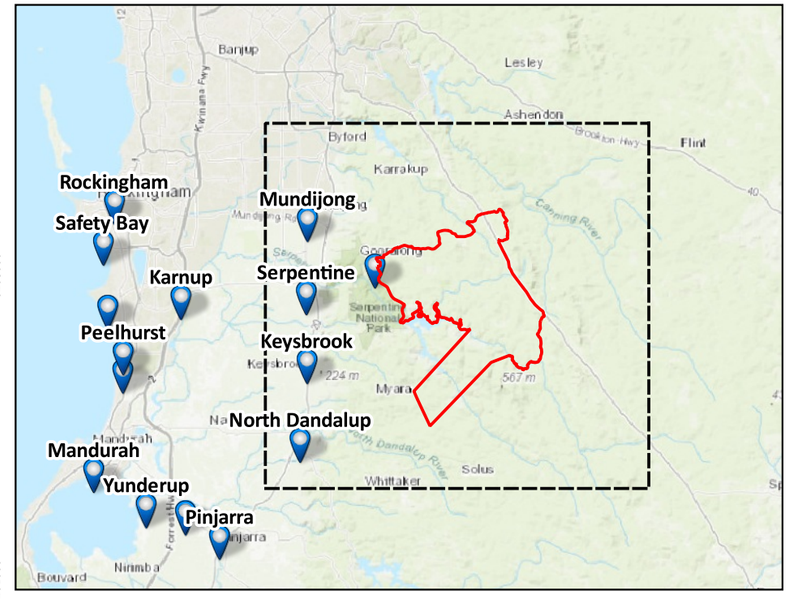


Figure 1: Survey Area

N 0 1 2 3 4 km

SCALE: 1:120,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT: Alcoa of Australia Limited

PROJECT NUMBER	VERSION
A22.055	0
DRAWN BY / REVIEWED BY: MD / LT	DATE: 9/3/2023

Legend

- Myara North Development Envelope
- Additional Frollett Road Survey Area
- Additional Survey Road
- Albany Hwy Intersectoin
- Frollet Road Intersection
- HUNG_G_000473-000_B_Frollet Rd
- Myara North Facilities
- Power Alignment
- Water Alignment
- Power Alignment

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	9/3/2023

NOTES:
Cadastral boundary (LGATE-002). Base map ESRI Topo. Townsites (LGATE-248).

WESTERN ENVIRONMENTAL
Western Environmental Pty Ltd
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Level 3/25 Prowse St, West Perth WA 6005
westenv.com.au

G:\GIS\Project Data\A22.055\A22.055.qgs

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Designed and Automated by AC

1.4 Legislation and Guidance

This environmental assessment was conducted in accordance with Commonwealth and State legislation, guidelines and advice:

- *Environment Protection and Biodiversity Conservation Act 1999.* (EPBC Act) (Cth).
- *Environmental Protection Act 1986.* (EP Act) (WA).
- *Biodiversity Conservation Act 2016.* (BC Act) (WA).
- Biodiversity Conservation Regulations 2018 (WA).
- EPA. (2016). *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.* Known herein as the 'Flora and Vegetation Technical Guidance' (WA).
- Commonwealth of Australia. (2013). *Survey Guidelines for Australia's Threatened Orchids* (Cth).

Brief descriptions of relevant Commonwealth and State legislation is provided in Appendix A. While definitions and criteria for Commonwealth and State conservation codes is provided in Appendix B.

2. Existing Environment

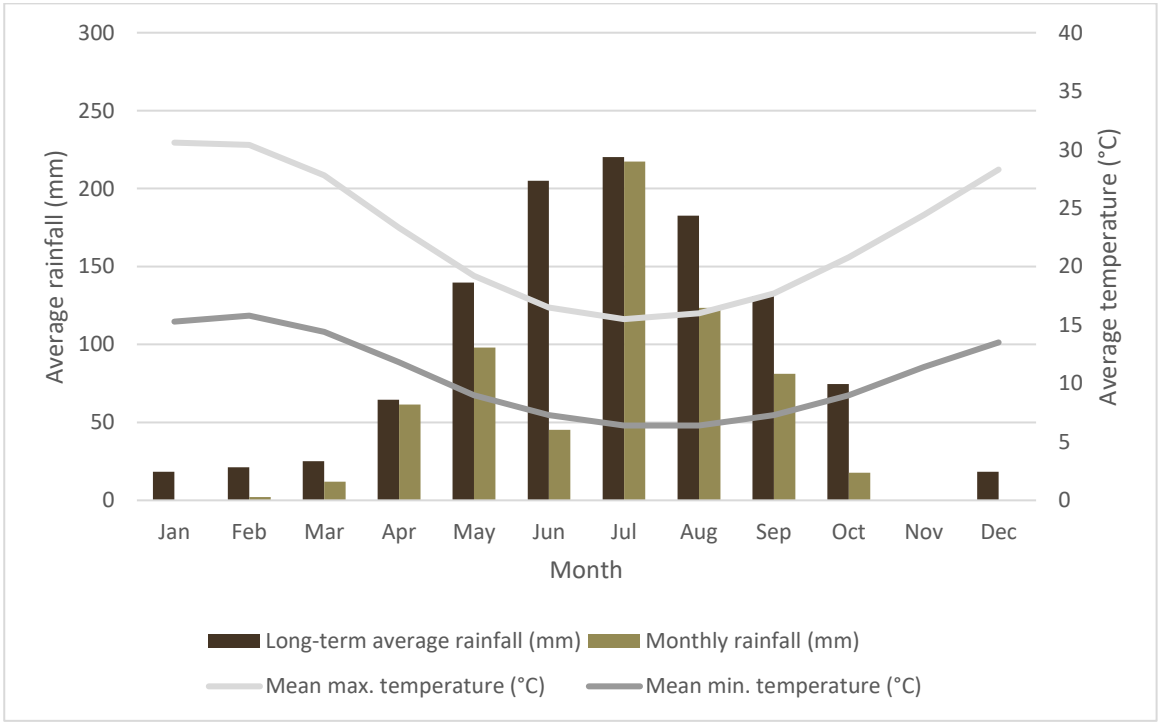
2.1 Climate and Pre-Survey Rainfall

The closest long-term Bureau of Meteorology (BoM) weather station with a complete dataset is Karnet WA (Station 009111), located approximately 14 km south-west of the Survey Area.

Climate statistics were calculated utilising data from the most current climate normal, which is defined as a 30-year interval (BoM, 2007), where possible. A climate normal is a period long enough to include year-to-year variations while avoiding the influence of longer-term changes in climate.

The long-term mean minimum temperature for Karnet ranges from 6.4˚C (July and August) to 15.8˚C (February) (1991 to 2022) and the long-term mean maximum temperature ranges from 15.5˚C (July) to 30.6˚C (January) (Graph 1) (BoM, 2022).

Karnet weather station recorded 668.1 mm of rain in the eleven months prior to the survey (December 2021 – October 2022), which is 432.9 mm below the long-term average of 1101.6 mm in the same period (BoM, 2022). Conditions during winter 2022 showed considerably below average rainfall in June (45.3 mm in 2022 compared to 205.1 mm) and slightly below average rainfall in July (217.4 in 2022 mm compared to 220.3 mm) and August (123.4 mm in 2022 compared to 182.7 mm) (BoM 2022). In the three months prior to the survey (August to October 2022), 222.3 mm of rainfall was recorded, which is 166.2 mm below the long-term average at 388.5 mm (BoM, 2022).



Graph 1: Long Term and Monthly Total Rainfall, Maximum and Minimum Temperatures for Karnet WA (009111) (BoM, 2022)

3. Methodology

3.1 Desktop Assessment

3.1.1 Literature Review

Background information on the Survey Area and surrounds was reviewed prior to the field survey. The Mattiske (2021) detailed flora and vegetation survey report was reviewed in detail, the full report is provided as Appendix C.

Previous locations of Priority flora identified by Mattiske (2021) were provided by Alcoa.

3.1.2 Database Searches

The results of the Mattiske (2021) desktop assessment database searches were reapplied to identify potentially occurring Threated and Priority Flora. The database searches and dates are summarised below in (Table 2).

Table 2: Database Searches of the Survey Area

Database Name	Date	Search Type	Search Area
NatureMap (DBCA)	2021	Threatened and Priority Taxa	20 km buffer of point -32° 21' 54" S, 116° 10' 23" E.
Protected Matters Search Tool (PMST) (Department of Climate Change, Energy, the Environment and Water)	2021	Commonwealth listed Threatened flora and fauna and TECs	20 km buffer around the MN Project Area
Threatened and Priority Flora (TPFL) database search (Department of Biodiversity Conservation and Attractions)	2020	Threatened and Priority Flora	
Western Australian Herbarium (WAHerb) flora database search (Department of Biodiversity Conservation and Attractions)	2020	Threatened and Priority Flora	

3.1.3 Likelihood of Occurrence

A pre-survey likelihood of occurrence assessment, specific to the eight packages of work within Survey Area was undertaken. This was updated following survey to provide a post-survey likelihood of occurrence.

To identify potential habitat suitability the pre-survey likelihood of occurrence assessment considered:

- Intersection of Survey Area with Mattiske and Havel (1998) vegetation complexes. This was compared to the table listing relationship between locations of previous records and vegetation complex the records occurred in (Refer to *Table 6: Summary of Potential Threatened and Priority Flora Recorded in The MN Survey Area By Vegetation Complexes, And Dominant Landform And Soil Groupings* in Mattiske [2021]).

- Intersection with Site Vegetation Types (SVT) and Dominant Landform and Soil Groupings (Refer to *Table 11: Summary of Site-vegetation Types (SVT) on the Myara North Survey Area* in Mattiske [2021]).

- Review of aerial imagery to identify features such as granite outcrops, wetlands or sandy patches.

Further contextual information was gained through assessment of:

- Proximity of previous records from the Mattiske (2021) surveys.

- Proximity of previous records from DBCA database records.

- The findings of the previous likelihood of occurrence assessment (Refer to *Table 6: Summary of Potential Threatened and Priority Flora Recorded In The Myara North Survey Area By Vegetation Complexes, and Dominant Landform And Soil Groupings* in Mattiske [2021]).

The criteria presented in Table 3 were applied to determine final pre-survey likelihood of occurence.

Only species either recorded within the MN project area or considered as having a high or medium likelihood of occurrence under the Mattiske (2021) were included in the likelihood of occurrence assessment. Species classified by WEPL as having a low likelihood of occurrence will not be discussed unless a justification for this classification is required.

Table 3: Likelihood of Occurrence Criteria

Likelihood	Criteria
Recorded	Recorded in the Survey Area from database searches (if confident record is accurate), previous survey by others or by current survey.
High	Suitable habitat occurs within the Survey Area; and • Records of flora species <5 km from the Survey Area. With record <30 years old.
Medium	Suitable or marginally suitable habitat occurs within the Survey Area; and • Records of flora species <5 km from the Survey Area with record >30 years old. • Records 5-20 km from the Survey Area. • Species is strongly linked to a specific habitat, which occurs within the Survey Area and records are present >20 km from the Survey Area.
Low	• Records are >20km from the Survey Area • The species has a well understood and specific habitat preference/ requirements, which is absent from the Survey Area. • Records are historical only, or are pre mapping procedures (e.g. records assigned to towns or place names). • Suitable habitat is present, but there are no existing records of the species from the region despite reasonable previous search effort.

3.2 Field Survey

3.2.1 Field Survey Timing and Survey Team

The targeted field survey was conducted across 25 person days from 7–30 November 2022 by WEPL ecology team as summarised in Table 4.

Table 4: Survey Team and Effort According to Location

Survey Area and Date	Name	Position and years of Experience	DBCA Licence No.
The Water/Power Alignments 7-10 November 2022	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2
	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468
Frollett Road intersection and additional Frollett Road survey area 17-18 November 2022	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2
	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468
Albany Highway Intersection Survey 21-23 November 2022	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2
	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468
MN Facilities	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2

Survey Area and Date	Name	Position and years of Experience	DBCA Licence No.
24, 29 & 30 November 2022	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468
HUNG_G_000473-000_B_Frollet Rd and Additional Survey Road	Andrew Fry	Senior Environmental Scientist, 10 years	FB62000002-2
23, 28 & 29 November 2022	Lovisa Thambert	Graduate Environmental Scientist, 1 year	FB62000468

3.2.2 Targeted Searches

Threatened and Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted. Searches were undertaken as 20 m spaced grid searches. In some locations narrowed to 10-15 m where necessary. Due to open understory 20 m spacing were typical applied. Where target species have specific micro habitat preferences these receive a higher intensity of search effort.

The locations of any records were marked using a handheld GPS with the following data recorded:

- Observer, date, and time.
- Local abundance/population size and/or population boundary.
- Representative photos of each species and habitat.
- Collection of representative specimens.
- Notes on habitat and vegetation type.

3.2.3 Flora Taxonomy and Lodgement of Specimens

A pre-field survey identification guide was prepared from plant descriptions and images and by inspection of relevant species from Western Australian Herbarium (WAH) reference collection.

Where field identification of plant taxa was not possible, specimens were collected for identification using resources of the WAH. Identification of flora collections was primarily completed by senior ecologist Andrew Fry with suspected or potential conservation significant flora species submitted to the WAH for identification by Mike Hislop.

3.3 Survey Limitations and Constraints

Limitations and constraints of the targeted searches as outlined in the Flora and Vegetation Technical Guidance are detailed below in Table 5.

Table 5: Limitations and Constraints

Possible Limitation	Degree of Limitation (Significant, Moderate or Negligible)	Potential Constraints on Survey Outcomes
Survey Level/ Scope	Negligible	Targeted pre-clearance searches following a detailed flora and vegetation survey was undertaken at a sufficient level of detail and in accordance with the *EPA Flora and Vegetation Technical Guidance.* Is considered appropriate to support approvals applications and EIA processes.
Availability of contextual information at a regional and local scale	Negligible	All data required to complete the scope of works including regional and local contextual information was available. Previous detailed surveys have been undertaken by Mattiske (2021) across the MN area. As part of that project, lower intensity targeted searched have been undertaken providing good contextual information. Available literature was reviewed, and publicly available databases were also searched. Contextual information is therefore not considered to be a limiting factor for this study.
Site Access	Negligible	The Survey Area was readily accessible by foot, and the entire the Survey Area was traversed.
Survey Intensity and Extent	Negligible	The entire Survey Area was traversed by foot to search to conservation significant flora. Sufficient time was allocated to survey, given the size and complexity of the Survey Area. The survey effort was considered adequate to assess values of the Survey Area and provide information required to support approvals applications.
Experience	Negligible	The field survey team and leading scientist (Andrew Fry) has suitable experience in conducting flora and vegetation surveys in the southwest. All flora collections of potential conservation significant species were submitted to the WAH for identification.
Timing, weather, season	Negligible	The recommended primary survey period for flora and vegetation surveys for the region as per the EPA Technical Guidance occurs during Spring (September through November). The survey was completed in November, after below average rainfall in July and August 2022 (see Graph 1). Observed conditions were good with many species in fruit and flower and annuals present. Survey period aligned with the flowering period for majority of the species but outside of flowering period for four species, three of which can be identified without flowering material. This limitation is discussed in Section 4.2 and was considered negligible
Mapping Reliability	Negligible	The entire of the Survey Area was traversed by foot and mapping reliability is considered high.
Disturbances (fire, flood etc.)	Moderate	Areas of disturbance associated with access tracks, previous clearing and weeds were recorded but were not a constraint on the results of the survey. There was recent fire (<2 years ago) at Albany Highway Intersection Survey Area, about 15% of the survey area affected. This represents a minor constraint for the specific Survey Area.

4. Results

4.1 Desktop Assessment

Previous records identified by the desktop search are shown in Figure 2. As discussed in Mattiske (2021) the use of a 20 km radius results in species that are restricted to the Swan Coastal Plain or occurring in areas on granite outcrops (e.g. Mt Cooke, Mr Windsor and Mt Wells), or species restricted to the eastern Jarrah forest being included.

The Mattiske (2021) desktop assessment identified 39 Threatened or Priority species as being previously recorded or having a high or moderate likelihood of occurrence, see Table 7.

Previous Records Mattiske (2021)

Mattiske (2021) undertook a detailed survey of the MN project area. The survey which ran across 302 person days included 6121 recording sites on a 120 m x 120 m grid system, 22 permanent quadrats, targeted searches throughout the area and mapping vegetation, soils and condition.

The Mattiske (2021) Threatened and Priority flora search area overlays the Survey Area for this project. No previous records of Threatened or Priority flora were identified as present. In the broader MN project area, no Threatened flora species and four new Priority flora locations were recorded. Species recorded are shown in the likelihood of occurrence assessment (Table 7) and in Figure 2.

Mattiske (2021) reported their results reflected the importance of granite outcrop areas and the sandier and sandy gravel soils, with many species associated with these. Fewer species occur on the gravellier laterite soils. It was also identified that a higher concentration of Priority flora species occurred on the eastern fringes of the MN area which supports species that are more tolerant of sandier soils and outcrops.

Previous Records DBCA Database

Ten Priority flora species as listed by DBCA have been recorded in the MN Survey Area and 25 Threatened or Priority species within the 20 km desktop search area, see Table 7. The remaining four species were only recorded from the PMST search.

Pre-Survey Likelihood of Occurrence Assessment

The pre-survey likelihood of occurrence assessment specific to the eight packages of work within the Survey Area is presented below in Table 7. The intersection with Mattiske and Havel (1998) vegetation complexes, which was used to understand habitat present is presented in Table 6.

The likelihood of occurrence assessment identified that three species have a high likelihood of occurrence, 14 species a medium likelihood of occurrence and 22 species a low likelihood of occurrence. No Threatened species had a high or medium likelihood of occurrence. The species assed as having a low likelihood or occurrence were typically associated with granites, drainage lines, wetlands or sandy habitats. These were identified as not occurring or having marginal/ restricted occurrences within the Survey Area.

Table 6: Vegetation Complexes Within the MN Survey Area

Vegetation Complex	Description	Water Pipeline Alignment	Power Corridor Alignment	Frollett Road Intersection and Additional Frollett Road	Albany Highway Intersection	MN Facilites	HUNG_G_000473-000_B_Frollett Rd and Additional Survey Road
Dwellingup 1	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.	x	x			x	x
Dwellingup 2	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.	x	x	x	x		
Goonaping	Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata* (humid zones) and *Eucalyptus marginata* subsp. *thalassica* (semiarid to periarid zones) on the sandy gravels, low woodland of *Banksia attenuata* on the drier sandier sites (humid to periarid zones) with some *Banksia menziesii* (northern arid and periarid zones) and low open woodland of *Melaleuca preissiana – Banksia littoralis* on the moister sandy soils (humid to periarid zones).		x				
Murray 1	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.	x					
Pindalup	Open forest of *Eucalyptus marginata* subsp*. thalassica – Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones.						
Swamp	Mosaic of low open woodland of *Melaleuca preissiana – Banksia littoralis*, closed scrub of Myrtaceae spp., closed heath of Myrtaceae spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.	x	x		x		x
Yarragil 1	Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.	x				x	
Yarragil 2	Open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* on slopes, woodland of *Eucalyptus patens – Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors.	x	x	x	x	x	x

Table 7: Pre-Survey Likelihood of Occurrence

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
Anthocercis gracilis	T	V	Low	Not recorded within MN area previously or during 2020 and earlier studies. Recorded in Dwellingup 1 in wider Jarrah Forest.	Sandy or loamy soils. Granite outcrops. Mainly near granites (Florabase records) and less likely in lateritic gravels.	Sep to Oct	Previous records >20km and preferred habitat not present.
Diuris drummondii	T	V	Low	Not recorded within MN area previously or during 2020 and earlier studies.	Low-lying depressions, swamps. Not likely in lateritic soils.	Nov to Dec or Jan	Previous records >20km and preferred habitat not present.
Diuris micrantha	T	V	Low	Not recorded within MN area previously or during 2020 and earlier studies.	Brown loamy clay. Winter-wet swamps, in shallow water. Not likely in lateritic soils.	Sep to Oct	Previous records >20km and preferred habitat not present.
Eleocharis keigheryi	T	V	Low	Not recorded within MN area previously or during 2020 and earlier studies.	Clay, sandy loam. Emergent in freshwater: creeks, claypans. Not likely in lateritic soils.	Aug to Nov	Previous records >20km and preferred habitat not present.
Grevillea flexuosa	T	V	Low	Recorded in Cooke in wider Jarrah Forest.	Red-brown sand with laterite & gravel, sand over granite. Ridgetop plateau & associated breakaways.	Jul to Oct	Preferred habitat not present. Previously recorded in a vegetation complex that was not within the Survey Areas.
Lasiopetalum pterocarpum	T	E	Low	Recorded on Darling Scarp, Murray 1 and Helena 1 so may extend to granite outcrops. Not in lateritic soils.	Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines.	Aug to Dec	Preferred habitat not present. Previously recorded in a vegetation complex that was not within the Survey Areas.
Verticordia fimbrilepis* subsp. *fimbrilepis	T	E	Low	Recorded in Swamps in wider Jarrah Forest. Some potential in lateritic soils.	Gravelly sandy or clayey soils. Flats, road verges.	Oct to Dec or Jan	Preferred habitat not present. Previously recorded in a vegetation complex that was not within the Survey Areas.
Verticordia plumosa* var. *ananeotes	T	E	Low	Not recorded within MN area North previously or during 2020 and earlier studies. Not likely in lateritic soils.	Sandy loam. Seasonally inundated plains.	Nov to Dec	Records 15 km west at base of scarp. Preferred habitat not present.

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
[2]***Andersonia* sp. Saxatilis (F. & J. Hort 3324)**	P1		Low	Recorded on Dwellingup, and Cooke.	Dry, brown loam, clay over granite. Slope, outcrops, granite.	Jan or Sep-Oct	Preferred habitat (granites) not present. Previously recorded in a vegetation complex that was not within the Survey Areas.
Calytrix simplex* subsp. *simplex	P1		Low	Recorded in Dwellingup 2 within wider Jarrah Forest. Potential in lateritic soils.	On sandplain. With *Eucalyptus tetragona*, etc.	Oct to Nov	Preferred habitat is not present within Survey Areas. The closest recording was 8.5 km away within Swamp complex with grey clay and loamy soil (WA Herb). This habitat was not present within the Survey Area.
Paracaleana gracilicordata	P1		Low	Not likely in lateritic soils as associated mainly with outcrops (may be localised small occurrences in Dwellingup 2, Pindalup) but more likely in Cooke	Growing on moss mats, granite.	Oct-Nov	Closest recording is 1.1 km from the Survey area (WA herb), however has strong association with moss mats on granite which was not present.
[2]***Paracaleana granitica***	P1		Low	Mainly on granite outcrops, not in lateritic soils, may be in other complexes if small, localised outcrops that are small in size Recorded on Dwellingup 2, Pindalup and Murray 1.	Growing on moss mats, granite.	Oct-Dec	Closest recording is 750 m from the Survey Area (WA herb), however habitat not present in Survey Areas.
Banksia recurvistylis	P2		Low	Recorded in Cooke and Dwellingup 2 within wider Jarrah Forest. Less likely in deeper lateritic soils.	Shallow, lateritic soils associated with granite outcrops.	Nov to Dec	Closest recording is 7.8 km from the Survey Area (WA herb), however preferred habitat (granites) not present.
Grevillea crowleyae	P2		Medium	Not recorded within MN previously or during 2020 and earlier studies. East of area in Dwellingup 2	Gravel. In gravel pit.	Aug to Nov	Previous record >5 km from the Survey Area (WA herb). Potentially suitable habitat present.
[2]***Grevillea manglesii* subsp. *ornithopoda***	P2		Low	Recorded in Dwellingup 1 and Murray 1. Less likely in deeper lateritic soils.	Loam, loam over clay, clay. Edge of riverbank and creek, dunes.	Sep-Nov	Vegetation complexes species previously recorded in present. Closest record 2.4 km from the Survey Area. However, the record is from 1901 (WA herb). Considered that preferred habitat is not present.
Millotia tenuifolia* var. *laevis	P2		Medium	Recorded in Dwellingup. Potential in lateritic and granite soils.	Granite or laterite soils.	Sep to Oct	Vegetation complexes previously recorded in present. Preferred habitat is present throughout the Survey Area. Previous recordings >10 km from the Survey Area (WA herb; TPFL).

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
Tetratheca phoenix	P2		Low	Recorded in mainly Cooke and occasionally in Dwellingup 4 in wider Jarrah Forest area. Most likely on granite. Not likely in deeper lateritic soils.	Brown gravelly loam over granite. Mid-upper slopes, often near large rock outcrops.		Preferred habitat (granites) not present. Previously recorded in a vegetation complex not within the Survey Area.
[1]***Acacia drummondii*** **subsp. *affinis***	P3		High	Potential in lateritic soils. Recorded in Yarragil 1 and Dwellingup 1 on soils associated with Dwellingup 2, Cooke and Yarragil 2 within wider Jarrah Forest. Recorded by Mattiske (2021) in Dwellingup 2, Cooke and Yarragil 2.	Lateritic gravelly soils.	Jul-Aug	Recorded within 2 km. Vegetation complexes association, soils and preferred habitat present.
[1]***Acacia horridula***	P3		High	Recorded in Dwellingup 2, Swamp, Yarragil 1 and Darling Scarp in wider Jarrah Forest. Potential in lateritic soils.	Gravelly soils over granite, sand. Rocky hillslopes.	May-Aug	Recent records <5 km from the Survey Area, within a vegetation complex (Swamp) that was present.
Acacia oncinophylla **subsp. *oncinophylla***	P3		Low	Recorded in Dwellingup 1 in wider Jarrah Forest. More likely on granites (Florabase, WAH 1998-).	Granitic soils.	Aug to Oct	Previously recorded in habitats associated with granite outcrops (WA herb) which was not present.
[2]***Andersonia*** **sp. Audax (F. Hort, B. Hort & J. Hort 3179)**	P3		Low	Recorded on Dwellingup 1, Dwellingup 2, Dwellingup 4, Yarragil 2, Swamp, Yarragil 2, and Cooke.	Loam, clay, sand, gravel. Granite slopes and drainage lines.	Oct-Nov	Previously recorded in habitats associated with granite outcrops (WA herb) which was not present.
[1]***Conospermum scaposum***	P3		Medium	Recorded in Yarragil 2. Not likely in lateritic soils.	White-grey sand, sandy clay. Low swampy areas, road verges.	Oct to Dec or Jan to Feb	Previously recorded 5.5 km from the Survey Area, within a vegetation complex that had minor coverage within the Survey Area. The preferred habitat was present in small patches of the Survey Area.
Grevillea manglesii **subsp. *dissectifolia***	P3		Medium	Recorded in in Dwellingup, Murray 1, Cooke and Pindalup. Potential in lateritic soils.	Gravelly loam, moist. Roadsides.	Jun or Sep or Nov	Previously recorded 7km east of Survey Area within a vegetation complex present in Survey Area.

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
Halgania corymbosa	P3		Medium	Recorded in Darling Scarp 2. Potential in lateritic soils.	Gravelly soils, soils over granite.	Aug to Nov	Previous records >10 km from Survey Area and >30 years old (WA herb) in a vegetation complex that was not present within the Survey Area. Potentially suitable habitat present.
Lasiopetalum glutinosum* subsp. *glutinosum	P3		Medium	Recorded in Dwellingup 1, Darling Scarp 2, and Murray 1, in wider area. Potential in lateritic soils.	Grows in open woodland and low scrub, mostly on the Darling Scarp near the Avon Wheatbelt, Jarrah Forest, Swan Coastal Plain.		Previous records >10 km from Survey Area and >20 years old (WA herb) in vegetation complexes present within the Survey Area.
Petrophile filifolia* subsp. *laxa	P3		Low	Recorded in Yarragil 1 in wider area. Not likely in lateritic soils.	White gritty sand, brown, red, yellow, white or grey sand, brown-yellow sandy clay. Winter-wet sites, flats, slopes, swamps, drainage lines.	Nov to Jan	Previous recording >10 km from Survey Area (WA herb). The preferred habitat was not present.
Pithocarpa corymbulosa	P3		Low	Recorded in Yarragil 2, Dwellingup 2 and Swamp. Not likely in deeper lateritic soils.	Gravelly or sandy loam. Amongst granite outcrops.	Jan to Apr	Previous records >10 km away from Survey area (WA herb) and in vegetation complexes that are within the Survey Area. Preferred habitat (granites) not present.
[2]***Stackhousia* sp. Redblotched corolla (A. Markey 911)**	P3		Medium	Recorded north of MN in Dwellingup 2 in wider Jarrah Forest. Potential for occurrence in lateritic soils.	Brown loamy sand clayey sand over laterite, white sandy clay over granite, grey clay. Slopes.	Sep-Nov	Previous records 1.9 km from the Survey Area, record is > 30 years old (WA herb). Vegetation complex association present within the Survey Area.
Synaphea pandurata	P3		Medium	Recorded in Pindalup, Swamp and Dwellingup 2 in wider Jarrah Forest and earlier studies.	Yellow-grey, yellow-brown, yellow-red sands and sandy loams, dark brown loam, laterite gravel, granite. In undulating areas.		Previous records >9 km from the Survey Area (WA herb) and within vegetation complexes present within the Survey Area.
Thysanotus anceps	P3		Medium	Recorded in Murray 1 and Dwellingup in wider Jarrah Forest. Potential for occurrence in lateritic soils.	White or grey sand, lateritic gravel, laterite.	Oct to Dec	Previous records in vegetation complexes present in Survey Area. Previous records >10 km from the Survey area and are >20 years old (WA herb). Preferred habitat was present in patches.

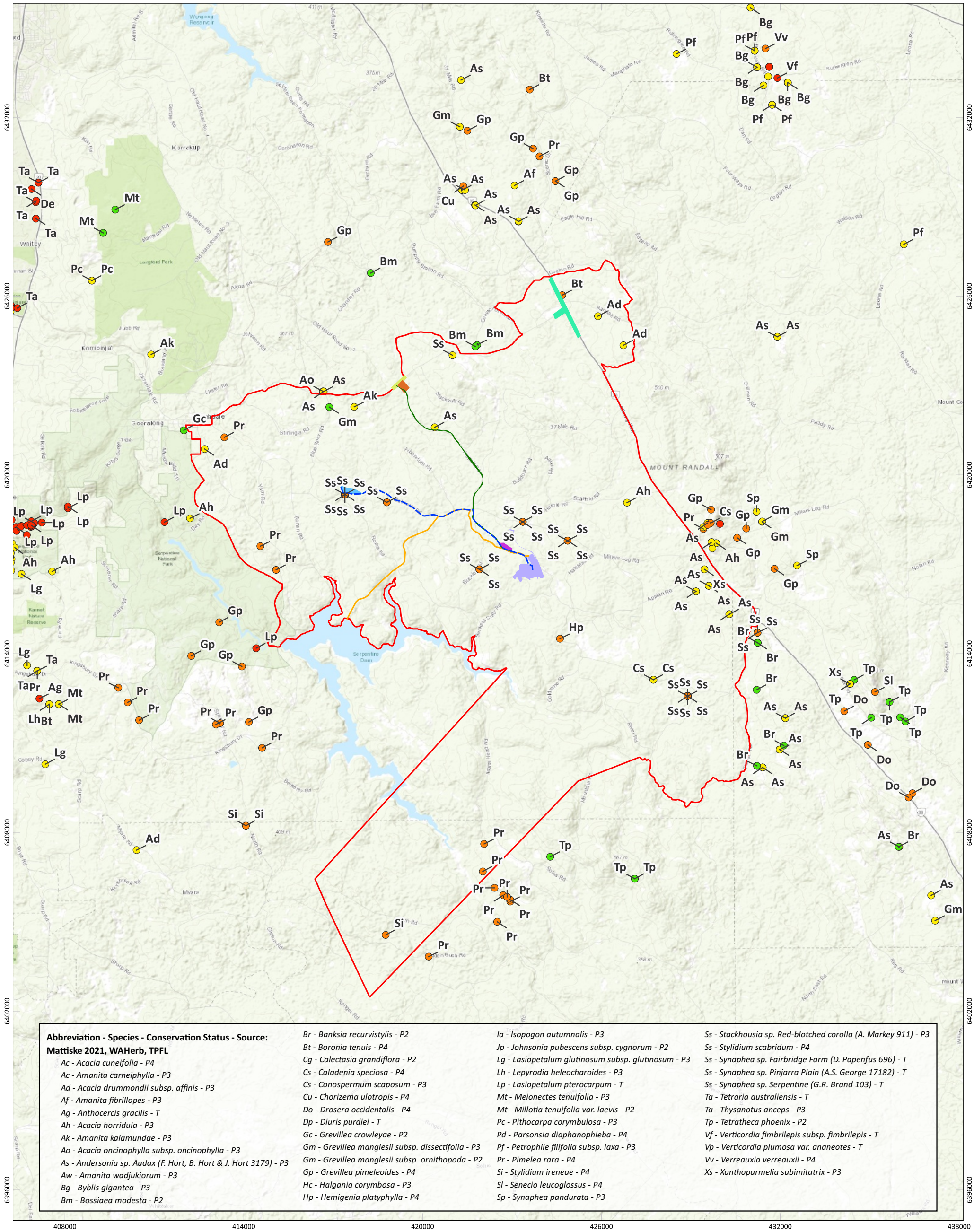
Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
[2]*Boronia tenuis*	P4		Medium	Recorded in Dwellingup 2, Yarragil 1 and Murray 1 in wider Jarrah Forest. Potential in lateritic soils in valleys and on granite outcrops.	Laterite, stony soils, granite.	Aug-Nov	Previous records located <1 km from Survey Area, however >30 years old and listed as from Turtle Pool (WA herb). Likely inaccurate location. Vegetation complex association present within the Survey Area.
Chorizema ulotropis	P4		Medium	Recorded in Dwellingup 1 and Dwellingup 2 within wider Jarrah Forest. Potential in lateritic soils.	Moist to dry soils, white sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats.	Jul to Sep	Previous records in vegetation complexes present within the Survey Area. Record is 5 km from the Survey Area (WA herb) and the preferred habitat is marginally suitable within the wider Survey Area.
Grevillea pimeleoides	P4		Medium	Recorded in Murray 1 Dwellingup 1, Dwellingup 2, Pindalup and Cooke in wider Jarrah Forest.	Gravelly soils over granite. Rocky hillsides. Although on outcrops, there is potential in lateritic soils.	May to Nov	Several records 5-10 km from Survey Area. Majority of records >30 years old (WA herb). Records <30 years old within vegetation complexes not present. Potentially suitable habitat considered present.
[2]*Hemigenia platyphylla*	P4		Medium	Recorded in Dwellingup 1. Less likely in deeper lateritic soils. Potential in sandy gravels.	Sandy and loamy soils. Granite rocks, slopes.	Sep-Nov	Previous records within vegetation complex present in the Survey Area. Record is >5 km away (WA herb). Habitat present marginally suitable.
Lasiopetalum cardiophyllum	P4		Low	Recorded on sandy gravels and further east in wider Jarrah Forest. May occur in lateritic soils.	Lateritic gravelly soils, sandy clay. Flats, hillslopes.	Aug to Dec or Jan	Previously records >20 km from Survey Area. Potentially suitable habitat present (WA herb).
Parsonsia diaphanophleba	P4		Low	Recorded in Murray 1 and Yarragil 1 in wider Jarrah Forest. Less likely in lateritic soils.	Alluvial soils. Along rivers.	Jan to Feb or Apr to Jun or Sep	Previous records either >30 years old or >20 km from the Survey Area, all records in association with riverbank (WA herb). Vegetation complexes that associated with previous records present, however preferred habitat not present.
[2]*Pimelea rara*	P4		Medium	Recorded in Dwellingup 1, Dwellingup 2, Murray 1, Yarragil 1, Yarragil 2 and to a lesser degree Cooke in wider Jarrah Forest. Potential to occur in lateritic soils.	Lateritic soils.	Dec-Jan	Vegetation complexes and preferred habitat present. Closest previous record 6.3 km from the Survey Area (WA herb).

Species	DBCA listed	EPBC Act listed	Likelihood of Occurrence	Vegetation Complex Previously Recorded in (up to 20 km Radius)	Preferred Habitat	Flowering Period	Justification
[2]***Stylidium ireneae***	P4		Low	Recorded in Yarragil 1 and Yarragil 2 in wider Jarrah Forest.	Sandy loam. Valleys near creek lines. Not likely in lateritic soils.	Oct-Dec	Previous records in vegetation complexes that cover smaller areas of the Survey Area. Previous records >8 km (WA herb) from the Survey Area and preferred habitat not present.
[1]***Stylidium scabridum***	P4		High	Less likely in lateritic soils, although was recorded in Dwellingup complexes. Recorded on Dwellingup 1, Dwellingup 2, Yarragil 2, Goonaping in range of soils and site conditions.	Sand. Open woodland or heath.	Sep-Nov	Records in five locations <2 km, within vegetation complexes that are common across the Survey Area. Preferred habitat was present in some patches.

[1]-Recorded by Mattiske 2021.

[2]-DBCA database.

This table based on *Table 6: Summary of Potential Threatened and Priority Flora Recorded In The Myara North Survey Area* in Mattiske (2021). Preferred habitat and flowering period from Florabase (WAH, 2022).


408000
414000
420000
426000
432000
438000
6432000
6426000
6420000
6414000
6408000
6402000
6396000
Wungong Reservoir
Karrakup
Whitby
Langford Park
Korribinjal
Gooralong
Serpentine National Park
Kamet Nature Reserve
Serpentine Dam
MOUNT RANDALL
Mount Co
Myara
Ta Ta Ta De Ta Ta
Mt Mt
Pc Pc
Ta
Ak
Ad
Lp Lp Lp Lp Lp Lp Lp Lp Lp
Ah Ah Lg
Gp Gp Gp Gp
Lg Ta TaPr Ag Mt LhBt Mt Lg
Pr Pr Pr Pr Pr Pr Pr Pr Pr Pr
Si Si Si
Ad
As
Bm
Gp
Ao As Ak As Gm Gc Pr Ad
Ss Ss Ss Ss Ss Ss Ss Ss Ss Ss
Lp Ah Pr Pr
Gm Gp
As As Cu As As As As
Gp Pr Af Gp Gp
Bt
Bm Bm Ss
Pf
Pf Pf Vv Bg Bg Vf Bg Bg Bg Bg Pf Pf
Ah
Gp Pr Cs Gp Sp Gm Gm As As Ah Gp Sp Gp
As As As Xs As As As Ss Ss Br Ss Br
Hp
Cs Cs Ss Ss Ss Ss Ss
Br As As Br As As
Xs Tp Sl Tp Tp Do Tp Tp Tp Tp Tp Do
Do Do
As Br
As Gm
Tp Tp Tp
Pf
As As
Ad
Ad
Br
Bt
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Ra
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4.2 Field Survey Results

Threatened and Priority Flora

No Commonwealth EPBC Act listed, or State BC Act listed Threatened flora or DBCA listed Priority flora were recorded in the Survey Area. The absence of Threatened and Priority flora was not an unexpected outcome considering the absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).

Thirty-five collections were made in the field for identification to check for potential threaten and priority species. Five collections (four *Acacia* and one *Pimelea*) were subsequently submitted to the WAH to confirm identifications. It was confirmed that none of the collections were Priority species.

The survey was undertaken outside of the flowering period of four species assessed as having a high or medium likelihood of occurrence. This potentially limits the ability to detect or confirm identification. These are discussed below.

- *Acacia drummondii* subsp. *affinis* (P3) flowers Jul-Aug: Medium size perennial shrub, is identifiable in the field without flowers by pinnae dimensions and hair structures. Four collections were submitted to the WA herbarium for confirmation. All were identified as other *Acacia* sp. Not considered a survey limitation.

- *Acacia horridula* (P3) flowers May-Aug: Perennial shrub, is identifiable in the field without flowers by robust, harsh single stemmed form. Not considered a survey limitation.

- *Chorizema ulotropis* (P4) flowers Jul-Sep: Flowers required for positive identification. No suspected occurrence was identified. All *Chorizema* collections were positively identified as common species. Due to form as a spawning or twining shrub detection may be more difficult if not in flower. May represent minor survey limitation.

- *Pimelea rara* (P4) flowers Dec-Jan: Likely identifiable by having concolorous dull leaves and small (<40 cm) size vs common species present which have sheen an adaxial leaf surface and are larger. One collection was submitted to the WA herbarium and was confirmed as not as Priority species.

Brief descriptions of survey effort, the habitats encountered and comments on vegetation condition and disturbance for the eight packages of work within the Survey Area are provided below.

Survey Area Descriptions

Water/Power Alignment

Eight person days of survey effort, see tracklogs in Figure 3a-3c and Figure 4a-4d. Follows Balmoral Rd or forestry tracks for majority of area. Water Corridor runs through bushland with limited disturbance in southern branch.

Geology throughout was lateritic with gravel and shallow loams. The vegetation was considered Good to Very Good with patches of Very Good to Excellent condition. Due to the activity of firewood harvesting along the edges of Balmoral Rd and the forestry tracks the ground stratum was sparse with vehicle disturbance present. The vegetation was consistent *Eucalyptus marginata* and *Corymbia calophylla* forest.

HUNG_G_000473-000_B_Frollet Rd and Additional Survey Road

Five person days of survey effort, see tracklogs in Figure 5a-5d. Survey Area follows Frollet Rd and Balmoral Rd verges. 1.6 km of the Survey Area intersected pine plantations, these were not traversed. Ground stratum was generally sparse with vehicle disturbance present.

Majority geology was lateritic gravel and shallow loams. Some lower lying areas with a more clay loam soil was present. On lateritic soils vegetation was comparable to the Power Alignment with *Eucalyptus marginata* and *Corymbia calophylla* forest. Where the soil type was associated with the Swamp vegetation complex *Melaleuca preissiana* and myrtaceous shrublands were present.

MN Facilities Area

Five person days of survey effort, see tracklogs in Figure 6a-6d. Extending north and south of Balmoral Rd and north along proposed magazine access track.

Majority of the area was associated with lateritic gravel and *Eucalyptus marginata* and *Corymbia calophylla* forest. The southwest corner was associated with a soil type of grey sand over laterite supporting myrtaceous shrubland. This area received additional focus as the desktop identified several species associated with this habitat type.

Vegetation was Very Good to Excellent condition with minor forestry tracks going through the area. Firewood collection disturbance was common around tracks.

Frollett Road Intersection and Additional Frollett Road Survey Area

Two person days of survey effort, see tracklogs in Figure 7. Survey Area followed verges and intersection of Jarrahdale Rd and Frollet Rd.

Geology throughout the was lateritic gravels with *Eucalyptus marginata* and *Corymbia calophylla* forest. The vegetation was in Good condition. The ground stratum was sparse with low species diversity. This is the main access road to a firewood harvesting block, hence the vegetation was disturbed from the high

concentration of vehicles and people accessing firewood. Additionally, a part of the area was historically cleared for a borrow pit which was revegetated.

Albany Highway Intersection Survey Area

Five person days of survey effort, see tracklogs in Figure 8. Follows the verges of Albany Highway and Jarrahdale Rd. Several sections of pine plantation were present, these were not traversed. The survey area along the northern side of Jarrahdale Road had recently burnt (<2 years prior) impacting around 15% of the Survey Area. Most of the mid and ground stratum had not re-established limiting ability to undertake searches. This is considered a minor limitation in the context of the overall survey effort.

Majority of the area was associated with the Dwellingup 2 complex with lateritic gravels but had pockets of the Swamp complex with clay loam soils and Yarragil 2 complex also with clay loam soils. In the clay loam areas dense thickets of myrtaceous shrubland were present. In the southern corner a moderate size drainage line was present with flowing water. In this area the soil type was loamy. This area received additional focus as the desktop identified several species associated with this habitat type.

The vegetation along Albany Highway was disturbed with partial clearing present for access tracks and pine plantations. Outside of clearing impacts vegetation Good to Very Good condition.

Post Survey Likelihood of Occurrence Assessment

Following suitable targeted search effort, the likelihood of occurrence for all Threatened and Priority flora species identified by the desktop was reassessed as low. This assessment is discussed further in Section 5.

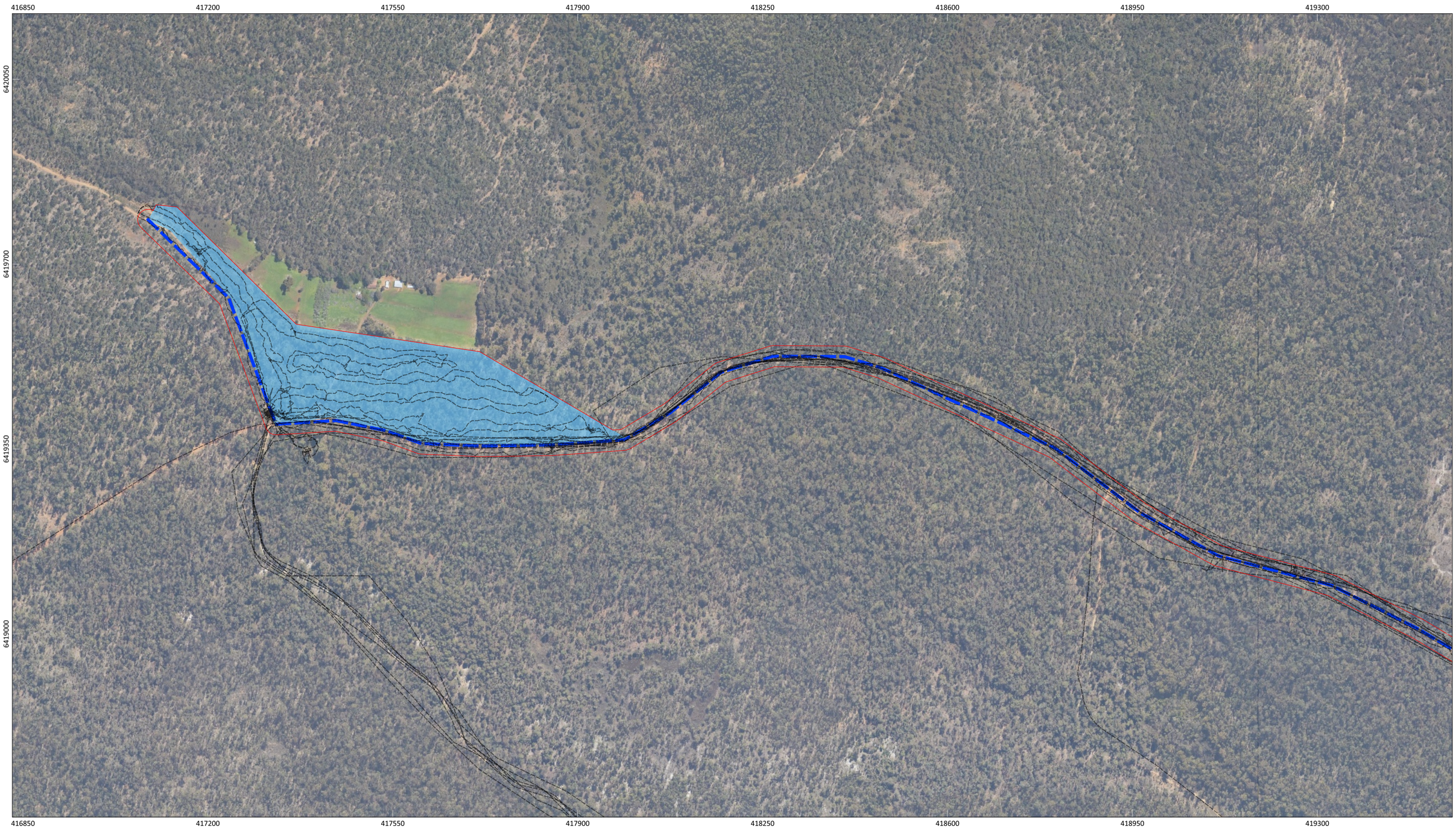


Figure 3a: Survey effort: Power Alignment

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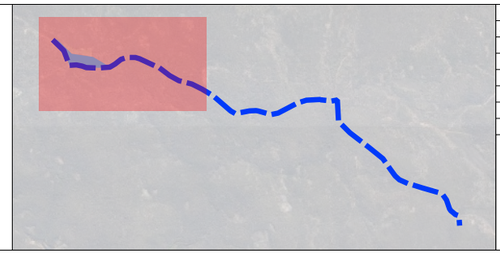
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PROJECT/REPORT NAME
Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT
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Legend

- Survey Area
- Power Alignment
- Power Alignment
- Track Log



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Figure 3b: Survey effort: Power Alignment

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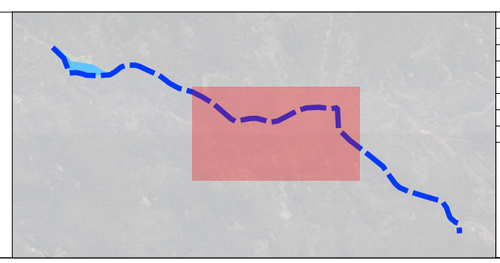
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- Track Log



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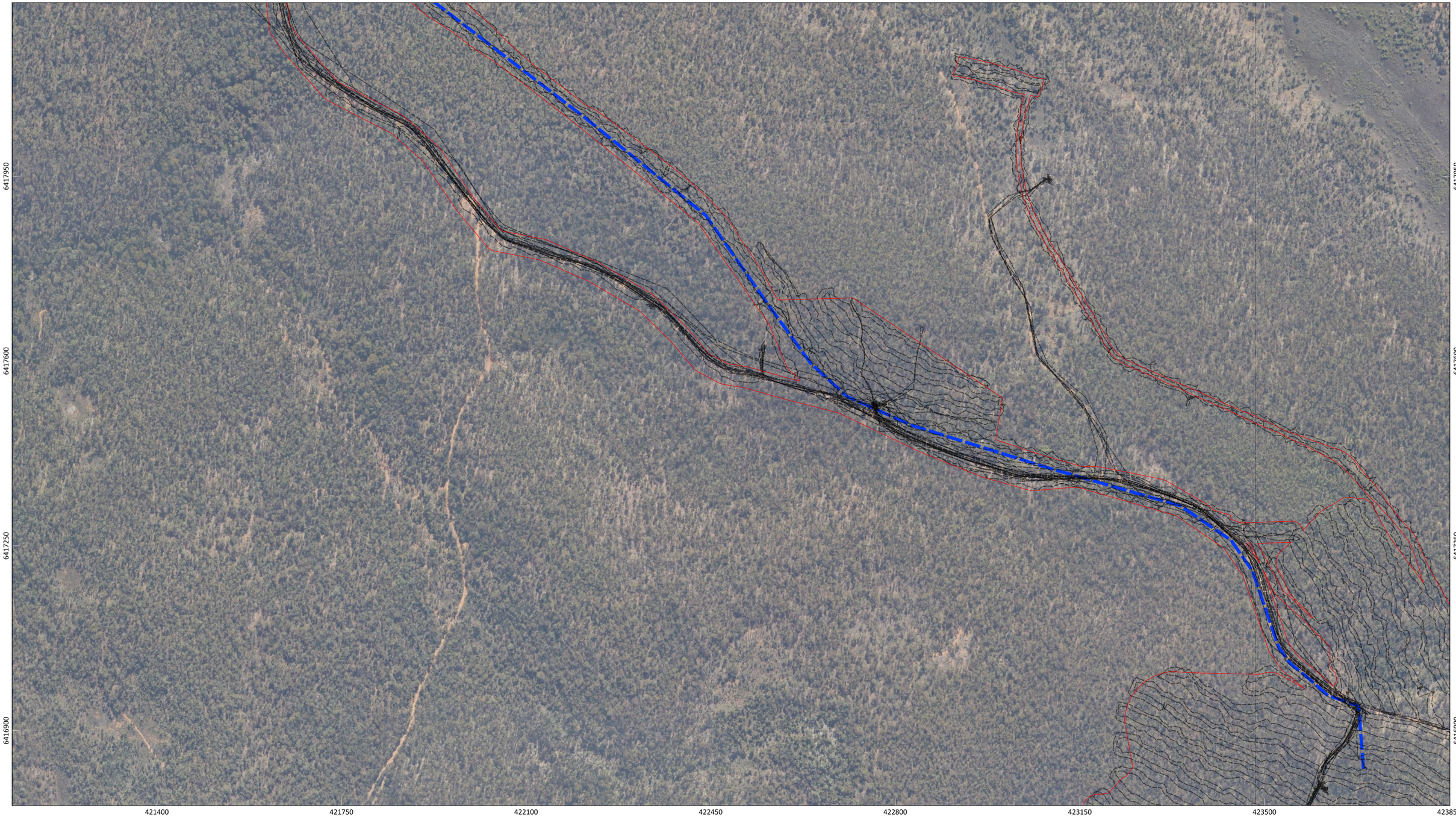


Figure 3c: Survey effort: Power Alignment

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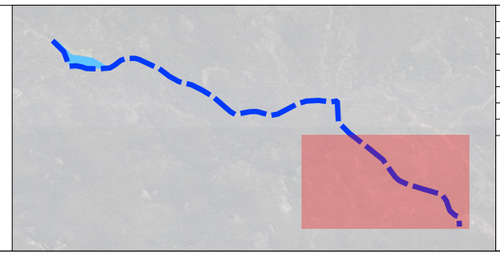
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- Survey Area
- Power Alignment
- Track Log



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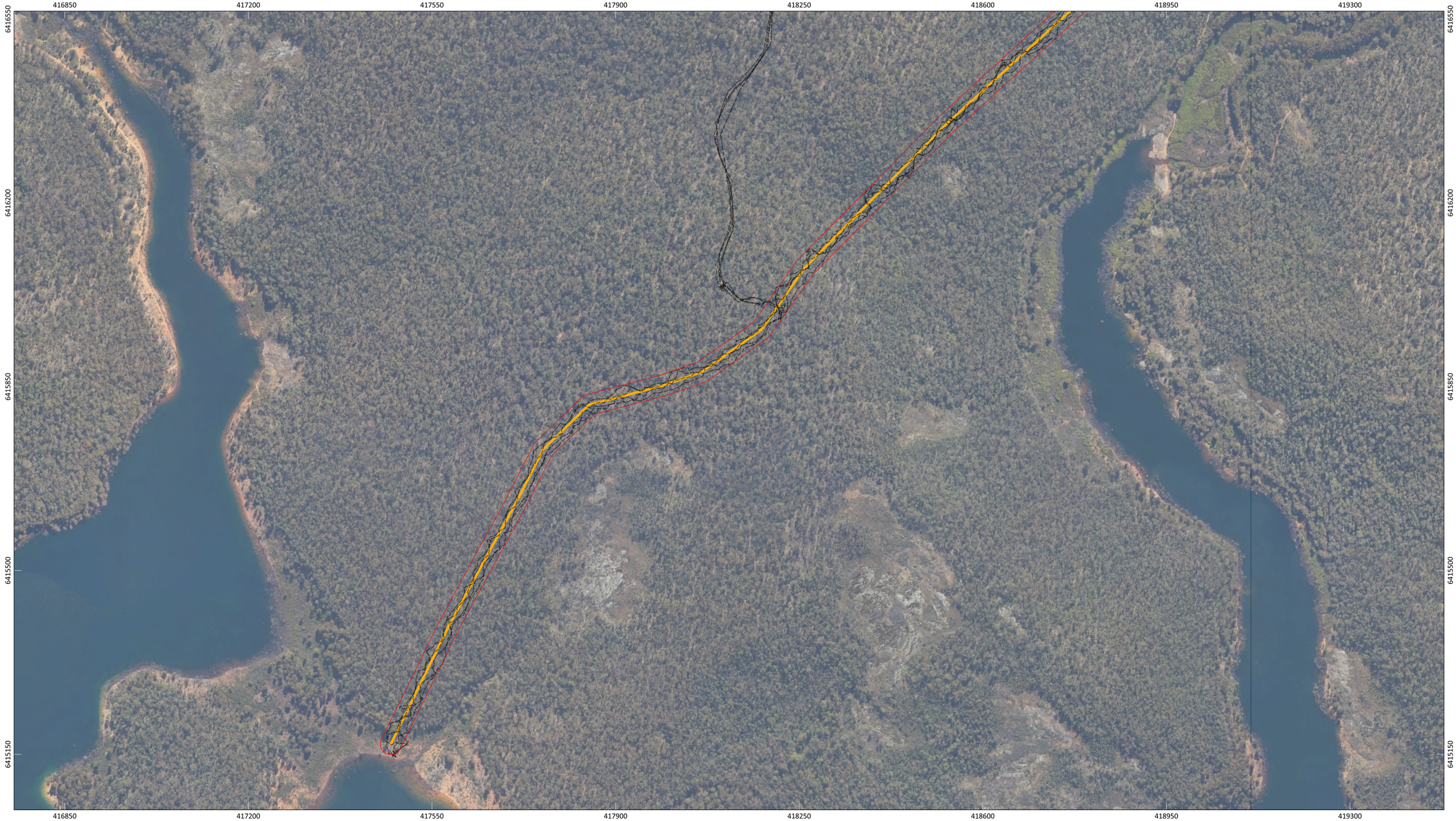


Figure 4a: Survey effort: Water Alignment

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Figure 4b: Survey effort: Water Alignment

N

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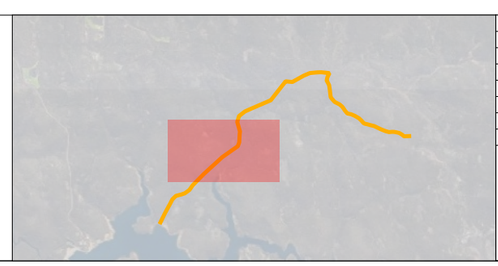
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Figure 4c: Water Alignment

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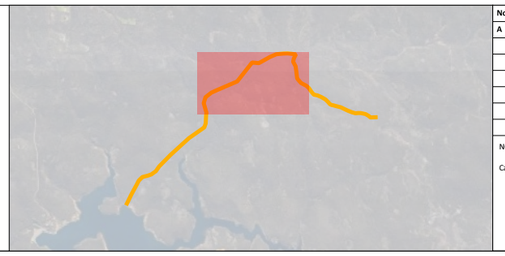
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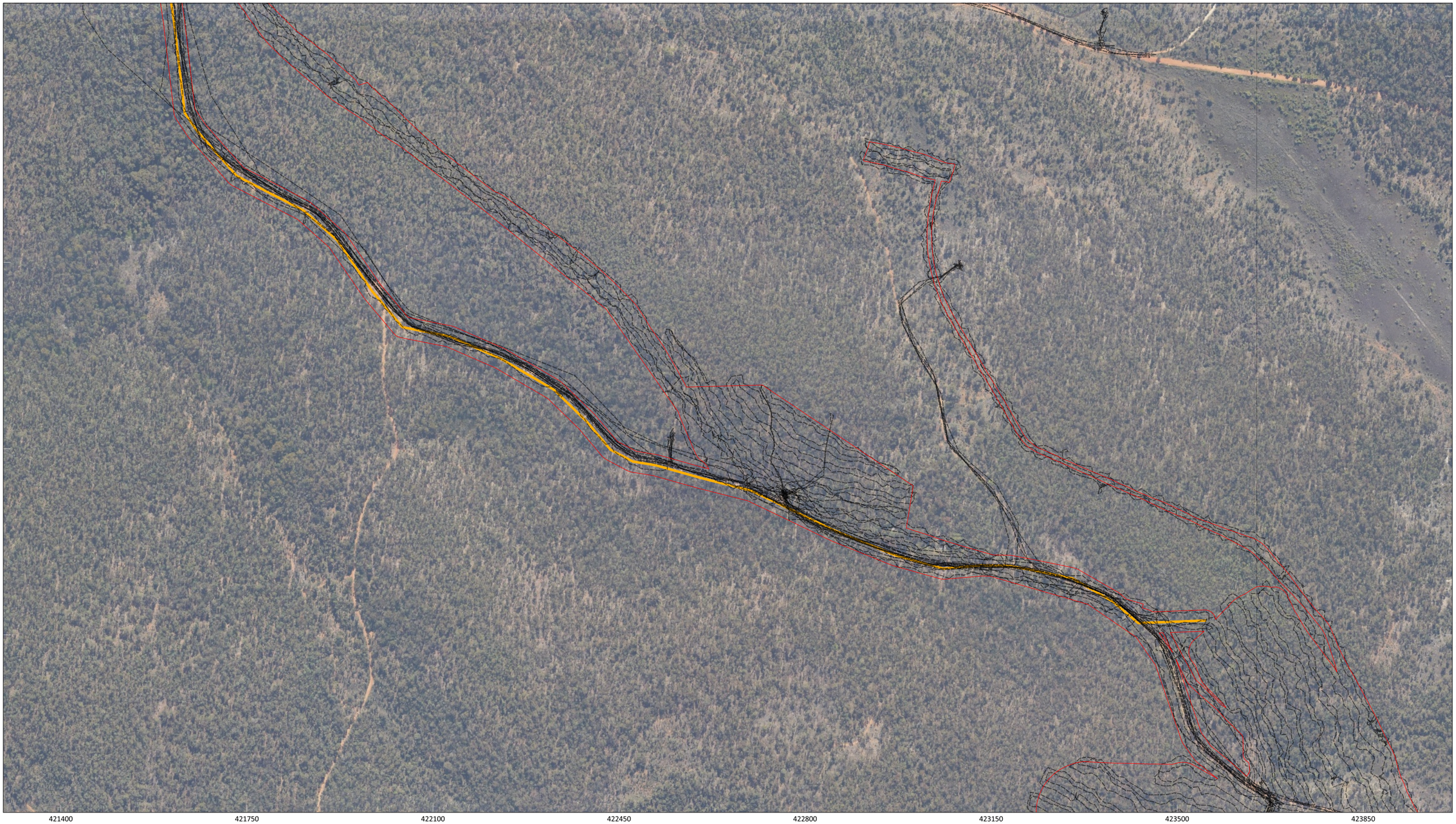


Figure 4d: Water Alignment

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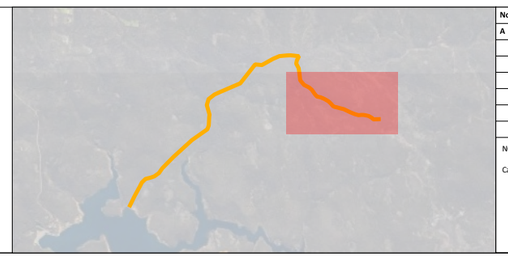
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- Track Log



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Figure 5a: Survey Effort: HUNG_G_000473-000_B_Frollet Rd and Additional Survey Area

N

0 100 200 300 400 m

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SHEET SIZE	A3 COLOUR
CLIENT	Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A22.055
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY 2022
DRAWN BY / REVIEWED BY	MD / LT
DATE	13/3/2023

Legend

- Survey Area
- HUNG_G_000473-000_B_Frollet Rd
- Track Log

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Figure 5b: Survey Effort: HUNG_G_000473-000_B_Frollet Rd and Additional Survey Area

N

0 100 200 300 400 m

SCALE: 1:7,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
CLIENT: Alcoa of Australia Limited		
PROJECT NUMBER: A22.055	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023	

Legend

- Survey Area
- HUNG_G_000473-000_B_Frollet Rd
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:

Cadastral boundary from LANDGATE 2022

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Figure 5c: Survey Effort: HUNG_G_000473-000_B_Frollet Rd and Additional Survey Area

N

0 100 200 300 400 m

PROJECT/REPORT NAME	Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North
SCALE	1:7,000
SHEET SIZE	A3 COLOUR
CLIENT	Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A22.055
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY 2022
DRAWN BY / REVIEWED BY	MD / LT
DATE	13/3/2023

Legend

- Survey Area
- HUNG_G_000473-000_B_Frollet Rd
- Track Log

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:

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Figure 5d: Survey Effort: HUNG_G_000473-000_B_Frollet Rd and Additional Survey Area

N

0 100 200 300 400 m

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
SCALE: 1:7,000	SHEET SIZE: A3 COLOUR	CLIENT: Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A22.055	VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023

Legend

- Survey Area
- HUNG_G_000473-000_B_Frollet Rd
- Additional Survey Area
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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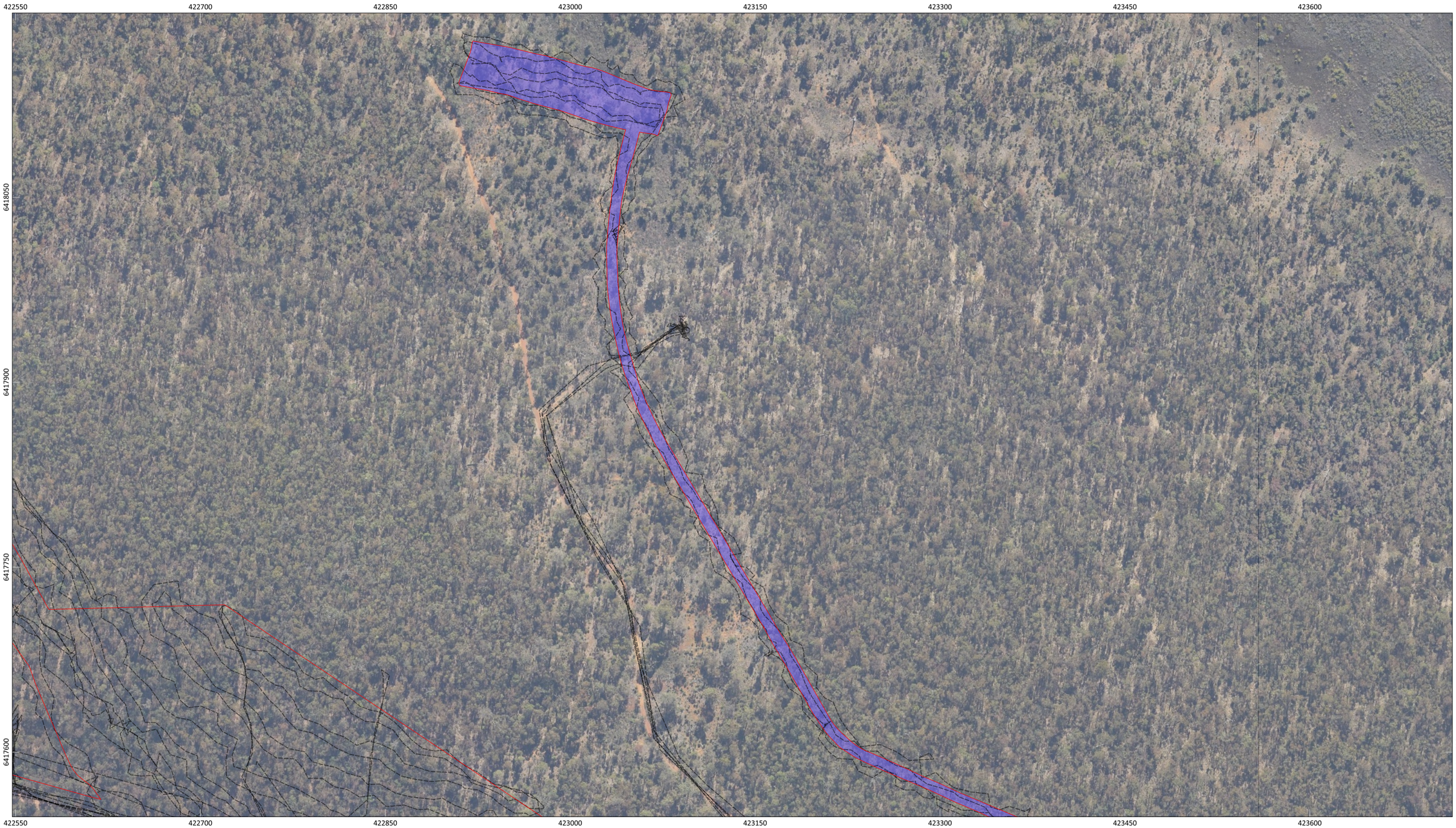


Figure 6a: Survey Effort: Myara North Facilities

N

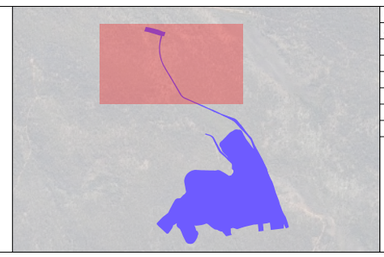
0 40 80 120 160 m

SCALE: 1:3,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
CLIENT: Alcoa of Australia Limited		
PROJECT NUMBER: A22.055	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023	

Legend

- Survey Area
- Myara North Facilities
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:

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Figure 6b: Survey Effort: Myara North Facilities

N

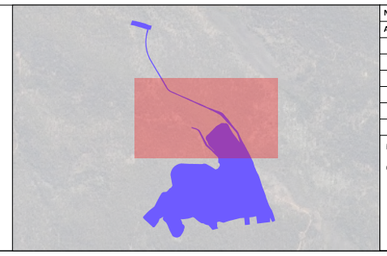
0 40 80 120 160 m

SCALE: 1:3,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
CLIENT: Alcoa of Australia Limited		
PROJECT NUMBER: A22.055	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023	

Legend

- Survey Area
- Myara North Facilities
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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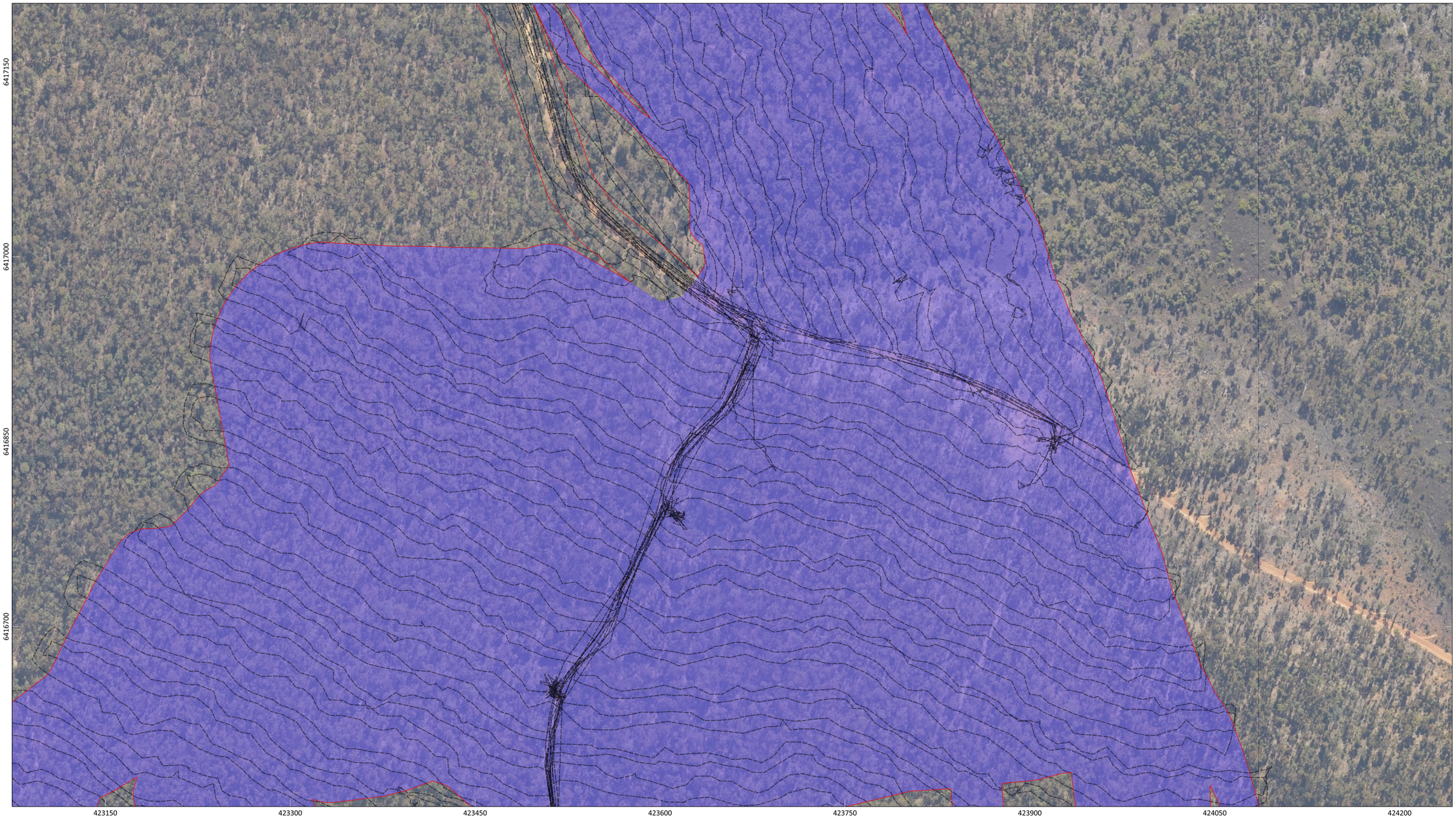


Figure 6c: Survey Effort: Myara North Facilities

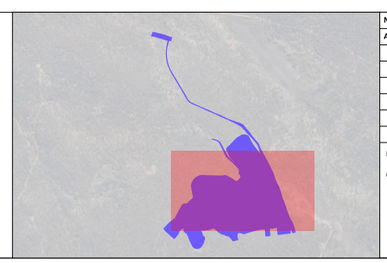
N

0 40 80 120 160 m

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
SCALE: 1:3,000	SHEET SIZE: A3 COLOUR	CLIENT: Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A22.055	VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023

Legend

- Survey Area
- Myara North Facilities
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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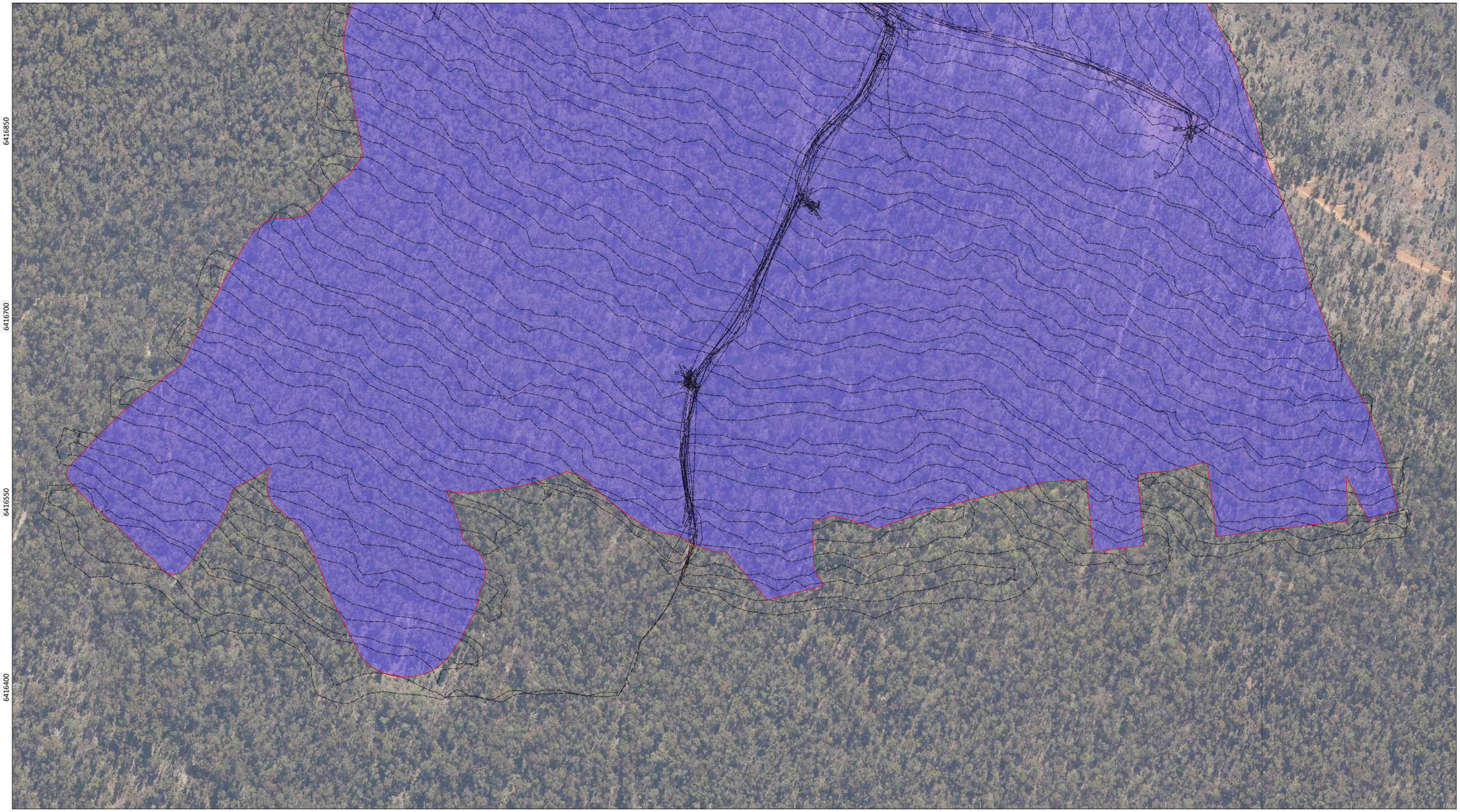


Figure 6d: Survey Effort: Myara North Facilities

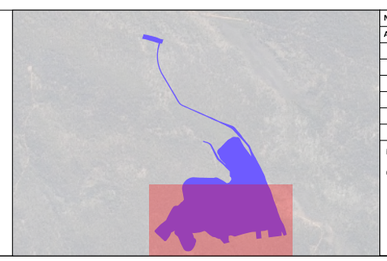
N

0 40 80 120 160 m

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North		
SCALE: 1:3,000	SHEET SIZE: A3 COLOUR	CLIENT: Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A22.055	VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: MD / LT	DATE: 13/3/2023

Legend

- Survey Area
- Myara North Facilities
- Track Log



No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

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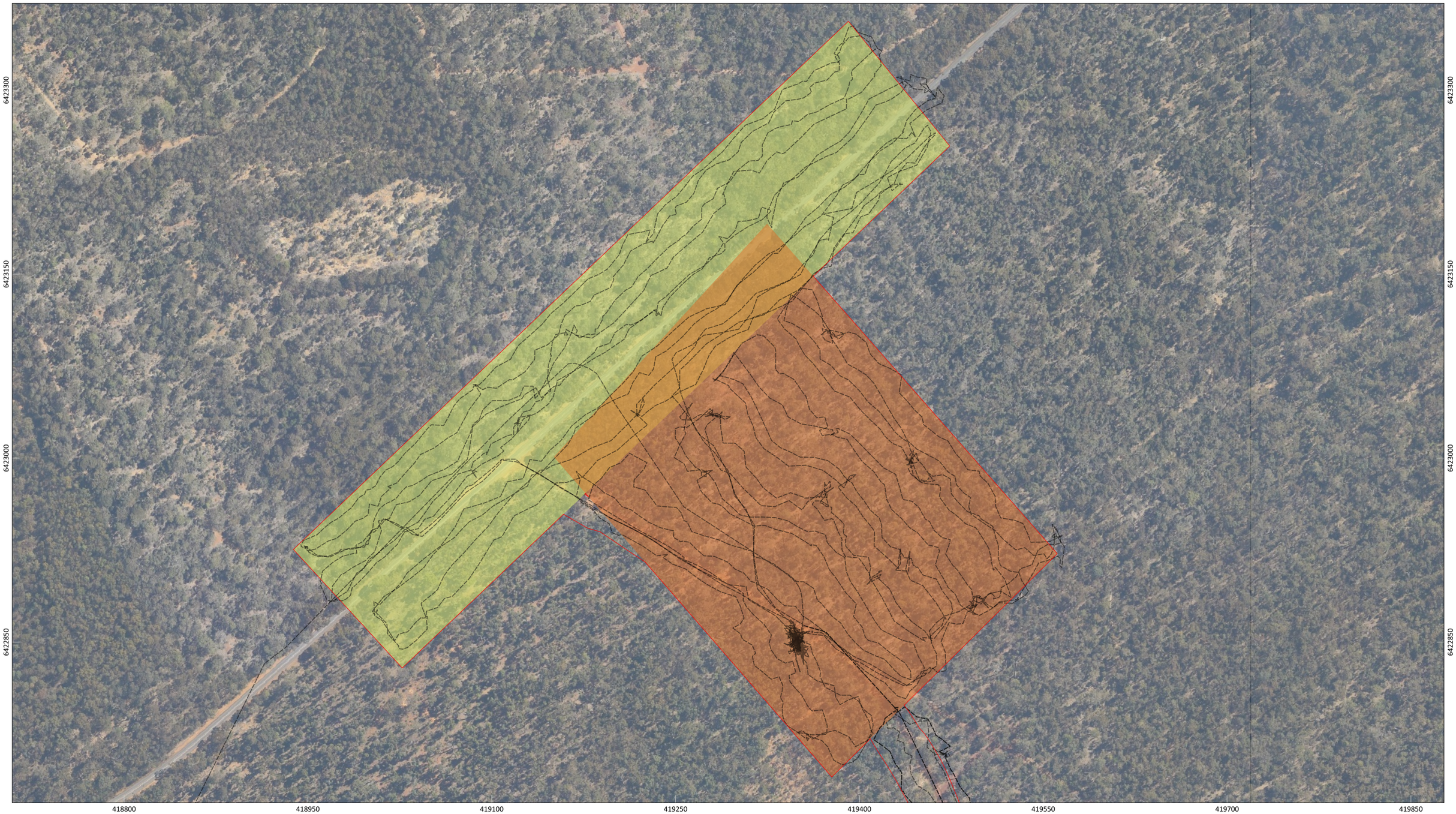


Figure 7: Survey effort: Frollett Road Intersection and Additional Frollett Road Survey Area

N

0 40 80 120 160 m

SCALE: 1:3,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	

PROJECT/REPORT NAME: Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search
Myara North

CLIENT: Alcoa of Australia Limited

PROJECT NUMBER	VERSION
A22.055	0
DRAWN BY / REVIEWED BY	DATE
MD / LT	13/3/2023

Legend

- Survey Area
- Additional Frollett Road Survey Area
- Frollet Road Intersection
- Track Log

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:

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Figure 8: Survey Effort - Albany Highway Intersection

0 50 100 150 200 m

N

PROJECT/REPORT NAME	Pre-Clearance Survey 2022/23: Targeted Threatened and Priority Flora Search Myara North
SCALE	1:7,000
SHEET SIZE	A3 COLOUR
CLIENT	Alcoa of Australia Limited
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A22.055
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY 2022
DRAWN BY / REVIEWED BY	MD / LT
DATE	13/3/2023

Legend

- Survey Area
- Albany Hwy Intersectoin
- Track Log

No	Description	Drawn	Approved	Date
A	Original issue	MD	LT	13/3/2023

NOTES:

Cadastral boundary (LGATE-002)

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5. Discussion

No Commonwealth EPBC Act listed, or State BC Act listed Threatened flora or DBCA listed Priority flora were recorded in the Survey Area.

The pre-survey likelihood of occurrence assessment identified three species as having a high likelihood of occurrence, 14 species medium and 22 species low. No Threatened species had a high or medium likelihood of occurrence. The species assed as having a low likelihood of occurrence were typically associated with granites, drainage lines, wetlands or sandy habitats. These were identified as not occurring or having marginal/ restricted occurrences within the Survey Area.

Following suitable targeted search effort, the likelihood of occurrence for all Threatened and Priority flora species identified by the desktop was reassessed as low. This assessment has been reached considering:

- The results of the pre-survey likelihood of occurrence assessments, both by WEPL for the specific Survey Area and Mattiske (2021) for the MY project area.
- Having undertaken suitable targeted search efforts during the primary spring survey season and within the flowering period of the majority of species. For the four species with flowering periods outside the survey period, three can likely be identified without flowering material.
- The absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).
- Disturbance to the understory in many areas through vehicle access for firewood collection and clearing of access tracks.
- The alignment of much of the Survey Area on existing disturbed areas, roads and forestry tracks.

The absence of Threatened and Priority flora was not an unexpected survey outcome considering the dominance of habitat with *Eucalyptus marginata* and *Corymbia calophylla* forest over laterite and the absence or limited extent of habitat types identified by the desktop as containing a significant portion of the Threatened and Priority flora for the region (e.g. granites, breakaways, major drainages, wetlands, sandy soils).

6. References

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Mattiske, E.M. and Havel, J.J. (1998). *Vegetation Complexes of the South-west Forest Region of Western Australia*.

Mattiske. (2021). *Alcoa of Limited Australia: Pinjarra Alumina Refinery Revised Proposal Detailed Flora and Vegetation Survey for Huntley Mine – MN*.

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Appendix A
Legislation

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act aims to protect matters of national environmental significance (MNES). Under the EPBC Act, the Commonwealth Department of Climate Change, Energy and the Environment lists Threatened species and communities in categories determined by criteria set out in the EPBC Act.

Projects likely to cause a significant impact on MNES should be referred to the DCCEEW for assessment under the EPBC Act.

Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 aims to conserve and protect biodiversity and biodiversity components within the State and to promote ecologically sustainable use of biodiversity components in the State.

Environmental Protection Act 1986

Declared Rare Flora (DRF) and Threatened Ecological Communities (TECs) are given special consideration in environmental impact assessments and have special status as Environmentally Sensitive Areas (ESAs) under the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Exemptions for a clearing permit do not apply in an ESA. In addition, habitat necessary for the maintenance of indigenous fauna is considered in the clearing principles and assessed during consideration of applications for a clearing permit.

Biosecurity and Agricultural Management Act 2007

Plants may be 'Declared' by the Minister for Agriculture and Food under the BAM Act. The Western Australian Organism List contains information on the area(s) in which a plant is declared and the control and keeping categories to which it has been assigned in Western Australia. A declaration may apply to the whole State, to districts, individual properties or even to single paddocks. If a plant is 'Declared', landholders are obliged to control that plant on their properties.

Weeds of National Significance

The Australian Government along with the State and Territory governments has endorsed 32 WoNS. Four major criteria were used in determining WoNS:

- The invasiveness of a weed species.
- A weed's impacts.
- The potential for spread of a weed.
- Socio-economic and environmental values.

Each WoNS has a national strategy and a national coordinator, responsible for implementing the strategy. WoNS are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts.

Department of Biodiversity, Conservation and Attractions Priority Lists

DBCA lists 'Priority' flora and fauna that have not been assigned statutory protection as "Threatened" under the BC Act and are under consideration for declaration as Threatened. Flora and fauna assessed as Priority 1-3 are considered to be in urgent need of further survey. Priority 4 flora requires monitoring every 5 -10 years.

DBCA maintains a list of Priority Ecological Communities (PECs) which identifies plant communities that require further investigation before possible nomination for TEC status. Once listed, a community becomes a PEC and, when endorsed by the WA Minister for Environment, becomes a TEC and protected as an ESA under Environmental Protection (Clearing of Native Vegetation) Regulations 2004.

Informal Recognition of Flora and Fauna

Certain populations or communities of flora and/or fauna may be of local significance or interest because of their patterns of distribution and abundance. For example, specific locations of flora and may be locally significant because they are range extensions to the previously known distribution, or are newly discovered taxa (and have the potential to be of more than local significance). In addition, many species are in decline as a result of threatening processes (land clearing, grazing, and changed fire regimes) and relict populations of such species assume local importance for DBCA. It is not uncommon for DBCA to make comment on these species of interest.

Appendix B
Definitions and Criteria

EPBC Act Categories for Flora, Fauna and Ecological Communities

Category	Threatened Species	Threatened Ecological Communities
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.	N/A.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.	N/A.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish. (ii) the species is the focus of a plan of	N/A.

Category	Threatened Species	Threatened Ecological Communities
	management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised. (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory. (iv) cessation of the plan of management would adversely affect the conservation status of the species.	

Conservation Codes for Western Australian Flora and Fauna (DBCA)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, Threatened, extinct or in need of special protection, and have been gazetted as such. **The Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** **Categories of Threatened, Extinct and Specially Protected fauna and flora are:**	
T	**Threatened species** Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as Threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using International Union for Conservation of Nature (IUCN) Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
EN	**Endangered species** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare

Conservation Codes for Western Australian Flora and Fauna	
	Flora) Notice 2018 for endangered flora.
VU	**Vulnerable species** Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct species **Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.**	
EX	**Extinct species** Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
EW	**Extinct in the wild species** Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no Threatened fauna or Threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species **Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.** **Species that are listed as Threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.**	
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Conservation Codes for Western Australian Flora and Fauna	
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as Threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
P	**Priority species** Possibly Threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of Priority for survey and evaluation of conservation status so that consideration can be given to their declaration as Threatened fauna or flora. Species that are adequately known, are rare but not Threatened, or meet criteria for near Threatened, or that have been recently removed from the Threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority 1: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	**Priority 2: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	**Priority 3: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Conservation Codes for Western Australian Flora and Fauna	
4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently Threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of Threatened species during the past five years for reasons other than taxonomy.

[1] The definition of flora includes algae, fungi and lichens.

DBCA Definitions and Criteria for TECs and PECs

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years). ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years). ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes.

Criteria	Definition
	iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short-term future (within approximately 20 years). ii. modification throughout its range is continuing such that in the short-term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short-term future (within approximately 20 years). ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes. iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few

Criteria	Definition
	locations. C. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority Ecological Communities	
Priority One	**Poorly known ecological communities** Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	**Poorly known ecological communities** Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three	**Poorly known ecological communities** i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or. ii. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or. iii. Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities, but do not meet adequacy of survey requirements and / or are not well defined, and known threatening processes exist that could affect them.
Priority Four	**Ecological communities that are adequately known, rare but not Threatened or meet criteria for Near Threatened, or that have been recently removed from the Threatened list**. These communities require regular monitoring. i. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently Threatened or in need of special protection, but could be if present circumstances change These communities are usually represented on conservation lands. ii. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii. Ecological communities that have been removed from the list of Threatened communities during the past five years.

Criteria	Definition
Priority Five	**Conservation Dependent Ecological Communities** Ecological Communities that are not Threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming Threatened within five years.

Appendix C
Mattiske (2021) Detailed Flora and Vegetation Survey for Huntly Mine – Myara North

Appendix 6 - Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine – Myara North (GHD, 2021)

Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine - Myara North

Pinjarra Alumina Refinery Revised Proposal

Alcoa of Australia Limited

August 2021

→ The Power of Commitment

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Executive summary

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery by 5 per cent from 5 million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite Mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel Region of Western Australia (WA), approximately 100 km south-east of Perth

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

This Terrestrial Vertebrate Fauna Survey and Black Cockatoo Habitat Assessment (the Survey) has been prepared to support the EPA assessment of the Proposal and addresses the Myara North mine region of the Proposal.

Survey Area

The Survey Area comprises the Myara North Development Envelope (DE) and adjacent conveyor and haul road corridors. The Survey Area lies in Jarrahdale State Forest and is bordered by Jarrahdale town and Serpentine National Park to the west, Monadnocks Conservation Park to the east, and the existing Myara mine region to the south. The Survey Area covers approximately 18,000 hectares (ha).

The Survey included a desktop assessment, a consolidation of previous fauna studies, and a detailed and targeted vertebrate fauna survey undertaken in the Myara North region in winter (June/July) and spring (November) of 2020. The Survey included a Black Cockatoo habitat assessment in accordance with Commonwealth guidance and a targeted assessment of Carter's Freshwater Mussel.

Survey Results

The Survey Area consists of eight broad fauna habitat types: Bullich forest, Granite outcrop, Blackbutt forest, Flooded Gum woodland, Jarrah -Marri forest, Melaleuca dampland. Mine rehabilitation and Pine plantation. Jarrah-Marri forest predominated at 83% of the Survey Area. A small portion of the Survey Area comprises rural cleared land.

The conservation value of each fauna habitat type is specific to the locally occurring conservation significant fauna species and the type of usage by those species. All three Black Cockatoos were recorded primarily throughout the Marri-Jarrah forest, however all habitat types will be utilised for foraging by either one or all of the species. Melaleuca Damplands and riparian areas comprising Bullich Forest, Blackbutt Forest and Marri-Jarrah Forest support a Quokka population with records scattered throughout the Survey Area. Chuditch are wide ranging and expected to use all habitat types at a relatively low density.

In total 13 conservation significant species were recorded in the Survey Area including the Quokka, Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Forest Red-tailed Black Cockatoo, Baudin's Cockatoo, Carnaby's Cockatoo, Western False Pipistrelle, Southern Death Adder, Quenda, Rakali, Masked Owl and Peregrine Falcon. All species identified are likely to have significant populations and habitat present within the Survey Area. With regard to migratory shorebirds, the Survey Area lacks open water bodies that feature shallow shorelines for foraging habitat. The creek lines and vegetated dampland areas within the Survey Area are not suitable for migratory shorebirds.

Carter's Freshwater Mussel was targeted during the survey but no presence was recorded. The species is known to reside in the Serpentine Dam on the southern edge of the Survey Area and while mussels may disperse upstream from the Dam during winter/spring flows, all streams are seasonal and any dispersing mussels are unlikely to survive the extended dry summer period. Therefore, significant populations are unlikely in the Survey Area.

The DBCA NatureMap search identified 185 vertebrate fauna taxa previously recorded within 20 km radius of the Survey Area. This total included 28 mammals, 113 birds, 32 reptiles and 12 amphibians.

The detailed and targeted program recorded 132 vertebrate fauna species utilising the Survey Area, including 23 mammals, 76 birds, 26 reptiles and seven amphibians. Of these, eight introduced species (mammals and birds) were identified.

Fire was observed to cause substantial impact to fauna habitats of the Survey Areas. Large areas of the Survey Area had been burnt within the last 2 to 3 years impacting fauna habitat. During the Survey the north west portion of the Survey Area was prescribed burned in October 2020.

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Appendices

Appendix A Map figures
Appendix B Relevant legislation, background information and conservation codes
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Acronyms

DE	Development Envelope
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter Breast Height
DAWE	The Department of Agriculture Water and Energy
DEE	Department of the Environment and Energy
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DSEWHA	Department of Environment, Water, Heritage and the Arts (Canberra)
EMRC	Environmental Management and Research Consultants
EPA	Environmental Protection Authority
EPBC	Environment Protection Biodiversity Conservation
EP	Environmental Protection
ERD	Environmental Review Document
ESD	Environmental Scoping Document
FRTBC	Forest Red-tail Black Cockatoo
GoWA	Government of Western Australia
IBSA	Index of Biodiversity Surveys for Assessments
LOO	Likelihood of Occurrence
LTFMP	Long Term Fauna Monitoring Program
MNES	Matters of National Environmental Significance
PMST	Protected Matters Search Tool
SM	Song Meter
SOP	Standard Operating Procedure
SRE	Short-Range Endemic

1. Introduction

1.1 Project background

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery by 5 per cent from 5 million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite Mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel Region of Western Australia (WA), approximately 100 km south-east of Perth

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

This Terrestrial Vertebrate Fauna Survey and Black Cockatoo Habitat Assessment (the Survey) has been prepared to support the EPA assessment of the Proposal and addresses the Myara North region of the Proposal. Separate reports address the Holyoake region, Pinjarra Refinery, Short-Range Endemic (SRE) invertebrate fauna, aquatic fauna, and subterranean fauna.

1.2 Purpose and scope of this report

The purpose of the surveys was to support the environmental assessment of the Project under Part IV of the *Environmental Protection Act 1986* (EP Act) and under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Specifically, the survey was to identify ecological values to support environment impact assessment of the Project against the EPA's Terrestrial Fauna factor and on MNES, including threatened and migratory fauna. The surveys will inform mine planning to avoid and minimise impacts to conservation values, enable quantification of impacts, and inform mine management arrangements.

This Survey report has been prepared in accordance with the Environmental Scoping Document (ESD) prepared for the Proposal under Part IV of the EP Act. The Survey has been undertaken in accordance with EPA (2020) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* and relevant Commonwealth guidance on surveys for relevant threatened and migratory species.

This Survey report details the results of desktop assessment, a consolidation of previous fauna studies, and the findings of a detailed and targeted vertebrate fauna surveys undertaken in the Myara North region in winter (June/July) and spring (November) of 2020. The Survey includes a black cockatoo habitat assessment in accordance with Commonwealth guidance.

1.3 Survey Area

The Survey Area comprises the Myara North Development Envelope (DE) and adjacent conveyor and haul road corridors, as presented in Figure 1, Appendix A. The Survey Area lies in Jarrahdale State Forest and is bordered by Jarrahdale town and Serpentine National Park to the west, Monadnocks Conservation Park to the east, and the existing Myara mine region to the south. The Survey Area covers approximately 18,000 ha (refer Figure 1, Appendix A).

The Study Area comprises the Survey Area with a 10 km buffer and defines the limits of desktop database searches as described in Section 2.2.

1.4 Scope of works

The scope of works was to:

– Complete a comprehensive desktop assessment comprising terrestrial vertebrate fauna database search for the Study Area to determine the presence, or likely presence, of conservation significant vertebrate fauna species
– Review relevant literature relating to terrestrial vertebrate fauna within Alcoa's ML1SA mineral lease, with particular focus on conservation significant fauna

– Undertake a two-season detailed and targeted (Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo, Baudin's Cockatoo, Chuditch, Quokka, and other priority species) vertebrate fauna survey within the Survey Area
– Provide a technical report (this document) detailing the results and findings of the survey
– Submit fauna survey data to the Index of Biodiversity Surveys for Assessments (IBSA) in accordance with Statutory requirements.
– Though not a vertebrate species, a targeted survey was undertaken for the threatened aquatic invertebrate Carters Freshwater Mussel as part of the field survey program. The targeted survey was undertaken further to the findings of a desktop aquatic fauna assessment (WRM 2021) which identified the potential presence of the species in the Survey Area.

1.5 Limitations and assumptions

This report: has been prepared by GHD for Alcoa of Australia Limited and may only be used and relied on by Alcoa of Australia Limited for the purpose agreed between GHD and Alcoa of Australia Limited as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Alcoa of Australia Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. The opinions, conclusions and recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Alcoa of Australia Limited and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.6 Project terminology and definitions

Some common project terminology are described below in Table 1.

Table 1 Project terminology and definitions

Term (Abbreviation)	Definition/Use
Alcoa of Australia Limited (Alcoa)	Proponent of the Project and client of GHD for this Project.
GHD Pty Ltd (GHD)	Consultant engaged by Alcoa to prepare environmental approvals documentation and supporting technical studies for the Proposal.
Mining region	Sub-regions that comprise the Huntly Mine, including current (Myara), past (Del Park, Huntly 1 & 2, White, McCoy and O'Neil) and future (Myara North, Holyoake), etc.
Survey Area	Myara North Development Envelope and associated infrastructure corridor.
Study Area	The Survey Area with a 10 km buffer used to define the limits of desktop database searches.
Haul Road	Truck and mine infrastructure access road linking into existing corridors.
Conveyor Corridor	New conveyor through the Myara region connecting to the Myara North Development Envelope.
Detailed fauna survey	As per EPA 2020 describing the type of survey required, replaces wording from EPA 2016 for Level 2 assessment.
Targeted fauna survey	As per EPA 2020 describing the type of survey required, refers to undertaking targeted assessments for specific fauna species.

2. Methodology

2.1 Relevant legislation, conservation codes and background information

In WA some ecological communities, flora and fauna are protected under both Australian Government and State Government legislation. In addition, regulatory authorities provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to the Survey is provided in Appendix B.

2.2 Desktop assessment

The desktop assessment comprises a review of various databases and literature sources (listed below) related to the environmental and ecological nature of the Survey Area.

The desktop assessment included a review of:

– The Department of Agriculture Water and Energy (DAWE), formerly Department of the Environment and Energy (DEE) Protected Matters Search Tool (PMST) to identify communities and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within the Study Area (DAWE 2020) (Appendix C).
– The DBCA *NatureMap* database for fauna species previously recorded within the Study Area (DBCA 2007–) (Appendix C).
– Existing datasets including previous broad-scale vegetation mapping of the Survey Area, aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with the potential to contain Threatened and Priority fauna species.
– Literature provided by Alcoa and relating to fauna recorded in Alcoa's ML1SA mining lease within the Northern Jarrah Forest, (refer Table 19).

Due to the varying complexity of the reviewed data, various search extents were used to best display the targeted information. The extent used on each database as well as the literature review is displayed in Table 2.

Table 2 Extent of data searches

Component	Extent	Rationale
Regional biogeography	Region	This is a regional characterisation.
Climate	Karnet	Closest reliable weather station
Geology	Study Area	Broad classification with low number of outputs in Study Area
Land systems	Study Area	Broad classification with low number of outputs in Study Area
Surface water and hydrology	Study Area	Considered important to include surface water sources in proximity to the survey are which may be used by fauna as a drinking water supply and which may impact habitat type and availability.
Conservation reserves	Study Area	To consider protected land in and in proximity to the Survey Area.
DBCA Managed Lands	Study Area	To consider protected land in and in proximity to the Survey Area.
Environmentally Sensitive Areas	Study Area	To consider protected land in and in proximity to the Survey Area.
Regional Ecological Linkages	Study Area	To consider protected land in and in proximity to the Survey Area.
Broad vegetation mapping	Survey Area	Fairly detailed and complex data
Fauna species databases	Study Area	Search area extended due to motile nature of some fauna
Literature review	Region	Much of the literature was from Alcoa's Huntly Mine sites and surrounding forest to the south of the current Survey Area. Available literature was reviewed if applicable to terrestrial fauna.

2.3 Field survey

2.3.1 Survey details and timing

Field surveys were performed between 25 June and 13 November 2020 and consisted of five site visits from one to eleven days in duration. Most of the survey timing falls within the recommended survey timing for the southern climatic region for all species groups (EPA 2020). However, the first phase was undertaken in winter 2020 outside of the recommended period. This was undertaken to fulfil the survey schedule and the ability to maximise reptile detection via hand searches during seasonally low activity periods. It is unlikely that this survey timing adversely influenced the potential detection of mammal, bird or amphibian via the captures and recording methods used as these fauna groups remain active throughout the year and are detectable during winter. Survey timing and personnel are represented in Table 3.

Table 3 Myara North survey details and timing

Field Trip	Dates	Task	Duration	Zoologist/Ecologist	Years of experience of field personnel
1	25 June 2020	Reconnaissance, camera and bat detector deployment	1 day	Principal Zoologist	20
				Senior Zoologist	20
2	29 June - 9 July 2020	Phase 1 Survey: Detailed and Targeted fauna surveys (including trapping) within the Survey Area, identification and mapping of potential Black Cockatoo breeding trees and selected large hollows.	11 days	Senior Zoologist	20
				Senior Zoologist	20
				Zoologist	5
				Ecologist	10
				Ecologist	3
				Graduate Ecologist	2
				Graduate Ecologist	2
				Hydrologist (field hand)	2
3	24 June, 16, 20-21, 27 July, 23 August 2020	Assessment of black cockatoo trees and habitat identified in Myara North	6 days	Black cockatoo specialist	20
4	7 September -16 September 2020	Collection of cameras deployed during Phase 1 survey	7 days	Zoologist	5
				Graduate Ecologist	2
	28-29 October, 11 November 2020	Assessment of black cockatoo trees and habitat identified in proposed Myara North facilities location	3 days	Black cockatoo specialist	20
5	3 November – 13 November 2020 (excluding weekend due to car rally)	Phase 2 Survey: Detailed and Targeted fauna surveys (including trapping) within the Survey Area, Carters Freshwater Mussel assessment, Quokka assessment, Chuditch assessment, Black Cockatoo assessment.	10 days	Principal Zoologist	20
				Senior Zoologist	20
				Senior Zoologist	20
				Zoologist	5
				Graduate Ecologist	2
				Graduate Ecologist	2
6	22 December 2020	Collection of cameras deployed in Phase 2 survey.	2 days	Senior Zoologist	20
				Zoologist	5
				Ecologist	3
				Graduate Ecologist	2

2.3.2 Guiding documents

The Survey methodology and data collection employed was scoped according to EPA *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* (EPA 2016a) and *Technical Guidance –Terrestrial Fauna Surveys* (EPA 2016b). However, during mobilisation of the Survey the updated *Technical Guidance –Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) was released. Where practicable the EPA (2020) guidance was followed.

The following Commonwealth survey guidance was adopted where relevant:

– EPBC Act Referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2012a).
– Survey guidelines for Australia's threatened birds (Commonwealth Department of the Environment, Water, Heritage and the Arts 2010).
– Survey guidelines for Australia's threatened mammals (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2011).
– Survey guidelines for Australia's threatened reptiles (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2011).

2.3.3 Permits and ethics

A Section 40 Authorisation to Take or disturb threatened Fauna (Licence Number: 2020-0075), and a Regulation 27 (Licence No. BA27000269) to take Fauna for biological assessment was obtained from DBCA prior to undertaking the fauna surveys. The fauna survey (specifically trapping and animal handling) was undertaken in accordance with Standard Operating Procedures (SOPs) which were required to be followed under the conditions of GHD's fauna trapping permit. At the time of survey, compliance with these SOPs was accepted by DBCA as evidence of ethical treatment of animals.

2.3.4 Habitat assessment

The Survey Area was assessed for fauna habitat type based on floristic species, structural complexity, connectivity, hydrology, disturbance, type and extent of resource availability and value for fauna. Specifically, the assessment included:

– Habitat structure (e.g. vegetation type, presence/absence of overstorey, midstorey, understorey, and ground cover).
– Description of geomorphology, topography and substrate where applicable.
– Presence/absence of refuge including: fallen timber (coarse woody debris), hollow-bearing trees and stags and rocks/breakaways, and the type and extent of each refuge.
– Location of the habitat within the Survey Area in comparison to the habitat within the surrounding landscape.
– Habitat connectivity of refugia i.e. low dense vegetation associated with drainage lines and damplands within the Jarrah Forest, and identification of wildlife corridors for habitat specialist fauna, namely Quokka and Quenda within and immediately adjacent to the Survey Area.
– Identification and evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance.
– Evaluation of the likelihood of occurrence of conservation significant fauna within the environments present (based on presence of suitable habitats and species recorded)
– A representative photograph of each habitat type to complement description of habitat characteristics.

Habitat types have been delineated to align with Mattiske (2021) vegetation community types. That is, each habitat type represents one or more vegetation types. Refer to section 4.1.

2.3.5 Fauna identification and nomenclature

Identification of fauna species was made in the field using available field guides and electronic guides (Table 4). Where identification was not possible, photographs of specimens were collected to be later identified.

Table 4 Fauna references

Fauna group	Field guide
Mammals	Menkhorst and Knight (2010), Van Dyck and Strahan (2008)
Bats	Churchill (2008), Menkhorst and Knight (2010)
Birds	Morcombe (2004)
Reptiles	Wilson and Swan (2017), Storr *et al*. (1999), Storr *et. al*. (2002)
Amphibians	Tyler and Doughty (2009)

Nomenclature

Nomenclature used in this report follows that used by the WA Museum as reported on *NatureMap*. This nomenclature is deemed the most up-to-date species information for WA fauna, with the exception of birds, which follows Christidis and Boles (2008).

2.3.6 Trapping program

The same sampling techniques and trap layouts were used during both phases of the Survey and involved a series of standardised systematic trapping quadrat sites comprising pit-fall traps, Elliott box traps, cage traps and funnel traps. Details of each trap type used are provided below. During both phases, a total of twelve quadrats were established across the Survey Area and each quadrat was systematically surveyed (trapped) for seven to eight nights. Trap quadrat details are presented in Table 15 and locations shown in Figure 3,Appendix A.

The trap quadrats were selected to sample across the major habitat types occurring within the Survey Area. Traps sites were established during the first phase of trapping and closed upon survey completion, before being reopened during the second phase of trapping and removed upon survey completion. During Phase 2 of the survey, traps were closed for three nights after four nights of being opened, and then reopened again for a further four nights (see section 2.3.11). Initial design focused on undertaking a detailed assessment (EPA 2020) however through refinement, it developed into a targeted focused survey for conservation significant species identified in the Likelihood of Occurrence assessment (section 3.6.2) as discussed below.

Potential SRE fauna bycatch was collected throughout the Phase 2 survey and provided to Phoenix Environmental for identification and assessment of SRE fauna (Phoenix 2021). Specimens collected were only those from SRE candidate groups such as isopods, mygalomorphs, scorpions, millipedes, and planarians.

Pit-trap with drift fence

Seven (7) pit-traps were established at each quadrat within the Survey Area. Pit-traps comprised of 20 litre (L) plastic buckets (30 cm diameter, 40 cm deep) at each quadrat. A 50 m long flywire drift fence (30 cm high) bisected the pits; directing fauna into them. Pits were spaced at seven metre intervals along the fence. Soil and an egg carton were placed within each pit to provide shade and protection for captured animals.

Species targeted through this method were the Dell's Skink (*Ctenotus delli*) and Southern Death Adder (*Acanthophis antarcticus*). There are no specific guidelines on the assessment of these reptiles specifically in Western Australia, however detection methods were derived from DSEWPaC (2011a).

Funnel traps

Twelve (12) funnel traps were used along the drift fence at each quadrat. Traps were placed such that animals were directed into them from the drift fence in between the pit traps. Funnel traps were covered with insulating materials to minimise heat or cold exposure to animals.

Species targeted through this method were the Dell's Skink and Southern Death Adder. There are no specific guidelines on the assessment of these reptiles specifically in Western Australia, however detection methods derived from DSEWPaC (2011a).

Elliot box traps

One line of ten (10) Elliot ® box traps was established at each quadrat and positioned approximately 50 m away (and parallel to) the drift fence. Traps were placed approximately ten metres apart and baited with universal bait (a mixture of peanut butter, rolled oats and sardines). Elliott traps were located within shady areas or covered with vegetation to minimise exposure to captured animals. Where practicable Elliot traps were placed (strapped) in trees and onto logs to increase the likelihood of arboreal mammal captures.

Species targeted through this method include Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*). The techniques utilised for this species were derived from Orell (2004), Scida and Gration (2017) and DSEWPaC (2011b).

Cage traps

Two (2) cage traps (with approximate dimensions 26 by 23 by 66 cm) were located at each quadrat site. These traps were placed at each end of the line of Elliot traps approximately 100 m apart. Cage traps were baited with universal bait and chicken wings.

Species targeted through this method include Brush-tailed Phascogale, Chuditch (*Dasyurus geoffroii*) and Quenda (*Isoodon fusciventer*). Specific survey guidelines exist for the Chuditch and this technique derived from DSEWPaC (2011b). Brush-tailed Phascogale and Quenda are also trapped via cage traps (Orell 2004).

Targeted cage trap lines

Cage traps (with approximate dimensions 26 by 23 by 66 cm) were deployed for a minimum of seven nights along five transects during both survey phases to target Brush-tailed Phascogale, Chuditch and Quenda. Each transect consisted of ten cage traps. These cages were baited with chicken wings as per recommendations from Alcoa (McGregor *et al*. 2014). For each trap deployed, the time and date deployed and recovered, as well as the GPS coordinates were recorded (see Table 5). Cage trap locations are presented in Figure 3, Appendix A.

Captured Chuditch were to be capture-marked-released to assess population size. Upon capture, gender, reproductive stage and health index would be recorded. Health index was rated on a scale from 1 to 3 after feeling the base of the Chuditch tail where a scale of 1 meant that bones could be felt and the Chuditch may be in poor health, and a scale of 3 meant that tail vertebrates could not be felt due to a layer of fat and the Chuditch was considered in excellent health. Photographs would then be taken of the Chuditch's head and back, one spot on the back would then be coloured with permanent marker before a second dorsal photograph was recorded and the Chuditch was released in a suitable hollow or burrow.

Cages would be closed if females carrying pouch young were recaptured, or any Chuditch was re-captured three consecutive nights in a row.

Table 5 Targeted Chuditch cage trap lines summary

Transect Number	Site name I.D	Habitat type	Location		Nights deployed	
			Easting	Northing	Phase 1	Phase 2
Transect 1	Cage trap 1	Jarrah Marri forest	419221	6422973	7 nights per cage trap	7 nights per cage trap
	Cage trap 2		419394	6422892		
	Cage trap 3		419514	6422675		
	Cage trap 4		419509	6422420		
	Cage trap 5		419565	6422228		
	Cage trap 6		419650	6422018		
	Cage trap 7		419761	6421852		
	Cage trap 8		419942	6421709		
	Cage trap 9		420119	6421576		
	Cage trap 10		420454	6421525		
Transect 2	Cage trap 11	Blackbutt forest	421648	6419061	7 nights per cage trap	7 nights per cage trap
	Cage trap 12		421627	6418960		
	Cage trap 13		421566	6418876		
	Cage trap 14		421507	6418709		
	Cage trap 15		421512	6418688		
	Cage trap 16		421542	6418576		
	Cage trap 17		421588	6418460		
	Cage trap 18		421554	6418336		
	Cage trap 19		421622	6418278		
	Cage trap 20		421670	6418167		
Transect 3	Cage trap 21	Jarrah Marri forest	428918	6412191	7 nights per cage trap	7 nights per cage trap
	Cage trap 22		429050	6412366		
	Cage trap 23		429269	6412380		
	Cage trap 24		429411	6412288		
	Cage trap 25		429604	6412250		
	Cage trap 26		429777	6412335		
	Cage trap 27		429896	6412492		
	Cage trap 28		430073	6412581		
	Cage trap 29		430240	6412663		
	Cage trap 30		430324	6412836		
Transect 4	Cage trap 31	Jarrah Marri forest	426343	6421760	7 nights per cage trap	7 nights per cage trap
	Cage trap 32		426311	6421557		
	Cage trap 33		426318	6421336		
	Cage trap 34		426370	6421155		
	Cage trap 35		426408	6420976		
	Cage trap 36		426292	6420861		
	Cage trap 37		426092	6420769		
	Cage trap 38		425938	6420749		
	Cage trap 39		425737	6420688		

Transect Number	Site name I.D	Habitat type	Location		Nights deployed	
			Easting	Northing	Phase 1	Phase 2
	Cage trap 40		425617	6420560		
Transect 5	Cage trap 41	Bullich and Blackbutt forest (for phase 2 this site was moved slightly due to a prescribed burn scar) to Jarrah Marri forest	418126	6419947	7 nights per cage trap	7 nights per cage trap
	Cage trap 42		418053	6420152		
	Cage trap 43		418040	6420333		
	Cage trap 44		418048	6420531		
	Cage trap 45		418030	6420734		
	Cage trap 46		417907	6420899		
	Cage trap 47		417881	6421081		
	Cage trap 48		417737	6421205		
	Cage trap 49		417716	6421245		
	Cage trap 50		417657	6421297		
Total of each Phase					**350**	**350**
Combined Total Effort					**700**	

Avifauna

Avifauna surveys were undertaken at each of the quadrat sites and opportunistically for a combined total of 2340 minutes. Avifauna surveys were undertaken at each of the quadrat sites. Each survey comprised of a 20 minute census of birds within an unbounded 2 ha area, which is the standard method used by Birds Australia for the Bird Atlas project. Birds detected visually (using binoculars) and/or aurally over a 20 minute period were recorded. Numbers of each species observed were also recorded.

All systematic bird surveys were undertaken either within four hours of dawn or two hours of dusk, as these are the times of day when birds are most active. In addition to systematic surveys, observations of birds were also made opportunistically throughout the survey activities. These are not part of the systematic quadrat surveys but add a significant proportion of the bird species observed.

Avifauna survey effort is displayed in Table 6.

Table 6 Avifauna survey effort

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Phase 1				
TL1	419173	6422951	Jarrah Marri forest	90
TL2	421559	6418605	Blackbutt forest	90
TL3	424227	6416681	Melaleuca dampland	90
TL4	426987	6413519	Jarrah Marri forest	90
TL5	427900	6412972	Granite outcrop Assoc.	90
TL6	427604	6410609	Flooded Gum woodland	90
TL7	428302	6417251	Jarrah Marri forest	90
TL8	426279	6422853	Jarrah Marri forest	90
TL9	424253	6425012	Jarrah Marri forest	90
TL10	424816	6421905	Jarrah Marri forest	90
TL11	420735	6417238	Granite outcrop	90
TL12	413197	6421772	Jarrah Marri forest	90

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Opportunistic	415684	6414906	Not recorded	30
Opportunistic	414570	6418045	Not recorded	30
Opportunistic	429971	6410176	Not recorded	30
Opportunistic	414320	6420879	Not recorded	30
Opportunistic	418523	6417302	Not recorded	30
Opportunistic	416068	6422764	Not recorded	30
Phase 1 Total				**1,260**
Phase 2				
TL1	419173	6422951	Jarrah Marri forest (recently burnt)	90
TL2	421559	6418605	Blackbutt forest	90
TL3	424227	6416681	Melaleuca dampland	90
TL4	426987	6413519	Jarrah Marri forest	90
TL5	427900	6412972	Granite outcrop Assoc.	90
TL6	427604	6410609	Flooded Gum woodland	90
TL7	428302	6417251	Jarrah Marri forest	90
TL8	426279	6422853	Jarrah Marri forest	90
TL9	424253	6425012	Jarrah Marri forest	90
TL10	424816	6421905	Jarrah Marri forest	90
TL11	420735	6417238	Granite outcrop Assoc.	90
TL12	413197	6421772	Jarrah Marri forest	90
Phase 2 Total				**1,080**
Phase 1 and Phase 2 Combined Total				**2,340**

Camera traps

Thirty-three remote cameras (Reconyx-Hyperfire ® and Reconyx-Pro ®) were deployed during Phase 1 for a total of 2,375 trap nights, and 20 remote cameras were deployed for 547 trap nights during Phase 2. In total 2,922 nights were undertaken. The duration of trap nights for each camera ranged from 21 to 89 trap nights. Remote cameras were deployed to target the conservation significant Chuditch (VU), Quokka (*Setonix brachyurus*, VU), Quenda (P4), Rakali (*Hydromys chrysogaster*, P4), Western Brush Wallaby (*Macropus irma*, P4), Brush-tailed Phascogale (CD) and general fauna (birds, reptiles and mammals). This was done by positioning cameras within the core habitat of targeted species, i.e. for Quokka, creek lines and damplands were investigated and cameras placed low in dense vegetation (within runnels if present). Conversely in upland habitat, Chuditch were targeted by utilising logs and hollows to position cameras. To target Brush-tailed Phascogale, cameras were set up similar to that described in Scida and Gration (2017). Cameras were baited with universal animal bait (a combination of peanut butter, oats and sardines) to attract fauna species within the Survey Area. For each camera location the number of nights deployed, and the GPS coordinates were recorded (Table 7). Cameras were used in this instant to supplement other trapping techniques and sample for more cryptic species such as the Quokka. The use of cameras also reduces the invasive impacts of trapping on species (DEC 2011).

Camera setup included fast trigger speed (faster than 0.5 sec) and colour photographs during the day and monochrome at night. The highest mega pixel possible, frames per second (>1) with capture set to three pictures per trigger with a one second delay.

Data from the cameras were downloaded to a computer and manually analysed for the presence of fauna following the field survey.

Species targeted through this method include Chuditch, Quokka, Quenda, Rakali, Western Brush Wallaby and Brush-tailed Phascogale.

Table 7 Camera trap locations

Camera Number	Habitat Type	Location		Deployed		Trap Nights Deployed
		Easting	Northing	Set	Collected	
Phase 1						
CAM 1	Jarrah Marri Forest	418864	6418040	6/07/2020	9/09/2020	65
CAM 4	Melaleuca dampland	416403	6416995	7/07/2020	9/09/2020	64
CAM 5	Jarrah Marri Forest	414533	6418380	7/07/2020	8/09/2020	64
CAM 6	Blackbutt forest	421796	6420180	4/07/2020	11/09/2020	69
CAM 7	Jarrah Marri Forest	417930	6422313	24/06/2020	11/09/2020	79
CAM 8	Jarrah Marri Forest	422863	6419611	4/07/2020	11/09/2020	69
CAM 10	Blackbutt forest	421279	6420885	4/07/2020	11/09/2020	69
CAM 11	Jarrah Marri Forest	413643	6419215	7/07/2020	9/09/2020	64
CAM 12	Blackbutt forest	421719	6418205	24/06/2020	11/09/2020	79
CAM 13	Jarrah Marri Forest	425487	6419041	4/07/2020	11/09/2020	69
CAM 14	Jarrah Marri forest	412543	6421508	7/07/2020	9/09/2020	64
CAM 15	Jarrah Marri Forest	418879	6417211	6/07/2020	9/09/2020	65
CAM 15b	Bullich forest	417973	6420573	24/06/2020	11/09/2020	79
CAM 16	Jarrah Marri Forest	423744	6415834	24/06/2020	11/09/2020	79
CAM 27	Bullich forest	417762	6421235	24/06/2020	11/09/2020	79
CAM 18	Bullich forest	417972	6420590	24/06/2020	11/09/2020	79
CAM 19	Granite outcrop Assoc.	427821	6410903	24/06/2020	11/09/2020	79
CAM 20	Jarrah Marri Forest	423469	6421514	4/07/2020	11/09/2020	69
CAM 21	Jarrah Marri Forest	426592	6419221	4/07/2020	11/09/2020	69
CAM 23	Jarrah Marri Forest	423494	6420401	4/07/2020	11/09/2020	69
CAM 24	Jarrah Marri Forest	419237	6423010	24/06/2020	11/09/2020	79
CAM 25	Jarrah Marri Forest	423668	6418484	4/07/2020	11/09/2020	69
CAM 28	Jarrah Marri Forest	426306	6417290	24/06/2020	11/09/2020	79
CAM 29	Blackbutt forest	422981	6418491	4/07/2020	11/09/2020	69
CAM 31	Melaleuca dampland	424732	6423215	4/07/2020	11/09/2020	69
CAM 41	Jarrah Marri Forest	415169	6416938	7/07/2020	9/09/2020	64
CAM 43	Melaleuca dampland	415525	6419259	7/07/2020	9/09/2020	64
CAM 44	Jarrah Marri Forest	413126	6420315	7/07/2020	9/09/2020	64
CAM 1	Melaleuca dampland	424674	6423235	6/07/2020	9/09/2020	65
CAM 4	Bullich forest	417780	6421235	7/07/2020	9/09/2020	64
CAM 77	Blackbutt forest	420846	6407514	14/09/2020	11/12/2020	89
CAM 7	Jarrah Marri Forest (conveyor corridor)	419320	6404938	14/09/2020	11/12/2020	89
CAM 24	Jarrah Marri Forest (conveyor corridor)	423753	6411977	14/09/2020	11/12/2020	89
Phase 1 Total						**2,375**

Camera Number	Habitat Type	Location		Deployed		Trap Nights Deployed
		Easting	Northing	Set	Collected	
Phase 2						
CAM 19	Jarrah Marri Forest	422598	6417606	4/11/2020	2/12/2020	28
CAM 26	Melaleuca dampland	425849	6413871	4/11/2020	2/12/2020	28
CAM 31	Melaleuca dampland	429026	6413236	4/11/2020	2/12/2020	28
CAM 27	Jarrah Marri Forest	423076	6417283	4/11/2020	2/12/2020	28
CAM 13	Melaleuca dampland	424219	6416023	4/11/2020	2/12/2020	28
CAM 16	Jarrah Marri Forest	422187	6417758	4/11/2020	2/12/2020	28
CAM 25	Melaleuca dampland	413390	6421527	4/11/2020	2/12/2020	28
CAM 12	Melaleuca dampland	420665	6414911	4/11/2020	2/12/2020	28
CAM GHDa	Jarrah Marri Forest	421144	6415089	4/11/2020	2/12/2020	28
CAM 18	Jarrah Marri Forest	419843	6416674	4/11/2020	2/12/2020	28
CAM 1	Blackbutt forest	414557	6419520	4/11/2020	2/12/2020	28
CAM 11	Bullich forest	417382	6419424	3/11/2020	2/12/2020	29
CAM 44	Melaleuca dampland	415880	6417989	5/11/2020	2/12/2020	27
CAM 6	Jarrah Marri Forest	426620	6416720	5/11/2020	2/12/2020	27
CAM 28	Jarrah Marri Forest	426043	6415364	5/11/2020	2/12/2020	27
CAM 15B	Jarrah Marri Forest	427392	6415617	5/11/2020	2/12/2020	27
CAM 14	Jarrah Marri Forest	428306	6416019	5/11/2020	2/12/2020	27
CAM 115	Granite outcrop Assoc.	426358	6425914	5/11/2020	2/12/2020	27
CAM 166	Granite outcrop Assoc.	426466	6426032	5/11/2020	2/12/2020	27
CAM 10	Melaleuca dampland	422643	6422180	11/11/2020	2/12/2020	21
Phase 2 Total						**547**
Combined Phase 1 and 2 Total						**2,922**

Bat Surveys

Bat Detectors (SM2 and SM4 SongMeters ®) were deployed for a period of between two and six nights at each survey location during both survey phases. Bat detectors were positioned in areas where bats might be recorded, i.e., utilising water bodies, fly ways, hill tops or open areas associated with damplands or granite outcrops. Bat detectors were set to record from 30 minutes pre-dusk to 30 minutes post-dawn. Detectors were set to record full spectrum and assessed using Kaleidoscope Pro (Wildlife Acoustics) and Anabat Insight (Titley Electronics). For each detector, the time and date deployed and recovered, and the GPS coordinates were recorded (Table 8). Bat detector locations are presented in Figure 3, Appendix A.

Data from the bat detectors were downloaded to a computer and analysed by Craig Grabham, GHD Principal Ecologist, for the presence of bats following the field survey.

Species targeted through this method include the Western False Pipistrelle (*Falsistrellus mackenziei*) with guidance on survey design from DSEWHA (2010) and Burgar *et al* (2017).

Table 8 Bat detector locations

Bat detector	Habitat type	Location		Deployed		Nights deployed
		Easting	Northing	Set	Collected	
Phase 1						
SM4-1	Jarrah Marri Forest	426282	6417199	24/06/2020	30/06/2020	6
SM4-1	Granite outcrop Assoc.	427915	6412940	30/06/2020	2/07/2020	2
SM4-1	Jarrah Marri Forest	425818	6421856	2/07/2020	4/07/2020	2
SM4-4	Jarrah Marri Forest	417931	6422315	24/06/2020	30/06/2020	6
SM4-4	Jarrah Marri Forest	425197	6414173	30/06/2020	2/07/2020	2
SM4-4	Jarrah Marri Forest	421309	6416290	3/07/2020	6/07/2020	3
SM4-5	Jarrah Marri Forest	419249	6423008	24/06/2020	29/06/2020	5
SM4-5	Blackbutt forest	421589	6418754	29/06/2020	2/07/2020	3
SM4-5	Granite outcrop Assoc.	427860	6411147	2/07/2020	6/07/2020	4
SM2-3	Bullich forest	417973	6420593	24/06/2020	30/06/2020	6
SM2-3	Melaleuca dampland	424270	6416696	30/06/2020	2/07/2020	2
Total Phase 1						**41**
Phase 2						
SM4-4	Granite outcrop Assoc.	415676	6414950	3/11/2020	5/11/2020	2
SM4-1	Granite outcrop Assoc.	420798	6417251	3/11/2020	6/11/2020	3
SM4-4	Jarrah Marri Forest	420771	6417263	3/11/2020	6/11/2020	3
SM4-1	Jarrah Marri Forest	426302	6422178	6/11/2020	9/11/2020	3
SM4-2	Jarrah Marri Forest	425097	6426021	6/11/2020	9/11/2020	3
SM2-3	Jarrah Marri Forest	423254	6417433	6/11/2020	9/11/2020	3
SM4-4	Blackbutt forest	421492	6418891	6/11/2020	9/11/2020	3
SM4 -1	Melaleuca dampland	422176	6420640	9/11/2020	11/11/2020	2
Total Phase 2						**22**
Combined Phase 1 and 2 Total						**63**

Nocturnal Bird Acoustics and Bird Census

Song Meter SM4 (Wildlife Acoustics) acoustic recorders were deployed at 13 sites throughout the Survey Area and recorded a combined total of 47 nights during both survey phases. Acoustics were positioned in areas where birds might be recorded, i.e. utilising water bodies, flyways and specifically targeted the Masked Owl (*Tyto novaehollandiae*). For each acoustic recorder site, the number of nights deployed, and the GPS coordinates were recorded (see Table 9). Acoustic recorder's locations are depicted in Figure 3, Appendix A.

Data from the acoustic recorders were downloaded to a computer and analysed for the presence of birds following the field survey. Data from the acoustic recorders was assessed by Nigel Jackett (Bird Specialist) for the presence of bird species. The methods of his assessment and results are provided in detail in Appendix D.

Table 9 Bird acoustics recorder locations

Bird Acoustics recorder site name	Habitat type	Location		Deployed		Nights deployed
		Easting	Northing	Set	Collected	
Phase 1						
SM4-AC1	Blackbutt forest	417220	6419709	4/07/2020	9/07/2020	5
SM4-AC1	Blackbutt forest	424795	6421966	1/07/2020	4/07/2020	3
SM4-AC2	Granite outcrop Assoc.	420722	6417160	4/07/2020	6/07/2020	2
SM4-AC2	Jarrah Marri forest	415306	6415314	7/07/2020	9/07/2020	2
SM4-AC3	Jarrah Marri forest	414389	6420890	1/07/2020	9/07/2020	8
SM4-AC4	Jarrah Marri forest (adjacent clearing/farmland)	415635	6419757	1/07/2020	9/07/2020	8
Total Phase 1						**28**
Phase 2						
SM4-AC3	Jarrah Marri forest	421995	6417174	3/11/2020	6/11/2020	3
SM4-AC1	Bullich forest	417415	6419370	3/11/2020	5/11/2020	2
SM4-AC2	Jarrah Marri forest	415679	6414947	3/11/2020	5/11/2020	2
SM4-AC2	Jarrah Marri forest (adjacent clearing/farmland)	424811	6426489	6/11/2020	9/11/2020	3
SM4-AC3	Jarrah Marri forest	426584	6421732	6/11/2020	9/11/2020	3
SM4-AC4	Jarrah Marri forest	423237	6417434	6/11/2020	9/11/2020	3
SM4-AC1	Blackbutt forest	421492	6418887	6/11/2020	9/11/2020	3
Total Phase 2						**19**
Combined Phase 1 and 2 Total						**47**

Carter's Freshwater Mussel assessment

Carter's Freshwater Mussel (*Westralunio carteri*) assessments were conducted during the Phase 2 survey. The survey approach was based on a method used by Klunzinger *et al.* (2012) to study Carter's Freshwater Mussel populations in the lower Vasse River. This method is aimed at detecting individual presence. Due to the ephemeral nature of the water bodies within the Survey Area this method was based on the assumption of low density of individuals

Eleven locations were selected for assessment prior to the field survey based on potential direct impacts from clearing and crossing construction over stream zone areas. Potential survey locations focussed on streams likely to have water present in order to maximise detection to confirm presents/absence. For each survey location zoologists walked 100 m upstream and 200 m downstream assessing 10 (1 x 1 m) quadrats at regular 30 metre intervals. While traversing the stream zone opportunistic searching for mussels was also done between each quadrat. In situations where stream zones may have become inaccessible due to dense riparian vegetation, the maximum number of quadrats was surveyed along the accessible stream zone. The following was recorded:

– Any evidence of Carter's Freshwater Mussel including live mussels and dead shell remains within the water, as well as any shell evidence on banks
– Presence of water and if so, still or flowing, size of water body and depth if determinable
– Riparian vegetation, bank/bed condition including evidence of bank erosion, bed sediment deposition and disturbance (i.e. tramping by pigs, dumped material etc.)
– Riparian vegetation condition
– Evidence of riparian terrestrial fauna including Rakali middens, quokka tracks/runnels/scat etc.
– For standing water the following was recorded:

- Approximate depth, width and (for pools) length
- Substrate (rocky, sandy etc)
- Water quality (clear, turbid, sheen etc)
- Opportunistic observations for aquatic fauna (fish, crayfish, frogs etc).

In total eleven (11) Carters Freshwater Mussel transects were surveyed over the Survey Area. Locations of these transects are presented in Table 10. Greater details on the assessment can be found in Appendix D.

Table 10 Carter's Freshwater Mussel transect summary

Site Type	Location		Date completed	Number of quadrats
	Easting	Northing		
CFM 1	423948	6412155	11/11/2020	10
CFM 2	427574	6410425	4/11/2020	9
CFM 3	425341	6413891	11/11/2020	10
CFM 4	424312	6416058	5/11/2020	10
CFM 5	425273	6419128	5/11/2020	10
CFM 6	421589	6418319	5/11/2020	10
CFM 7	416100	6417674	5/11/2020	10
CFM 8	417932	6419996	3/11/202010	10
CFM 9	420847	6407516	11/11/2020	10
CFM 10	419321	6404937	11/11/2020	10
CFM 11	419791	6417772	4/11/2020	11

Rakali assessment

Due to similarity of habitat preference, Rakali habitat assessments were performed in conjunction with the Carter's Freshwater Mussel assessments. Each Carter's Freshwater Mussel transect (ten 1 x 1m quadrats over a 300 metre distance) was also searched for the presence of middens, tracks and scat as well as an overall assessment of habitat quality (permanent water, presence of food species, refuge habitat, fire history etc.). In addition to those mentioned above, an additional three locations were actively searched for the presence of Rakali. The locations of these active searches are presented in Table 11.

Remote cameras were also set to target Rakali in areas considered potentially suitable to support their presence such as alongside streams and creeks. Remote cameras are considered unreliable to capture Rakali (due to cool temperatures a wet Rakali maintains). However, cameras placed slightly away from water with sufficient bait to keep the species present longer also yield results (GHD *pers comm*. Cockatoo Island Fauna Surveys). Remote camera locations are presented in Table 7 and Figure 3,Appendix A. Greater details on the assessment can be found in Appendix D.

Table 11 Additional Rakali active search summary

Site name	Location		Date completed	Survey effort (minutes)
	Easting	Northing		
R1	423948	6412155	11/11/2020	30
R2	427574	6410425	4/11/2020	30
R3	425341	6413891	11/11/2020	30
R4	424312	6416058	5/11/2020	30
R5	425273	6419128	5/11/2020	30
R6	421589	6418319	5/11/2020	30
R7	416100	6417674	5/11/2020	30
R8	417932	6419996	3/11/2020	30
R9	420847	6407516	11/11/2020	30
R10	419321	6404937	11/11/2020	30
R11	419791	6417772	4/11/2020	30
Additional searches	424220	6416019	4/11/2020	20
	425346	6413895	4/11/2020	20
	424902	6413431	5/11/2020	20
Total				390

Quokka Assessments

Quokka assessments were performed during the Phase 1 and 2 surveys (Table 12). Assessments were conducted by targeting potential Quokka habitat (primarily medium-long unburnt riparian vegetation with dense undergrowth and melaleuca dampland). Areas of potential Quokka habitat were searched for presence of runnels, tracks and scat as well as the extent of habitat and connectivity to surrounding potentially suitable habitat. Each identified habitat was searched (meandered) by two ecologists for approximately 60 minutes. This methodology (Quokka habitat assessment) was extracted from Bain (DEC 2013) and where habitat is considered suitable or quokka detected (due to evidence found) remote cameras were placed. In total approximately 31 hours of Quokka assessments were undertaken spread over 31 sites.

Targeted remote cameras were set during both survey phases at locations deemed to be suitable to support Quokkas to confirm their presence (see Table 6 and associated habitat type of Melaleuca damplands). Suitability of camera location was based on habitat characteristics. Habitat with relatively high density of shrubs associated with creeklines and / or Melaleuca damplands. As these habitats provide shelter and movement corridors under cover for Quokkas. Camera location were also selected in proximity to secondary Quokka evidence detected during Quokka assessments such as scats, runnels and footprints. Remote camera locations are presented in Table 7 and Figure 3, Appendix A.

Table 12 Quokka assessment summary

Site Type	Location		Date completed	Habitat type	Survey effort (minutes)
	Easting	Northing			
Quokka assessment	417780	6421235	24/6/2020	Bullich forest at creek	60
	423934	6412206	14/09/2020	Melaleuca dampland	60
	419322	6404957	14/09/2020	Melaleuca dampland	60
	420847	6407512	14/09/2020	Melaleuca dampland	60
	420884	6407494	14/09/2020	Melaleuca dampland	60
	418020	6420561	9/7/2020	Bullich forest	60
	427636	6410541	9/7/2020	Flooded Gum Woodland	60
	417973	6420573	24/6/2020	Bullich forest	60
	423744	6415834	24/6/2020	Bullich forest	60
	417972	6420590	24/6/2020	Bullich forest	60
	429043	6413217	4/11/2020	Melaleuca dampland	60
	425848	6413873	4/11/2020	Melaleuca dampland	60
	424220	6416021	4/11/2020	Melaleuca dampland	60
	420662	6414911	4/11/2020	Melaleuca dampland	60
	419747	6417722	4/11/2020	Jarrah Marri forest	60
	417388	6419420	4/11/2020	Bullich forest at creek	60
	414559	6419466	4/11/2020	Blackbutt forest at creek	60
	421923	6415255	4/11/2020	Melaleuca dampland	60
	421967	6417010	4/11/2020	Melaleuca dampland	60
	413396	6421535	4/11/2020	Melaleuca dampland	60
	423637	6418272	5/11/2020	Melaleuca dampland	60
	425397	6419091	5/11/2020	Jarrah Marri forest at creek	60
	428728	6414402	5/11/2020	Melaleuca dampland	60
	427394	6415618	5/11/2020	Jarrah Marri forest	60
	417343	6419328	5/11/2020	Melaleuca dampland	60
	424374	6416090	5/11/2020	Melaleuca dampland	60
	422647	6422250	5/11/2020	Bullich forest at creek	60
	419434	6405119	11/11/2020	Jarrah Marri forest at creek	60
	420860	6407493	11/11/2020	Melaleuca dampland	60
	426048	6412319	11/11/2020	Blackbutt forest at creek	60
	423869	6412250	11/11/2020	Blackbutt forest at creek	60
Total					**1860**

Brush-tailed Phascogale assessment

Brush-tailed Phascogales were targeted using remote cameras, cages and Elliot box traps. Remote cameras were deployed in habitats deemed potentially suitable to support phascogales and were deployed within key habitat features important to the Brush-tailed Phascogale such as in trees and facing onto logs. Cameras were deployed during both phases of the survey to increase the capture potential.

Elliot box traps deployed at the traplines were adapted to target Brush-tailed Phascogale during the Phase 2 survey. Elliot traps were strapped into trees and on logs to target phascogale which are largely arboreal (tree dwelling). The Elliot traps were baited with universal bait (a combination of peanut butter, oats and sardines) and covered with bark, leaves or Sheoak needles.

2.3.7 Black Cockatoo habitat assessment

A Black Cockatoo habitat assessment (for Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo) was undertaken over the Survey Area to assess the presence, quality and extent of habitat. The assessment involved visual and aural assessment of the Survey Area, identifying breeding habitat (presence/absence of actual and potential breeding trees), foraging habitat, roosting areas, current activity and any other signs of use by Black Cockatoos. For the purpose of this assessment, the DSEWPaC (2012) Black Cockatoo referral guidelines were used to define breeding, foraging and night roosting habitat.

The number and type of potential breeding trees within the Survey Area was estimated by surveying thirty one (31) plots (60 m by 500 m = 3 ha each) across the Survey Area (93 ha total). Each plot was traversed on foot and all potential Black Cockatoo breeding trees (based on Diameter Breast Height (DBH) recorded. Plots were selected to sample across all the vegetation complexes occurring locally based on vegetation mapping by Mattiske and Havel (1998). The number of plots within each vegetation complex was roughly proportional to the relative amount of each complex within the Survey Area. For example, the extensive Jarrah Marri forest habitat type had proportionately more plots than Bullich forest habitat type which comprised a small proportion of the Survey Area.

Breeding habitat was extrapolated using averaged results from these plot surveys per fauna habitat type throughout the Survey Area. This method was undertaken due to the large extent of the Survey Area and the commitment by Alcoa to undertaking detailed pre-clearing surveys of potential breeding trees in mining and haul road footprints once these are confirmed. For each potential breeding tree, details of the tree location, species, DBH, size and number of hollows observed, evidence of use and any other significant observations were recorded. Where trees were recorded to have a suitable large hollow that could be used or had signs of being used (potential or likely), trees were revisited by Tony Kirkby (Black Cockatoo Specialist) where the hollows were checked for Black Cockatoo use by using a drone, pole camera and telephoto lens.

Information collected during the field survey included:

– Foraging habitat - the location and extent of suitable Black Cockatoo species foraging habitat was identified and mapped for the Survey Area, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by Black Cockatoos was recorded via GPS.
– Breeding habitat - suitable breeding habitat for Black Cockatoos is defined by DSEWPaC (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable Diameter at Breast Height (DBH) to develop a nest hollow. For most tree species, suitable DBH is greater than 500 mm. For Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*), suitable DBH is greater than 300 mm (DSEWPaC 2012), however in this Survey Area no wandoo were present. On average, Carnaby's Cockatoos are known to nest in hollows with an entrance diameter greater than 20 - 30 cm (Johnstone and Storr 1998; Groom 2011). While the Forest Red-tailed Black Cockatoo is known to nest in hollows with an entrance of greater than 12 cm (Johnstone and Storr 1998). Therefore, during the field survey hollows size, as well as position, chew evidence and tree species was a guide for potential and likely use.
– Night roosting habitat - suitable roosting habitat is defined by DSEWPaC (2012). Suitable roosting habitat was identified based on the presence of suitable tall trees, evidence of roosting (feathers, twig clips etc.) and proximity of known roosting sites in the Survey Area and extended Survey Area. There was one suspected location of roosting within the Survey Area. This can be seen in Appendix D.

– Opportunistic observations - both visual and aural observations of Black Cockatoos within the Survey Area and surrounding region were noted during the survey. This information was used to provide context to the use of the Survey Area by all three Black Cockatoo species.

This information was used to calculate the amount of foraging habitat, potential breeding habitat and night roosting habitat within the Survey Area and a guide to the habitats available within the extended Survey Area. A summary of this information is presented below in Table 26.

2.3.8 Other Searches

Rare and threatened species may have a patchy, disparate distribution through landscapes. To provide the best opportunity to determine the presence and relative prevalence of these species, this study employed a variety of sampling methods. Systematic sampling sites were also assessed using non-systematic methods to ensure thorough coverage of the sites, and non-systematic techniques were used to sample the broader Survey Area and increase survey effort.

Diurnal searching

Each trapping site was surveyed for amphibians, reptiles, and mammals. Surveys comprised of active searching of potential shelter sites (overturning logs, rocks and leaf litter) and low vegetation (under bark and in tree stumps) and recording all individuals observed with a focus on conservation significant species. Species presence was also detected and identified via secondary evidence, in the form of scats, tracks, feathers, burrows and skeletal remains. A minimum of one hour was spent at each trap line including the general area around it. Diurnal (active) searching is known to be highly productive during optimal weather in selected habitat types and can account for a significant proportion of reptile species recorded. This method targeted granite outcrops during Phase 1 to maximise effectiveness. A summary of the diurnal search effort completed is provided below in Table 13 with survey locations shown in Figure 3, Appendix A.

Table 13 Active diurnal search summary

Site name	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Phase 1				
Active search	419166	6422868	Jarrah Marri forest	30
	427925	6412801	Melaleuca dampland	135
	426545	6422105	Jarrah Marri forest	30
	427854	6411179	Granite Outcrops Assoc.	30
	419111	6417875	Granite Outcrops Assoc.	30
	412511	6421533	Jarrah Marri forest	30
	415502	6415131	Jarrah Marri forest	120
	414359	6417984	Jarrah Marri forest	30
	427872	6410860	Granite Outcrops Assoc.	40
	418184	6422052	Granite Outcrops Assoc.	240
	420791	6417282	Granite Outcrops Assoc.	60
	428228	6418114	Granite Outcrops Assoc.	60
	427273	6417099	Jarrah Marri forest	60
	419542	6419115	Jarrah Marri forest	60
	427821	6418300	Granite Outcrops Assoc.	60
	420750	6417139	Granite Outcrops Assoc.	60
	418020	6422080	Granite Outcrops Assoc.	60
	426554	6425723	Granite Outcrops Assoc.	60
	430136	6410618	Jarrah Marri forest	30
	426378	6425909	Granite Outcrops Assoc.	120
	418557	6417351	Granite Outcrops Assoc.	140
	414085	6422412	Jarrah Marri forest	30
	420803	6417126	Granite Outcrops	60
Total Phase 1				**1,575**
Phase 2				
Active search	424329	6416182	Granite Outcrops	30
	428008	6410850	Jarrah Marri forest	120
	424219	6416025	Jarrah Marri forest	20
	424876	6414720	Jarrah Marri forest	60
	424609	6413211	Granite Outcrops	20
	419909	6424636	Jarrah Marri forest	60
	427714	6411184	Jarrah Marri forest	20
	428399	6413891	Jarrah Marri forest	20
	427103	6414267	Jarrah Marri forest	60
	426591	6421728	Jarrah Marri forest	60
	426543	6422105	Jarrah Marri forest	30
	426290	6422164	Jarrah Marri forest	20
	418184	6415922	Jarrah Marri forest	90

Site name	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
	418431	6415399	Granite Outcrops	180
	422622	6422820	Jarrah Marri forest	20
	426935	6413464	Jarrah Marri forest	20
	422059	6423729	Jarrah Marri forest	20
	419286	6419772	Jarrah Marri forest	60
	425697	6424851	Jarrah Marri forest	20
	416087	6422641	Jarrah Marri forest	60
	414743	6421898	Jarrah Marri forest	30
	426174	6423113	Jarrah Marri forest	30
	415025	6422056	Jarrah Marri forest	30
	414082	6422386	Jarrah Marri forest	20
Total Phase 2				**1,100**
Combined Phase 1 and 2 Total				**2,675**

Nocturnal searching

Spot lighting was undertaken to detect nocturnal species that may otherwise remain undetected using other survey techniques. Handheld or head mounted spotlights were used for a minimum of 15 minutes at each trap line for each survey phase and within the general area. Nocturnal searches involved spot lighting for a minimum of 200 m traversed at each location and recording all species observed during the exercise. A summary of the nocturnal searches completed is provided below in Table 14 with survey locations displayed in Figure 3, Appendix A.

Table 14 Nocturnal search summary

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Phase 1				
Frog / Nocturnal search	424263	6416733	Melaleuca dampland	15
Frog / Nocturnal search	427726	6410729	Blackbutt forest	30
Frog / Nocturnal search	425272	6413885	Jarrah Marri forest	15
Frog / Nocturnal search	424331	6416842	Melaleuca dampland	15
Frog / Nocturnal search	428035	6412958	Granite Outcrops Assoc	15
Frog census	424347	6415981	Melaleuca dampland	15
Nocturnal search	423543	6418321	Melaleuca dampland	30
Nocturnal search	417782	6421118	Bullich / Blackbutt forest	30
Nocturnal search	421610	6418810	Blackbutt forest	30
Nocturnal search	427636	6410541	Flooded Gum woodland	30
Nocturnal search	427615	6410458	Blackbutt forest	90
Nocturnal search	427616	6410462	Blackbutt forest	90
Nocturnal search	425445	6416692	Jarrah Marri forest	60
Nocturnal search	429006	6412852	Jarrah Marri forest	30
Total Phase 1				**495**
Phase 2				

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Nocturnal search	419178	6422955	Jarrah Marri forest	60
Nocturnal search	421550	6418600	Blackbutt forest	80
Nocturnal search	420745	6417248	Granite Outcrops Assoc	60
Nocturnal search	413297	6421782	Melaleuca dampland	60
Nocturnal search	417415	6419370	Bullich / Blackbutt forest	60
Nocturnal search	417781	6421118	Bullich / Blackbutt forest	60
Nocturnal search	421609	6418809	Blackbutt forest	60
Nocturnal search	427636	6410541	Flooded Gum woodland	60
Total Phase 2				**500**
Combined Phase 1 and 2 Total				**995**

Opportunistic observations

Opportunistic observations involve the recording of fauna taxa (physical presence and/or signs of presence) spatially throughout the Survey Area. These observations are gathered throughout the survey duration during all in-situ activities including travel, and generally account for a substantial proportion of the species assemblage recorded including conservation significant fauna. Opportunistic observations include physical observations (sighting or hearing fauna), and indirect evidence (scats, tracks, diggings, nests, feathers, slough, skeletal remains, pellets) which indicate the current or recent activity of a species present. Wherever possible, numbers of individuals, microhabitat use and other relevant information was recorded. Opportunistic observations were recorded outside of the diurnal, nocturnal or general trap site surveys (for example when driving, walking to a site, checking camera traps and bat detectors).

2.3.9 Summary of survey effort

Survey effort is described as the amount and type of survey that is undertaken during an assessment. Table 15 provides detail on the type and amount of survey time undertaken during both survey phases. Each of the trapping sites were sampled for a minimum of seven (7) trap-nights per survey phase including bucket, cages (both at general trap lines and cage trap transects), funnel and Elliott traps. The total trapping effort across both survey phases consisted of 6,412 trap nights. Additionally, over both survey phases remote cameras were deployed for a total of 2,922 nights, 2,340 minutes of bird census was undertaken (Table 5), 63 nights were sampled for bat acoustics (Table 7), 47 nights were sampled for bird acoustics (Table 8), 2,675 minutes of diurnal active searching was completed (Table 13), 995 minutes of nocturnal searching was completed (Table 14). Additionally, 390 minutes for Rakali (Table 11) and 1,860 minutes (Table 12) of Quokka assessments were undertaken.

Table 15 Summary of fauna survey effort

Fauna trapping sites Phase 1 2020				**Elliot traps**		**Pit traps**		**Cage traps**		**Funnel traps**	
Sites Phase 1	Easting	Northing	nights open	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights
TL 1	426987	6413519	7	10	70	7	70	2	14	12	84
TL 2	424252	6425012	7	10	70	7	70	2	14	12	84
TL 3	427900	6412972	7	10	70	7	70	2	14	12	84
TL 4	426279	6422853	7	10	70	7	70	2	14	12	84
TL 5	419173	6422951	7	10	70	7	70	2	14	12	84
TL 6	420734	6417238	7	10	70	7	70	2	14	12	84
TL 7	421559	6418605	7	10	70	7	70	2	14	12	84
TL 8	428302	6417251	7	10	70	7	70	2	14	12	84
TL 9	427604	6410609	7	10	70	7	70	2	14	12	84
TL 10	413197	6421772	7	10	70	7	70	2	14	12	84
TL 11	424815	6421905	7	10	70	7	70	2	14	12	84
TL 12	418020	6420561	7	10	70	7	70	2	14	12	84
Total –Phase 1				**120**	**840**	**84**	**840**	**24**	**168**	**144**	**1,008**
Fauna trapping sites Phase 2 2020				**Elliot traps**		**Pit traps**		**Cage traps**		**Funnel traps**	
Sites Phase 2	Easting	Northing	nights open	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights
TL 1	426987	6413519	7	10	70	7	70	2	14	12	84
TL 2	424252	6425012	7	10	70	7	70	2	14	12	84
TL 3	427900	6412972	7	10	70	7	70	2	14	12	84
TL 4	426279	6422853	7	10	70	7	70	2	14	12	84
TL 5	419173	6422951	7	10	70	7	70	2	14	12	84
TL 6	420734	6417238	7	10	70	7	70	2	14	12	84
TL 7	421559	6418605	7	10	70	7	70	2	14	12	84
TL 8	428302	6417251	7	10	70	7	70	2	14	12	84
TL 9	427604	6410609	7	10	70	7	70	2	14	12	84
TL 10	413197	6421772	7	10	70	7	70	2	14	12	84
TL 11	424815	6421905	7	10	70	7	70	2	14	12	84
TL 12	418020	6420561	7	10	70	7	70	2	14	12	84
Total Phase 2				**120**	**840**	**84**	**840**	**24**	**168**	**144**	**1,008**
Total Phase 1 and 2 combined				**240**	**1,680**	**168**	**1,680**	**48**	**336**	**288**	**2,016**

2.3.10 Species accumulation

The number and type of species trapped each day was recorded and a species accumulation curve was created for the Survey Area using PRIMER v6 (Clarke and Gorley 2006). The species accumulation curve represents the successfulness of the trapping program for its duration. Typically, the longer the trapping program the more complete the representation of species sampled per trapping location or habitat type. Accumulation curves should show “levelling” of the groups species counts prior to the completion of the survey. Many limitations can influence the results of a curve and should be observed as a guide to the project’s success. This curve is presented in Plate 10 in Section 4.3.1.

The data was run through Primer v6 against 8 existing models, these models are:

– Sobs - Curve of observed species counts
– Chao 1 - Chao's estimator based on number of rare species
– Chao 2 - Chao's estimator using just presence-absence data
– Jacknife 1 - Jacknife estimator based on species that only occur in one sample
– Jacknife 2 - Second order jacknife estimator
– Bootstrap - Bootstrap estimator based on proportion of quadrats containing each species
– MM (Michaelis-Menton) - Curve fitted to observed Sobs curve
– UGE - Calculated species accumulation curve based on Ugland, Gray and Ellingsen (2003)

2.3.11 Fauna survey limitations

EPA (2020) states that fauna and faunal assemblage survey reports for environmental impact assessment in Western Australia should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with the fauna component of this field survey are discussed in Table 16.

Table 16 Fauna survey limitations

Limitations	Constraints	Impact on Survey outcomes
Scope (what fauna groups were sampled and were some sampling methods not able to be employed because of environmental constraints)	Nil	All fauna groups were able to be sampled. During the Phase 2 survey the traps had to be closed for three nights due to a car rally in the Survey Area. The traps were re-opened following the rally and were open for a minimum of 7 nights (combined) each.
Seasonal environmental conditions	Minor	The surveys were scoped and designed around EPA (2016a) guidelines; however they were modified and completed when EPA (2020) guidelines was released. This document provides recommended survey timing for the Southern Climatic Region for amphibians, birds and mammals. The recommended survey timing for reptiles in accordance with these guidelines include a primary survey being undertaken between October-December (completed) and a secondary survey to be completed between February-March (not completed). The first survey undertaken for the Myara North Survey Area was completed in June/July 2020 which is outside of the recommended survey timing for reptiles (EPA 2020). The survey was arranged prior to the release of the EPA (2020) guidelines; however, the survey incorporated extensive active searching in habitats deemed suitable for the Dell Skink and Southern Death Adder - conservation significant reptiles identified in the desktop assessment as potentially occurring within the Survey Area. Raking of leaf litter and active searching in granite is considered particularly useful during the winter months to detect reptiles lying dormant in the cooler weather. A high proportion of the reptile species recorded were detected via active searching. The survey timing discrepancy is not considered a major limitation to this survey due to the effort applied to active searching with particular focus on the conservation significant reptiles. The survey timing had no impact of recording mammals and birds.
Proportion of fauna identified, recorded and/or collected	Nil	All fauna were identified and released on site.
Proportion of the task achieved and further work which might be needed.	Nil	All scoped work was completed successfully.
Remoteness and/or access problems	Nil	No issues were encountered with the exception of the aforementioned car rally resulting in the traps being closed for three consecutive nights.
Accordance to EPA guidelines	Minor	Change of EPA guidelines from 2016 vertebrate guidance to 2020 during Phase 1 survey. Original scoping was to perform a detailed terrestrial fauna survey over the Survey Area in accordance with EPA (2016a). Following the release of the EPA (2020) guidelines the survey was adapted to take on more of a targeted approach. Chuditch and Black Cockatoo were targeted during both phases of the survey, while targeted Carters Freshwater Mussel and Quokka assessments were included into the Phase 2 survey.

2.4 Climate data for survey period

Weather conditions during the Phase 1 survey were generally cool and damp with rainfall occurring most days. The Phase 2 survey period also experienced rainfall at the beginning and end of the survey duration; however experienced dry and warm conditions for the majority of the survey. An overview of the weather experienced

during the survey is presented in Table 17. Weather data was obtained from the Bureau of Meteorology website closest weather station to the site, Karnet (Station ID: 009111) located approximately 5 km southwest of the Survey Area.

Table 17 Weather data for survey period (Phase 1 and 2)

Date	Minimum temp (°C)	Maximum temp (°C)	Rainfall (mm)
Phase 1			
29 June 2020	10.2	15.0	34.1
30 June 2020	11.2	15.0	2.0
1 July 2020	9.2	14	7.4
2 July 2020	6.5	15.4	0
3 July 2020	5.9	17.4	0.3
4 July 2020	8.3	20.5	0.5
5 July 2020	9.7	21.6	0
6 July 2020	11	15.9	4.8
7 July 2020	9.5	15	22.3
8 July 2020	6	14.6	9.6
9 July 2020	5.2	14.9	0.3
Phase 2			
2 November 2020	13.4	16.5	15.8
3 November 2020	11.1	-	7.3
4 November 2020	-	20.3	0
5 November 2020	10.4	22.5	0
6 November 2020	10	27.4	0
9 November 2020	12.4	25.6	0
10 November 2020	13.7	26.6	0
12 November 2020	12.1	22.8	0
13 November 2020	10.4	22.5	5.6

3. Desktop Assessment

3.1 Climate

The Survey Area is located within the Northern Jarrah Forest subregion of Western Australia. The climate of this region is classified as Warm Mediterranean, with two distinct seasons: a warm and dry summer (December to February) and a cool wet winter (June to August) (Williams & Mitchell 2001).

The region is characterised spatially by rainfall, with rainfall being greatest on the scarp and decreasing to the east and north (Williams & Mitchell 2001). The majority of all rainfall received occurs during winter months and is a result of low pressure systems associated with westerly winds. The closest operating weather station is Serpentine Karnet (Station ID: 009111) located approximately 5 km southwest of the Survey Area.

Climate data (Bureau of Meteorology 2020) from this station indicates:

– Mean maximum temperature ranges from 15.5 °C in July to 30.6 °C in January
– Mean minimum temperature ranges from 6.3 °C in July and August to 15.8 °C in February
– Mean annual rainfall is 1,153 mm with average of 98.5 rain days/year.

3.2 Geology and land systems

3.2.1 Geology

The Australian continent is made up of four continental blocks: the Yilgarn, Pilbara and Gawler Cratons and the Wilyama Block. The Survey Area is located within the South West Terane of the Yilgarn Craton. The Yilgarn Craton is comprised of geological formation from the Archaean (2.5 billion years ago) to Cainozoic ages (66 million years ago to present) and bounded by the Murgoo Gneiss Complex of the Western Gneiss Terrane in the west and the Southern Cross Province in the east. The South West Terrane is composed of granitic rocks classified into groups based on characteristics. The Study Area overlays two geological units:

– South West Terrane greenstones – granulite and migmatite
– Yilgarn Craton Granites - granitic rock, undivided; metamorphosed

3.2.2 Land systems

The Survey Area is located within two land systems:

– Darling Plateau System - Lateritic plateau. Duplex sandy gravels, loamy gravels and wet soils. Jarrah-Marri-wandoo forest and woodland.
– Murray Valleys System - Western Darling Range from the Avon Valley to Harvey. Deeply incised valleys with Red loamy earths, shallow duplexes and rock outcrop and Jarrah-Marri-wandoo forest and woodland with mixed shrubland.

3.3 Surface water and hydrology

The Survey Area lies predominantly within the Serpentine River catchment and lies adjacent to the Serpentine River and Serpentine Dam and Pipehead Dam Reservoirs. Tributaries of the Serpentine River and Serpentine Dam Reservoir include 39 Mile Brook, Banksia Gully and Gold Mine Gully, which flow in a roughly south-west direction through the Survey Area. The north west portion of the Survey Area drains to Honour Brook, which flows west through Jarrahdale and discharges into the Serpentine River downstream of the Pipehead Dam. The north-east portion of the Survey Area lies within the Wungong Brook catchment, which drains into Wungong Dam Reservoir approximately 4 km to the north-west.

The Serpentine Dam, Pipehead Dam and Wungong Dam are public drinking water reservoirs. The south-west extent of the Survey Area lies within the Reservoir Protection Zone of the Serpentine Dam and Pipehead Dam reservoirs.

The Serpentine Dam and Pipehead Dam are man-made perennial water bodies. The Serpentine River, Wungong Brook and tributaries within the Survey Area are ephemeral and flow for periods of several months during winter and spring. Drainage floors occur in areas of alluvial deposits along the Serpentine River and tributaries and form ephemeral waterlogged damplands during the winter and spring.

3.4 Land use

3.4.1 Crown reserves and estates

There are three reserves located within the Survey Area (see Table 18 and Figure 2, Appendix A).

Table 18 Reserves within the Survey Area

Reserve number	Name	Class	Use	Approximate location relative to Survey Area
R 16634	Jarrahdale State Forest	Class C	State Forest	Covering majority of the Survey Area with the exception of the north eastern-most portion
R 335	Un-named	Class C	Waterway, resting place	Lies within a small portion of the eastern Survey Area, adjacent to Albany Highway
R 5913	Jarrahdale State Forest	Class C	State Forest	Lies within the south-eastern boarder of the Survey Area

The following DBCA managed lands lie adjacent to the Survey Area:

– Serpentine National Park (Class A) to the west
– Monadnocks Conservation Reserve (Class A) to the east.

3.4.2 Environmentally Sensitive Areas

Three Environmentally Sensitive Areas (ESAs) lie within the western portion of the Survey Area (Figure 2, Appendix A). An additional 51 ESAs lie within 10 km of the Survey Area.

3.4.3 Regional Ecological linkages

Three ecological linkages lie within the Survey Area, as presented in Figure 2, Appendix A. The ecological linkages are interpreted to be in association with riparian corridors of the Serpentine River, Wungong Brook and Gold Mine Brook-39 Mile Brook. An additional 11 ecological linkages lie within the Study Area.

3.5 Vegetation

3.5.1 Broad vegetation mapping and extents

Vegetation associations

Broad scale (1:250,000) pre-European vegetation mapping of the Study Area has been completed by Beard (1979) at an association level. The mapping indicates the Survey Area intersects two vegetation associations:

– West Darling_3 (association 3): Mainly Jarrah and Marri *Eucalyptus marginata*, *Corymbia calophylla*
– West Darling_128 (association 128): Rock

Vegetation complexes

Regional vegetation complex mapping has been completed by Mattiske & Havel (1998) with updates from Webb *et al.* (2016) based on major landform boundaries within the South West Forest and forested region of south-west Western Australia. The mapping indicates eight vegetation complexes are present within the Survey Area:

– Dwellingup (D1): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.
– Dwellingup (D2): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia* calophylla on lateritic uplands in subhumid and semiarid zones.
– Yarragil 1 (Yg1): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.
– Yarragil 2 (Yg2): Open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* on slopes, woodland of *Eucalyptus patens-Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors in subhumid and semiarid zones.
– Cooke (Ce): Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia* calophylla (subhumid zone) and open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* (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 *Eucalyptus laeliae* (semiarid), and *Allocasuarina huegeliana* and Eucalyptus wandoo (mainly semiarid to prearid zones).
– Swamp (S): Mosaic of low open woodland of *Melaleuca preissiana-Banksia littoralis*, closed scrub of *Myrtaceae* spp., closed heath of *Myrtaceae* spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.
– Murray 1 (My1): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia* calophylla-*Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.
– Goonapping: Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata* (humid zones) and *Eucalyptus marginata* subsp. *thalassica* (semiarid to perarid zones) on the sandy-gravels, low woodland of *Banksia attenuata* on the drier sandier sites (humid to perarid zones) with some *Banksia menziesii* (northern arid and perarid zones) and low open woodland of *Melaleuca preissiana-Banksia littoralis* on the moister sandy soils (humid to perarid zones).

3.6 Fauna

3.6.1 Fauna diversity

The *NatureMap* database identified 185 terrestrial vertebrate fauna species previously recorded within the Study Area. This total comprised of 113 birds, 32 reptiles, 28 mammals and 12 amphibians. Of the 185 fauna species previously recorded, 177 are native species and eight are naturalised (introduced) species. The EPBC Act PMST search detected an additional four threatened bird species as potentially occurring within the Study Area and the DBCA Threatened and Priority Fauna database returned one additional mammal within the Survey Area.

The *NatureMap* and PMST database search is provided in Appendix C. DBCA Threatened and Priority Fauna results are displayed in Figure 2, Appendix A.

3.6.2 Conservation Significant Fauna

Based on the above database searches, 13 conservation significant terrestrial vertebrate taxa were identified as likely to occur or known to be present within the Survey Area.

These species included:

– Two species listed as Endangered under the EPBC Act and BC Act including Baudin's Cockatoo (*Calyptorhynchus baudini*) and Carnaby's Cockatoo (*C. latirostris*)
– Three species listed as Vulnerable under the EPBC Act and BC Act including Forest Red-tailed Black Cockatoo (*C. banksii naso*), Chuditch (*Dasyurus geoffroii),* and Quokka (*Setonix brachyurus*)

– One species, Peregrine Falcon (*Falco peregrinus*) listed as 'Other specially protected' under the BC Act
– Six species listed as Priority 3 or 4 by DBCA
– *Phascogale tapoatafa wambenger* listed as 'Conservation Dependent' by the DBCA.

Desktop assessment for aquatic fauna (WRM 2021) identified the invertebrate species Carter's Freshwater Mussel (*Westralunio carteri*) as potentially present within the Survey Area. This species listed as Vulnerable under the EPBC Act and BC Act.

All conservation significant species identified as potentially occurring are presented in the Likelihood of Occurrence (LOO) assessment in Appendix D and further discussed regarding survey results in Section 4.3.

3.7 Previous Studies

A literature review was performed on previous terrestrial fauna studies considered relevant to the current Survey Area, to inform the basis of the fauna surveys. The review focuses on conservation significant species recorded during surveys on Alcoa mining lease and surrounding areas. A review of 26 existing reports that are considered relevant to the current study is provided in Table 19.

Table 19 Previous studies considered relevant to Myara North Survey Area

Project	Location and key findings	Location in relation to this Survey Area
Environmental Management and Research Consultants (EMRC) (1992) Long term fauna monitoring program 1992 (draft)	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 16 mammals, 61 birds, 21 reptiles, 6 frog and 80 ant species were recorded. Recorded threatened fauna comprise: • Quenda – trapped at Jarrahdale • Baudin's Cockatoo (recorded at all sites) • Red-eared Firetail (delisted) • Carpet Python (delisted)	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report but Jarrahdale plots are expected to be adjacent or within the current Survey Area.
EMRC (1995) Long term fauna monitoring program 1995	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 19 mammals (six introduced), 57 birds, 20 reptiles, 5 frog and 52 ant species were recorded. Recorded threatened fauna comprise: • Quenda – four individuals were trapped • Chuditch – all opportunistic sightings (one near Phillips Road/Nettleton Road and seven ay Huntly Mine in 1995).	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report but Jarrahdale plots are expected to be adjacent or within the current Survey Area.
EMRC (2003). McCoy Long Term Fauna Monitoring Program 2003	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly Mine McCoy region crusher site. The monitoring program surveyed all terrestrial vertebrate species and ants. Mammal trapping occurred over four successive trap nights in both summer and winter using 10 pit traps, 16 medium Elliot traps, four large Elliot traps and four cage traps. Reptiles were targeted using five PVC pot traps with drift fence during summer. Traps were open on 29th Jan (summer) and 13 Aug (winter). Birds were surveyed using quantitative methods (two permanent bird transects surveyed on three consecutive days in summer and winter) and inventory methods (opportunistic recordings at each plot during the trapping program). A total of six mammals (one introduced), 39 birds, 7 reptiles, 9 frog and 37 ant species were recorded. Recorded threatened fauna comprise: • Chuditch – two trapped plus sightings or signs • Baudin's Cockatoo - sightings	Approximately 31 km south of the current Survey Area.
EMRC (2006) Long term fauna monitoring program 2006	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 18 mammals (six introduced), 49 birds, 21 reptiles, 5 frog and 70 ant species were recorded. Recorded threatened fauna comprise: • Chuditch – opportunistic sightings at Huntly • Quokka – opportunistic sighting at Huntly • Baudin's Cockatoo – sighted at Jarrahdale, Huntly and Karnet • Carpet Python (delisted) • Quenda - trapped at Jarrahdale and Karnet • Western Brush Wallaby - sighted at Jarrahdale and Huntly	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report but Jarrahdale plots are expected to be adjacent or within the current Survey Area.
EMRC (2007a) McCoy Long Term Fauna Monitoring Program – results of the 2007 survey	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly McCoy crusher site. Methods used were identical to those used in the 2003 survey (above). A total of seven mammal (two introduced), 41 bird, seven reptile, five frog and 54 ant species was recorded. Recorded threatened fauna comprise: • Baudin's Cockatoo –sightings • Western Brush Wallaby – multiple sightings	Approximately 31 km south of the current Survey Area.
ALCOA World Alumina Australia (2010) No 40. Threatened fauna species management plans for Alcoa's bauxite mining operations in the Jarrah forest	Location: Mining Lease ML1sa Management Plan for seven species of fauna known to occur within the mining lease: • Chuditch • Quokka • Noisy Scrub-bird • Baudin's Black Cockatoo • Forest Red-tailed Black Cockatoo • Peregrine Falcon • Carpet Python (delisted)	The current Survey Area is within the 1sa Mining Lease

Project	Location and key findings	Location in relation to this Survey Area
Stokes (2011) Orion Long Term Fauna Monitoring Program	Location: six monitoring sites within Alcoa's Orion mine region comprising two typical upland forest areas, two associated with stream zones and two within rehabilitated forest (8 years old). Mammals, birds, reptiles and frogs were surveyed during both summer (March) and winter (July), and ground dwelling invertebrates were sampled in summer only. Survey methods were similar to those used in EMRC (2006) with the addition of a single large trapping transect designed to specifically target Chuditch and species of goanna. This transect covered approx. 880 ha and comprised 40 wire cage traps spaced 300 m apart and was trapped over four successive nights at the same time as the generic mammal survey. A total of 10 mammals (three introduced), 38 birds, 9 reptiles, two frogs, 22 ground invertebrates, 49 ant species was recorded. • Recorded threatened fauna comprise: • Chuditch – five males trapped in summer • Quenda – one trapped • Western Brush Wallaby – multiple sightings • Baudin's Cockatoo – sightings • Forest Red-tailed Black Cockatoo - sightings	Within 20 km of the far western boundary of the Study Area
Stokes (2012) Vertebrate Fauna Survey of Planted Mining Areas at Alcoa's Keats Mining Region 2011/2012	Location: Keats mining region. Fauna were surveyed using a range of techniques, including trapping, remote sensitive cameras, tracking tunnels, observational surveys and spotlighting. Pitfall traps were not used. Five areas were trapped for mammals comprising two dieback free Jarrah forest areas and three stream zones. One landscape trapping transect was deployed to target Chuditch and goanna and this encompasses upland Jarrah forest, stream zones, low lying open forest, dieback graveyards and Sheoak forest. Black Cockatoo habitat survey was also undertaken. Surveys were only undertaken in summer due to time constraints. Recorded threatened fauna comprise: • Forest Red-tailed Black Cockatoo – flock sighted (up to 11 individuals) • Baudin's Cockatoo – 2 individuals sighted • Western Brush Wallaby – sightings and recorded on remote camera • Chuditch – one male trapped • Carpet Python (delisted)	Approximately 37 km southwest of the current Survey Area.
Way *et al*. (2013), McCoy Long Term Fauna Monitoring Program Report of the 2013 Field Survey	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly McCoy crusher site and an additional three sites established in two year old rehabilitation within the McCoy Intermediate Rainfall Zone. In 2013 the McCoy Long Term Fauna Monitoring Program involved survey of terrestrial vertebrates (including mammals, birds and reptiles) and ground invertebrates, using the same methods used in previous LTFMP at McCoy (EMRC 2003, 2007a). Mammals, birds, reptiles, and frogs were surveyed in both winter (July-August 2013) and summer December 2013-January 2014). Additional survey methods were also implemented including a single large trapping transect to sample highly mobile species, remote sensor cameras and all invertebrates collected in pitfall traps were identified to taxonomic order. A total of 13 mammal species (four introduced), 46 birds, five frog, 31 invertebrates, and 64 ant species was recorded. Recorded threatened fauna comprise: • Western Quoll – one adult male trapped • Quenda – recorded on remote cameras • Western Brush Wallaby – multiple sightings and on remote cameras • Baudin's Cockatoo – multiple sightings • Forest Red-tailed Black Cockatoo – multiple sightings	Approximately 31 km south of the current Survey Area.
Chuditch survey raw data Myara 2013	This is an excel data file along with short summary document with the location description as 'Myara west' and 'Myara east'. Shows details of eight quoll captures at 'Myara west' and one quoll captured at 'Myara east' between 18-22 March 2013. Myara West excel data provides 8 GPS capture locations (in cage traps). Myara East excel data provides 40 locations with coordinates however according to the report only 1 capture location was recorded at Cage 26. The coordinates of this location were unable to be identified. Total number of captures comprised of five males and four females.	Location described as Myara west and east and general area surrounding Karnet Prison which is approximately within 10 km of the Survey Area. GPS coordinates provided: • 410458 E, 6409663 N • 410839 E, 6408964 N • 411357 E, 6408290 N • 411766 E, 6410671 N • 411138 E. 6407725 N • 412384 E, 6408752 N • 414231 E. 6408816 N • 414362 E, 6409006 N
McGregor *et al*. (2014). Does forest restoration in fragmented landscapes provide habitat for a wide-ranging carnivore?	Location: Huntly and Willowdale mines Fourteen Chuditch trapping sessions (13 at Huntly, one at Willowdale) across 9 trapping transects (8 at Huntly, one at Willowdale) were undertaken between June 2009 and Dec 2010. Radio collars with a two-stage transmitter and mortality mode were attached to 14 adult Chuditch (9 female, 5 males – all trapped at Huntly). Chuditch were tracked to their dens during the day. Spool and line tracking was also used. In total 29 individual Chuditch were captured on 60 occasions. Of the 14 individuals fitted with radio collars, three were found dead on the Huntly mine access road with evidence of road trauma. Another three Chuditch were also found dead from vehicle strikes along this road. The study identified 138 den sites from 11 tracked animals: 75 in unmined forest and 63 in restored forest ranging from 2-32 years old. In unmined forest, dens were mostly in hollow logs and ground burrows beneath tree stumps, but these substrates were never used in restored forest where dens were mostly ground burrows, usually associated with rock piles at the surface.	Huntly Mine and Willowdale Mine approx. 40 km and 55 km respectively southwest of the Survey Area.
Burgar *et al.* (2015) The importance of mature forest as bat roosting habitat within the production landscape	Location: forest surrounding Huntly mine site, for both restored and unmined forest. *Nyctophilus gouldii* and *Vespadelus regulus* were trapped and tracked during maternity and mating seasons using harp traps and position-sensitive radio transmitters. Few bats were captured in restored forest so traps were relocated to water sources. Study aimed at identifying roost habitat within restored forest vs unmined forest. Findings indicate that habitat restoration in production forest landscapes is unlikely to play a significant role in conserving species that rely on slow developing microhabitats such as tree hollows for decades or centuries and that retaining and managing forest remnants would be a more effective strategy to conserve populations of these species.	Huntly mine, approximately 40 km southwest of the current Survey Area.

Project	Location and key findings	Location in relation to this Survey Area
Burgar *et al.* (2017) Habitat features act as unidirectional and dynamic filters to bat use of production landscapes	Location: five forest types around the Huntly mine (four restored forest with different stages of vegetation succession, and one unmined forest) Ultrasonic detectors (Anabat Titley Electronics) were set at 64 sites four times per year between Oct and March 2010/2011 and 2011/2012 for a total of 512 survey nights. 31,347 bat call files were recorded over both years of which 22,520 were identified to species/species group. *Vespadelus regulus* was detected most frequently (15,833 call files) and *Falsistrellus mackenziei* least frequently (167 call files). Six species/groups were detected. Recorded threatened fauna comprise: • Western False Pipistrelle	Huntly Mine site, approximately 40 km southwest of the Survey Area
Craig *et al*. (2017) Can postmining revegetation create habitat for a threatened mammal?	Location: Jarrah Forest (Huntly mine site approximately 10 km north of Dwellingup) Most revegetation conducted for biodiversity conservation aims to mimic reference ecosystems present predisturbance. However, revegetation can overshoot or undershoot targets, particularly in the early stages of a recovery process, resulting in conditions different from the reference model. Revegetation that has, as yet, failed to fully meet revegetation targets may, nonetheless, provide habitat for threatened species not present in reference ecosystems. To investigate this possibility a survey of the Quokka (Setonix brachyurus), a threatened macropod, in a mining landscape in south-western Australia was conducted. Four sites in each of riparian forest (the preferred habitat of quokkas) but is not mined, mid-slope forest, which is the premining reference ecosystem but is not suitable habitat for quokkas, and revegetated forest on mine pits 16–21 years postmining. Quokkas were recorded in all riparian forest sites and two revegetated forest sites but not in any mid-slope forest sites. Occupied revegetated sites had greater cover between 0 and 2 m and were spatially closer to riparian forest than unoccupied revegetated sites, suggesting predation pressure was likely influencing which mine pits were occupied. The study demonstrated postmining revegetation can provide new habitat for a threatened species and suggested that revegetating a small proportion of sites to provide new habitat for threatened species could be considered as a management option in some scenarios. This could improve landscape connectivity and increase both the area of available habitat and between-site heterogeneity, which could all potentially increase the ability of revegetation to conserve biodiversity.	Huntly Mine site, approximately 40 km southwest of the Survey Area
EMRC (2015) Long Term Fauna Monitoring Program Summary of Results at Orion Mining Region.	Location: Numerous plots over the Willowdale Mine area Results of the 3rd survey of the LTFMP. Same methodology and plot locations as 2010 survey of the area. Additionally a large trapping transect targeting Chuditch and remote sensing cameras also deployed. Trapping conducted over 4 nights in both winter and summer seasons. The study results: • Twelve mammal species were trapped • Thirty five bird species recorded • Thirteen reptile species recorded • Three frog species recorded Results were indicative of some species being affected (not present afterwards or in lower numbers) by the January 2016 wildfire that burnt through the Willowdale Mine and surrounding areas including four of the six Orion sites.	Within 20 km of the far southern boundary of the Study Area.
Doherty *et al.* (2016). Successional changes in feeding activity by threatened cockatoos in revegetated mine sites.	Location: Numerous plots over the Huntly Mine, Boddington Bauxite Mine and Newmont Boddington Gold Mine. 232 plots were surveyed in revegetated forest and 480 plots were surveyed in unmined forest to determine whether there were successional patterns in cockatoo feeding activity in revegetation aged between 4 to 23 years. The study concludes that black cockatoos feed in vegetation at all three mine sites, despite variations in vegetation age, structure and floristics. Black cockatoos begun feeding on proteaceous and myrtaceous food plants within 4 and 7 years following revegetation, indicating that some food sources are restored quickly after mining disturbance of the Jarrah forest. The results highlight the importance of monitoring fauna recolonization over appropriate time scales to understand how successional processes in revegetation influence fauna persistence in production landscapes.	Huntly Mine approx. 40 km southwest of current Survey Area, Boddington Bauxite Mine approximately 60 km southeast of the current Survey Area, and Newmont Boddington Gold Mine 27 km southeast of current Survey Area.
Mastrantonis *et al.* (2019) Climate change indirectly reduces breeding frequency of a mobile species through changes in food availability	Location: the Northern Jarrah Forest of South West Western Australia over both the Swan and Murray River Catchments. Using a dataset of annual breeding frequency spanning 19 years, in combination with hydrological, climatological, and remotely sensed data, the effects of environmental variation on the annual breeding frequency of Forest Red-tailed Black Cockatoo's (FRTBC) were modelled. In total, 143 unique trees were surveyed over the 19 year period. A total of 173 breeding events were observed during this time with 104 and 71 events observed in the Swan and Murray River catchments respectively. On average there were 5.83 breeding events recorded per year with events ranging from 0 to 21 annually. Results found several significant relationships between annual breeding frequency of FRTBCs and environmental variation. While the model, which included a proxy for the availability of the cockatoo's primary food source and the previous season's rain, explained 49% of annual breeding frequency, there were also direct and indirect effects of heatwaves and forest productivity. FRTBC breeding was found to appear be linked to the spatiotemporal availability of its primary food sources, the fruit from the tree species, Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginata*. However, due to climate change experienced and predicted to be experienced in the future in Western Australia it is expected that the food resources during the breeding season for cockatoos will become increasingly limited in time and space, thus threatening their persistence.	The Survey Area is within the bounds of the literature Study Area.
Burn (2000) A survey of the impact of burning on mammals and birds in Alcoa's rehabilitated Bauxite mines at Jarrahdale	Location: Jarrahdale forest (two unmined and four rehabilitated bauxite mine pits) To ascertain the impact of burning on birds and mammals at the above location pre burning monitoring took place 1997, and post burn monitoring commenced in 1998 in both burnt and unburnt, rehabilitated and unmined forest sites. Low numbers of mammals were caught making it difficult to conclude with certainty whether burning had an effect on most species. New epicormic growth may have attracted possums into one rehabilitated area, while mice invaded the dense rehabilitated site after the burn. There was a large decline in the numbers of birds and bird species following the burn in the dense rehabilitation. Burning sparse rehabilitation only resulted in a small decline while fire had little effect on bird populations of unmined forest. It was concluded that more time was needed to define the longer-term effects of burning on mammals and birds. The present survey was therefore undertaken in 2000 to assess the situation three years after burning.	Approximately 9 km north of the northern boundary of the Study Area.

Project	Location and key findings	Location in relation to this Survey Area
Huntly rehabilitation (2000)	As no long term monitoring of fauna has been conducted at Huntly since 1998, it was decided a repeat of the 1994 survey using identical methods would occur to gain a better understanding of the extent to which vertebrate fauna colonise older rehabilitation. The sites ranged from 14 to 22 years. Sixteen mammal species are known to inhabit rehabilitation at Huntly including 10 native and 6 feral species. Thirty four bird species were recorded in the rehabilitated areas surveyed (similar to the 36 recorded in the 1994 survey. Eight reptile species and one frog species were recorded in the rehabilitated areas surveyed. Fourteen recommendations came about which if implemented should encourage the return of fauna species in similar number to which they occur in surrounding unmined forest. Some recommendations are identical to the 1994 study; they have either not been implemented or they should continue. Key recommendations include; • Where it is not yet known about species recolonisation follow up monitoring in rehabilitated areas will reveal whether they have recolonised. • Surrounding forest if the source of all fauna recruitment. It is important that fauna habitat be protected so that species are available to recolonise.	Huntly Mine - approximately 35 km south .
EMRC (2007b) A Vertebrate Fauna Survey of Rehabilitated Areas at Alcoa's Huntly Minesite. (Final report)	Provides an overview of the 1994, 2000 and 2007 vertebrate fauna surveys of Alcoa's rehabilitated bauxite mines at Huntly. Mammals, birds and reptiles were surveyed in six rehabilitated pits ranging in age from 8 to 16 years. In total 16 mammal species (11 indigenous and 5 introduced), 34 birds and 8 reptiles were recorded. Rare or specially protected species either recorded in the present survey or recently sighted or trapped in rehabilitation at Huntly include the Brush-tailed Phascogale, Chuditch, Quokka, Baudin's Cockatoo, Forest Red-tailed Black Cockatoo and Carpet Python. Other species recorded in rehabilitation during the survey included the Echidna, Brush-tailed Phascogale and Common Brushtail Possum, while Western Brush Wallaby, Chuditch and Quenda have also recently been either trapped or sighted in rehabilitation at Huntly. Total bird species numbers recorded have remained similar to those in 2000 and in 1994, however in individual rehabilitated sites, the numbers of bird species and bird diversity have both decreased. Numbers of reptile species remained similar to those of previous years, with the Specially Protected Carpet Python seen in rehabilitation on a number of occasions. Thirteen recommendations were given as a result including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Huntly Mine - approximately 40 km south
EMRC (2001a) Alcoa World Alumina Australia Ltd. Long Term Fauna Monitoring Program. (V2)	The Alcoa Long Term Fauna Monitoring Program was designed in 1991. Monitoring events took place in 1992, 1995, 1998 and 2001 (Nichols 1992) using identical methods each time (except for the baseline). The program is designed to monitor fauna every three years at twenty plots located in rehabilitation and nearby forest at Jarrahdale, Huntly and Karnet (remote from mining). A total of 16 mammal (10 indigenous, six introduced), 50 bird, 17 reptile, 7 frog and 73 ant species was recorded. In 1998, the corresponding figures were 18 mammal, 53 bird, 21 reptile, 7 frog and 56 ant species. Mammals recorded included one officially gazetted rare species, the Chuditch. Two of the species recorded in 1998 were not detected in 2001. These were the Brush-tailed Phascogale and an unidentified bat species. Numbers of several species appear to have changed significantly with some mammal and bird species declining, possibly due to very dry summer followed by very low winter rainfall. .Common brushtail possum and frog species increased. Baudin's Cockatoo was recorded at both Jarrahdale and Huntly. The reptile fauna included one 'Specially Protected' species, viz. the Carpet Python. Quantitative data showed that the composition of all rehabilitated sites was becoming more similar to that of the unmined sites. However, they remain linked to each other, particularly JR1 and JR2, which have become even more similar to each other.	Jarrahdale plots are expected to be adjacent or within the current Survey Area, Huntly (approximately 40 km south) and Karnet (approximately 10km north)
EMRC (1998) Alcoa of Australis Ltd. Long Term Fauna Monitoring Program (1998)	Location: Plots located in rehabilitation and nearby forest at Jarrahdale, Huntly and Karnet. This report provides the results of the 1998 fauna monitoring program. Methods used were identical to the 1995 monitoring program. Results are then compared to previous monitoring programs (1992 and 1995) in detail and the influence of mining and successional processes on fauna can be assessed. A total of 18 mammal (12 indigenous, six introduced), 53 bird, 20 reptile, 5 frog and 56 ant species was recorded. Mammals recorded included two officially gazetted rare species, viz. the Chuditch and the Quokka. Two of the species recorded (Dunnart *Sminthopsis gilberti* and the Honey Possum) in 1995 were not detected in 1998. A number of species have increased since the previous monitoring event (Mardo and Quenda). There wasn't any evidence of any mammal species declining due to proximity of mining. All bird species recorded in 1992 and 1995 were recorded in 1998. Only one rare bird species, Baudin's Cockatoo was recorded and this was present at all sites. One new skink species was collected - *Glaphyromorphus gracilipes* was trapped at stream site HS1 (Banya Road) during the summer trapping program. Insufficient reptile numbers were collected to determine trends over time.	Jarrahdale plots are expected to be adjacent or within the current Survey Area Huntly (approximately 40 km south) and Karnet (approximately 10km north)
EMRC (2004) Orion LTFMP report 2004 Final	Location: Willowdale -north east portion of Orion region (two healthy forest and two dieback forest plots, two steam zone plots and two plots in rehabilitation) The LTMFP was reviewed in 2003 (Majer, 2003) which included a recommendation for a similar program to be established at Orion so that any differences in faunal successional processes taking place at Willowdale could be detected. Similar techniques to those used at Jarrahdale, Huntly and McCoy. Mammals recorded during the survey included the Chuditch, Quokka, Mardo, Dunnart, Common Brushtail Possum, Western Brush Wallaby. Only one mammal species was recorded in the young rehabilitation (Feral Mouse). Forty one bird species was recorded including the Baudin's Cockatoo. Bird numbers were highest at steam sites and lowest at rehabilitated sites. Six reptile species were recorded compared with 15 species recorded in the 1999 pre-mining survey. Three frog species were recorded. Fifty ant species were recorded. Further monitoring was recommended to determine successional patterns.	Willowdale (within 20 km of the far southern boundary of the Study Area)
EMRC (1999) A fauna survey of planned mining areas at Alcoa's Orion Mining region	Location: Orion mining region at Willowdale This report provides the results of the fauna survey conducted between February and November 1999. The habitats monitored were poorly surveyed in current mining areas, extensive dieback affected areas, small dieback free areas and on sites where mining operations are planned. A total of 46 bird species, nine mammals (6 native, 3 introduced), 13 reptiles and five frogs was recorded. These included three rare species (the Chuditch, Baudin's Cockatoo and possibly the Quokka) and one Specially Protected species (the Carpet Python). As well as these, the Noisy Scrub-bird has been reintroduced into the area and the uncommon Brush-tailed Phascogale is present albeit in low densities. The fauna of the Orion area was largely comparable to that of existing Willowdale mining areas. Results emphasise the need for ongoing fox control. Rehabilitation using Jarrah and other indigenous species offers the best prospects of successfully recreating suitable habitat for the species. Eleven recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Willowdale (within 20 km of the far southern boundary of the Study Area)

Project	Location and key findings	Location in relation to this Survey Area
EMRC (2007c) A Vertebrate Fauna Survey of Rehabilitated Areas at Alcoa's Willowdale Minesite	Location: Willowdale (rehabilitated bauxite mine sites) This report details the 2007 results of the long term fauna monitoring. Previous monitoring events occurred in 1994, 2000 (following fox control) and again in 2007. In the 2007 survey a total of 25 bird species, 10 mammals (seven indigenous, three introduced) and five reptiles was recorded in rehabilitation. They included three rare species, viz. the Chuditch, Brush-tailed Phascogale and Forest Red-tailed Black Cockatoo. Numbers of native mammals trapped in rehabilitation were higher than in previous years, with Yellow-footed Antechinus increasing from 0 in 1994 to 6 in 2007; Brush-tailed Phascogales increased from 0 to 1 and Chuditch increased from 0 to 3. Bird species had declined since the 2000 survey. Total numbers of both insectivores and honeyeaters both showed large declines between 1994 and 2000. There was a gradual decline in numbers of the skink *Acritoscincus trilineatum* as the rehabilitated sites become more like upland forest habitat and less suitable for this species. Fifteen recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles	Willowdale (within 20 km of the far southern boundary of the Study Area)
EMRC (2001b) A Vertebrate Fauna Survey of rehabilitated areas at Alcoa's Willowdale Minesite	Location: Willowdale (rehabilitated bauxite mine sites) This report details the 2000 fauna monitoring event results after the introduction of fox control following the 1994 monitoring event. A total of 31 bird species, nine mammals (five introduced, four indigenous) and five reptiles was recorded. Although not trapped or recorded in the present survey, both the rare Chuditch and the specially protected Carpet Python have been recently recorded in rehabilitation at Willowdale. Numbers of native mammals trapped in rehabilitation were low, as in 1994. Some evidence suggests that Fox predation may still be a problem near farmland. The 31 bird species recorded in the 2000 survey is less than the 45 recorded in 1994. The five reptile species recorded indicate that the rehabilitation has not yet become more suitable for this fauna group. Fifteen recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Willowdale (within 20 km of the far southern boundary of the Study Area)

4. Survey Results

4.1 Fauna Habitats

There were eight broad fauna habitat types delineated in the Survey Area during the field survey. These habitat types are categorised based on flora species, hydrology, soil and topography. They align with the vegetation types identified by Mattiske (2021). The habitat types recorded in the Survey Area are described in Table 20 and mapped in Figure 5a and 5b, Appendix A. The broad fauna habitat types are:

– Jarrah-Marri forest
– Bullich forest
– Granite outcrop
– Blackbutt forest
– Flooded Gum woodland
– Melaleuca dampland
– Mine rehabilitation
– Pine plantation.

In addition to the fauna habitats listed above, a small proportion (0.7%) of the Survey Area comprised cleared rural land. These areas are included in Figure 5a and 5b, Appendix A. They have limited habitat values due to lack, paucity, or low quality of intact native vegetation.

4.1.1 Fauna habitat linkages

The Survey Area represents a large continuous tract of forest with good connectivity to all habitats directly adjacent.

4.1.2 Quality of habitat

Whilst the vegetation is mostly intact the impact by logging, frequent and extensive fire and dieback in some areas were evident. Despite this the habitat presents a large contiguous intact forest with multiple habitat types suitable for large ranging species such as the Chuditch, Brush-tailed Phascogale and Western Brush Wallaby.

The granite outcrop habitat provides quality resources (refuge, breeding, feeding and disbursal) for a diverse suite of fauna particularly reptiles. However some areas of granite outcrop are damaged in the form of broken/shattered rocks with tyre tracks observed over portions of outcrops. This may impede on species density as damaged habitat reduces the opportunity for species to hide or create refuge.

The forested areas covering the majority of the Survey Area were in very good to excellent condition (with respect to disturbance) with the exception of some areas of dieback infestation and some areas of recent timber harvesting. The forested habitats provided an array of micro-habitats such as logs, hollows, leaf litter, soft sand and dense foliage with a broad range of floristic species providing a range of foraging, roosting, denning and sheltering habitat. However prescribed burning in spring of 2020 destroyed several known Black Cockatoo breeding hollows in a patch of Bullich forest in the northern portion of the Survey Area (Tony Kirkby pers.comm). The same burn destroyed known Quokka habitat along the densely vegetated drainage line. This is based on Quokka detection during the current survey. Inappropriate fire frequency, intensity and extent can have adverse impacts on habitat quality for significant species and broader fauna assemblages.

Small streams were recorded throughout the Survey Area which provide accessible drinking water to fauna. Most of the streams appear to be seasonal however the Serpentine Dam lies adjacent south of the Survey Area which provides accessible drinking water year-round, particularly to birds. Floodplains were associated with some of the streams that provide suitable Quokka habitat as well as where frogs were recorded during both survey phases.

Table 20 Major habitat types within the Survey Area

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Extent (ha)	Percentage of Total Survey Area	Representative Images
Blackbutt Forest Blackbutt open forest with occasional Bullich, and Marri over sparse *Banksia littoralis* over *Trymalium, Macrozamia, Xanthorrhoea preissi*, over *Lepidospermum tetraquetrum*, *Astartea scoparia* and areas of dense Swamp peppermint (*Taxandria linearifolia*). This habitat is limited to localised patches often associated with creeks and drainage lines. Disturbance factors include frequent fire, feral pigs, dieback, damage caused rock removal, trail bike and 4WD on granite. **Fauna Species recorded during survey:** Provides habitat for a range of small forest and woodland birds such as Rufous Treecreeper, Golden Whistler, and Grey Shrike Thrush. Low dense understory provides shelter and suitable corridors for Quokka and Quenda. Forest reptiles recorded include Rosenburg Monitor and Southern Carpet Python. **Habitat for conservation significant species** Western Brush Wallaby, Quenda, Quokka, Chuditch and Western False Pipistrelle. Breeding and roosting habitat for all three Black Cockatoo species.	CW, AW, AW/AX, AX/CW, C	673	14	687	3.9%	
Bullich forest. Valleys and drainage areas dominated by Bullich (*Eucalyptus megacarpa*) and with some Black Butt (*E. patens*), occasional Marri (*Corymbia calophylla*), over Sheoak (*Allocasuarina fraseriana*), *Banksia littoralis* over Grass trees (*Xanthorrhoea preissii*), Bracken fern, patches of dense *Gahnia trifida* shrubland over *Lasiopetalum floribundum*, sedges and herbs. Substrate is dark clayloam soil. These areas are associated with seasonal creeks and drainage areas. This habitat is limited in extent to localised patches within the Survey Area. Disturbance factors include frequent fire, feral pigs, dieback. **Fauna species recorded during survey:** Provides habitat for a range of forest and woodland birds and frogs such as Ticking frog. Quokka and Quenda were recorded via camera within dense understory and shrub areas of this habitat. Potential breeding habitat for Black Cockatoo species, and nesting has been confirmed in areas of old growth Bullich (Tony Kirkby pers.comm). **Habitat for conservation significant species:** Black Cockatoos, Chuditch, Quokka, Quenda, Western Brush Wallaby, Masked Owl, Brush-tailed Phascogale, Western False Pipistrelle.	W, WA	239	28	267	1.5%	

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Extent (ha)	Percentage of Total Survey Area	Representative Images
Flooded Gum woodland Flooded Gum (*E. rudis*) open woodland with occasional Blackbutt, over open to open to sparse *Banksia littoralis* over Prickly Moses (*Acacia pulchella*), myrtaceous species such as Swamp peppermint (*Taxandria linearifolia*), *Astertea scoparia Trymalium odoratissimum*, low shrub/sedgeland. Substrate varies from dark grey to grey brown sandy clays. Associated with poorly drained broad valleys forming seasonal swamps and occasionally tall open forest along drainage lines. Disturbance factors include frequent fire, feral pigs. **Fauna Species recorded during survey:** Provides habitat for a range of woodland shrubland birds such as Scrubwrens, Fairy-wrens, and nectar feeding birds such as Honeyeaters, wattlebirds and parrots. **Habitat for conservation significant species** Chuditch and potential foraging habitat for Black Cockatoos. Favoured areas for Western Brush Wallaby. In areas of dense Myrtaceous thicket (low fire frequency) this provides refuge and movement corridors for Quokka and Quenda.	AC, AD, AX	674	13	688	2.9%	
Granite outcrop Granite outcrops with associated lithic vegetation complexes and adjacent associated fringing open Jarrah and Marri areas with scattered Sheoak, Melaleuca, *Banksia ilicifolia* over occasional Grass trees over mixed open heath communities of Myrtaceous and Proteaceous low shrubs. Soils are pale grey to yellowish fine sand or sandy clay. Granite outcrops often associated with seasonal watercourse and seasonally damp areas. This habitat found as localised patches throughout the Survey Area. Disturbance factors include frequent fire, feral pigs, dieback, damage caused by rock removal, trail bike and 4WD on granite. **Fauna Species recorded during survey:** Provides shelter and foraging for a range of reptile and frog fauna e.g. Ornate Crevice-dragon, Barking Gecko, Speckled stone gecko, Gould's hooded snake, Southern Carpet Python, and Black-headed Monitor. Associated water courses provide seasonal breeding for locally common frog species such as Quacking froglet and Moaning frog. Two Death Adders were also recorded on this habitat. **Habitat for conservation significant species:** Foraging and denning habitat for Chuditch. Habitat for Western Brush Wallaby, Southern Death Adder, and Dell's Ctenotus. Fringing open forest provides foraging and potential breeding habitat for Black Cockatoo species.	R, G, G1, G2, RG	366	7	373	2.1%	

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Extent (ha)	Percentage of Total Survey Area	Representative Images
Jarrah – Marri forest *E. marginata* and *C. calophylla* open forest over Grass trees (Xanthorrhoea preissi), *Lasiopetalum floribundum*, Macrozamia mid shrubland. Patches have dominance of understory *Allocasuarina fraseriana* and *Banksia grandis*. Often with complex mosaic of low shrubs such as Fabaceae , Hibbertia, Leucopogon, Adenanthos, and Pteridium. This is the most extensive habitat identified and comprises a number of vegetation types dominated by Jarrah on upper, mid and low slopes and broad valleys. Soils range from well drained gravely sand to sandy clay loam. Historical logging is a significant disturbance factor: extensive areas of forest are at varying ages of regeneration. Other disturbances include frequent fire (significant), feral pigs, dieback, trail bike, 4WD and dumped rubbish including weed plants. **Fauna species recorded during survey:** Provides habitat for a range forest and woodland birds such as Thornbills, Rufous Treecreeper, Pardalotes, Sitella, and Purple-crowned Lorikeet. All three Black cockatoo species observed feeding extensively throughout. Forest reptiles include Crevice Skink (*Egernia napoleonis*). Gould's Monitor (*Varanus gouldii*), *Lerista distinguenda*, and Southern Blind Snake (*Anilios australis*). Small mammals include forest micro-bats, and Mardo (*Antechinus flavipes*). Other species include Echidna, Western Brush Wallaby, Peregrine Falcon and Western Grey kangaroo. **Habitat for conservation significant species:** Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Peregrine Falcon, Masked Owl, Western False Pipistrelle, Dell's Skink, Southern Death Adder. Foraging and potential roosting habitat for all three locally occurring Black Cockatoo (*Calyptorhynchus*) species. Breeding habitat for all three Black Cockatoo species.	D, DA, DG, E, J, M, P, PG, PJ, PT, PS, PW, S, SP, ST, T, SW, TP, TS, Q	14,601	121	14722	83.2%	
Melaleuca dampland. Paperbark (*Melaleuca pressiana*) over sparse isolated *Banksia littoralis* over open Hakea, occasional Woody Pear (Xylomelum), Grass trees and over mixed shrublayer of Cyperaceae, Restionaceae, Babingtonia, Jacksonia and Acacia, over low shrubs, sedges and herbs. There are areas of sparse to occasional stunted Jarrah and Marri however these are limited to lowland transitional zones adjacent to slightly higher elevation and drainage open forest areas. Generally limited to areas of poor drainage and subject to winter inundation such as broad valleys and swamps. Substrate is grey gravely clay and clay loam. Disturbance factors include frequent fire and feral pigs. **Fauna species recorded:** Provides habitat for a range forest and woodland birds. Black cockatoo species forage on Banksia, Hakea and occasional Jarrah and Marri. Several frog species breed seasonally such as Glauert's Froglet (*Crinia glauerti*) and Moaning Frog (*Heleioporus eyrei*). Reptiles include Cool Skink (*Acritoscincus trilineatum*), and Earless Skink (*Hemiergis initialis*). Small mammals include forest micro-bats, and Mardo (*Antechinus flavipes*). Other species include Echidna, Western Brush Wallaby and Western Grey kangaroo. **Habitat for conservation significant species during survey:** Western Brush Wallaby, Western False Pipistrelle. Foraging habitat for all three locally occurring Black Cockatoo (*Calyptorhynchus*) species although Jarrah and Marri are generally stunted and sub-optimal for potential breeding habitat. Where creek lines or dense vegetation is present Quokka and Quenda reside.	A	130 ha	0	130	0.7%	

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Extent (ha)	Percentage of Total Survey Area	Representative Images
Mine rehabilitation Historic mine rehabilitation (> 20 years old) of the Jarrahdale Mine. This is historic rehabilitation under previous completion criteria and not representative of current or future rehabilitation programs. These areas are Jarrah dominated 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.	Rehab	387	14	402	2.4%	Image not available
Pine plantation These are monocultures of Pine timber tree species (Pinus). 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.	PL	162	0	162	0.9%	Image not available

4.2 Fauna Diversity

The combined fauna surveys (Phase 1 and Phase 2) recorded 132 vertebrate fauna species utilising the Survey Area, including 23 mammals, 76 birds, 26 reptiles and 7 amphibians. A breakdown of the fauna assemblage is provided below.

4.2.1 Mammals

The combined surveys recorded 23 mammal species from 12 families within the Survey Area including six species of introduced mammals and 17 native mammal species. The most specious family was the Dasyuridae and Vespertilionidae (both with four species) and Macropod (three species). Six micro-chiropteran bats were positively identified from call analysis and further two species were unconfirmed. Seven of the mammal species recorded are listed as conservation significant and are further discussed in section 4.3.

A breakdown of mammal families recorded during the surveys is provided in Table 21.

Table 21 Mammal families recorded during the field survey

Mammal Family	Number of species	
	Phase 1	Phase 2
Canidae (Fox)	1	1
Dasyuridae (Dasyurid mammals)	3	4
Felidae (Cat) (domestic)	1	1
Leporidae (Rabbit)	1	1
Macropodidae (Kangaroo)	3	3
Molossidae (Free-tail Bat)	2	2
Muridae (Rodent)	2	3
Peramelidae (Quenda)	1	1
Phalangeridae (Possum)	1	1
Suidae (Wild pig)	1	1
Tachyglossidae (Short-billed Echidna)	1	1
Vespertilionidae (Simple-nosed Bats)	4	4
Total	**21**	**23**

4.2.2 Birds

Bird surveys identified 76 bird species from 36 families over the combined Phase 1 and Phase 2 surveys. The most specious families were the Meliphagidae (8 species), Acanthizidae (6 species) and Psittaculidae (6 species). Five of the bird species recorded are listed as conservation significant and are further discussed in section 4.3.

No migratory shorebirds were recorded during the survey. The phase 2 survey coincided with the seasonal occurrence of shorebirds across the southwest region. The survey area lacks open water including shallow shorelines for foraging habitat. The creek lines and vegetated dampland areas within the survey area are not suitable. Therefore, they are unlikely to occur within the survey area, and any occurrence would be as vagrant visitation due to proximity of Serpentine Reservoir.

A breakdown of bird families recorded during the survey is provided in Table 22.

The Masked Owl (*Tyto novaehollandiae*) was specifically targeted for assessment utilising SM4 Acoustic Song Meters in suspected habitat areas as shown in Table 6 and Figure 3, Appendix A. Song Metres recorded 25 opportunistic bird species and detected the presence of Masked Owl during the Phase 1 survey with no detections during the Phase 2 survey. A comprehensive detailed summary of the results of the Acoustic Song meters is provided in Appendix D.

It should be noted that Song Meters were placed at targeted Masked Owl habitat during the Phase 1 survey and deployed to fill in ‘gaps’ in the Phase 2 survey to increase coverage over the Survey Area and indicate distribution of Masked Owl.

Table 22 Bird families recorded during the field surveys

Bird Family	Number of species	
	Phase 1	Phase 2
Acanthizidae (Weebill/Gerygone)	5	6
Accipitridae (Diurnal birds of prey)	1	2
Aegothelidae (Nightjar)	0	1
Alcedinidae (Kingfisher)	1	2
Anatidae (Duck)	2	1
Artamidae (Magpie group)	3	5
Cacatuidae (Cockatoo group)	3	4
Campephagidae (Cuckoo-shrikes)	1	1
Casuariidae (Emu)	1	1
Charadriidae (Lapwing)	1	0
Climacteridae (Tree Creeper)	1	2
Columbidae (Pigeon)	2	1
Corvidae (Crow, Raven)	2	1
Cuculidae (Cuckoos)	1	1
Dicaeidae (Flowerpeckers)	1	0
Estrildidae (Finches)	0	1
Falconidae (Falcons)	0	1
Hirundinidae (Swallows)	2	1
Locustellidae (Songlark)	1	0
Maluridae (Wrens)	3	2
Meliphagidae (Honeyeaters)	3	8
Meropidae (Bee-eater)	0	1
Monarchidae (Lark)	1	1
Neosittidae (Sitellas)	0	1
Pachycephalidae (Whistlers)	3	3
Pardalotidae (Pardalotes)	0	2
Petroicidae (Robin)	3	3
Podargidae (Frogmouths)	1	1
Psittaculidae (Parrots)	3	6
Rhipiduridae (Fantail)	1	1
Rallidae (Rails)	1	0
Strigidae (True Owls)	1	1
Threskiornithidae (large wading birds)	0	1
Turnicidae (Quail)	1	1
Tytonidae (Owl)	1	0
Zosteropidae (Silvereye)	1	1

Bird Family	Number of species	
	Phase 1	Phase 2
Total	**51**	**64**

4.2.3 Amphibians

A combined total of seven amphibians from three families were recorded during the Phase 1 and Phase 2 surveys. The most species family was Myobatrachidae (three species). No conservation significant amphibians were recorded during this time. A breakdown of amphibians recorded during the survey is provided in Table 23.

Table 23 Amphibian families recorded during the field surveys

Amphibian Family	Number of species	
	Phase 1	Phase 2
Myobatrachidae (Quacking/Bleating Frog)	3	2
Limnodynastidae (Moaning Frog)	1	1
Pelodryadidae (Slender tree Frog)	1	1
Total	**5**	**4**

4.2.4 Reptiles

A combined total of 26 reptile species from nine families were recorded during the Phase 1 and Phase 2 surveys. The most specious family was Scincidae (10 species) followed by Elapidae (four species). One conservation significant reptile was recorded during the survey which is further discussed in section 4.3.

A breakdown of reptile families recorded during the survey is provided in Table 24.

Table 24 Reptile families recorded during the field surveys

Reptile Family	Number of species	
	Phase 1	Phase 2
Agamidae (Dragons)	1	2
Boidae (Pythons)	1	1
Carphodactylidae (Terrestrial Geckoes)	1	0
Elapidae (Snakes)	2	4
Gekkonidae (Geckos)	1	2
Pygopodidae (Legless Lizards)	0	1
Scincidae (Skinks)	8	9
Typhlopidae (Blind Snakes)	0	1
Varanidae (Monitors)	3	2
Total	**17**	**22**

4.2.5 Introduced Species

Mammals comprised the main group in which introduced fauna were recorded. In total eight species were observed and included:

– Feral Pig (*Sus scrofa*)
– European Fox (*Vulpes vulpes*)
– European Rabbit (Oryctolagus cuniculus)
– Black Rat (Rattus rattus)

– House Mouse (*Mus musculus*)
– Feral cat (*Felis catus*)
– Rainbow Lorikeet (*Trichoglossus moluccanus*)
– Laughing Kookaburra (*Dacelo novaeguineae*).

These species are considered feral to the region.

4.3 Conservation Significant Fauna

Thirteen conservation significant fauna species were recorded within the Survey Area during the surveys. This includes:

– Baudin's Cockatoo (*Calyptorhynchus baudinii*) – listed as Endangered under the BC Act and Endangered under the EPBC Act.
– Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – listed as Endangered under the BC Act and Endangered under the EPBC Act.
– Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act.
– Quokka (*Setonix brachyurus*) – listed as Vulnerable under the BC Act and the EPBC Act.
– Chuditch (*Dasyurus geoffroii*) listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act.
– Peregrine Falcon (*Falco peregrinus*) listed as Special Protection (Schedule 7) under the BC Act.
– Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) listed as Conservation Dependent by DBCA.
– Masked Owl Southwest (*Tyto novaehollandiae novaehollandiae*) listed as Priority 3 by the DBCA.
– Rakali (*Hydromys chrysogaster*) listed as Priority 4 by the DBCA.
– Quenda (*Isoodon fusciventer*) – listed as Priority 4 by the DBCA.
– Western Bush Wallaby (*Notamacropus Irma*) – listed as Priority 4 by the DBCA.
– Southern Death Adder (*Acanthophis antarcticus*) listed as Priority 3 by the DBCA.
– Western False Pipistrelle (*Falsistrellus mackenziei*) listed as Priority 4 by the DBCA.

Likelihood of occurrence assessment

In addition to the field survey results, an assessment of the likelihood of conservation significant species occurring in the Survey Area was undertaken. This assessment is based on species' biology, habitat requirements, the quality and availability of suitable habitat as determined during the field survey and records of the species in the Survey Area and locality. The *NatureMap* database identified 185 terrestrial vertebrate fauna species previously recorded within the Study Area. This total comprised of 113 birds, 32 reptiles, 28 mammals and 12 amphibians. Of the 185 fauna species previously recorded, 177 are native species and eight are naturalised (introduced) species. The EPBC Act PMST search detected an additional four threatened bird species as potentially occurring within the Study Area and the DBCA Threatened and Priority Fauna database returned one additional mammal within the Survey Area. Based on the above database searches and GHD observations, fourteen conservation significant terrestrial vertebrate taxa were identified as likely to occur or present within the Survey Area.

With regard to migratory shorebirds, the survey area lacks open suitable foraging habitat, namely shorelines or extensive shallow open water. The creek lines and vegetated seasonal dampland areas within the survey area are not considered suitable foraging habitat and in most cases are dry during the period of migratory bird use in the south west of Western Australia. Therefore, they are unlikely to occur within the survey area, and any occurrence would be as rare vagrant.

Table 25 summarises the species of conservation significance that are either known or considered likely to occur in the Survey Area. A brief description of these species and their associated habitat types within the Survey Area are described below. The parameters of assessment for this likelihood of occurrence assessment and the full likelihood of occurrence assessment are provided in Appendix D.

Table 25 Summary of likelihood of occurrence assessment for conservation significant fauna

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
Birds			
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	EN	EN	Known. The species was recorded during the survey and shown in Figure 4d, Appendix A.
Carnaby's Cockatoo (*C. latirostris*)	EN	EN	Known. The species was recorded during the survey and shown in Figure 4d,Appendix A.
Forest Red-tailed Black Cockatoo (*C. banksii naso*)	VU	VU	Known. The species was recorded during the survey and shown in Figure 4b, Appendix A.
Peregrine Falcon (*Falco peregrinus*)	-	SP	Known. One individual was recorded during the survey and the Jarrah Marri forest within the Survey Area is suitable nesting habitat.
Masked Owl (southwest) (*Tyto novaehollandiae novaehollandiae*)	-	P3	Known. The species was recorded on acoustic recorders during the survey and shown in Figure 4c, Appendix A.
Mammals			
Western False Pipistrelle (*Falsistrellus mackenziei*)	-	P4	Known. This species was recorded on Song Meters in both the Phase 1 and Phase 2 surveys. Suitable habitat is available to support this species.
Chuditch (*Dasyurus geoffroii*)	VU	VU	Known. This species was recorded on two remote cameras during Phase 1 and Phase 2 of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.
Quenda (*Isoodon fusciventer*)	-	P4	Known. The species was recorded via cage trapping, remote cameras and diggings during the survey and shown in Figure 4c, Appendix A.
Quokka (*Setonix brachyurus*)	VU	VU	Known. The species was recorded on remote camera during the Phase 1 and Phase 2 of the survey shown in Figure 4a, Appendix A. The species appears to be wide spread and associated with riparian areas and damplands.
Brush tailed Phascogale (*Phascogale tapoatafa wambenger*)	-	CD	Known. At least three individuals were recorded on one remote camera within the Survey Area. Suitable habitat occurs within Survey Area.
Western Brush Wallaby (*Notamacropus irma*)	-	P4	Known. The species was recorded throughout the Survey Area as shown in Figure 4c, Appendix A.
Rakali (*Hydromys chrysogaster*)		P4	Known. The species was recorded on one remote camera along a flowing stream section of Big Brook that bisects the proposed conveyor location shown in Figure 4c, Appendix A.
Reptiles			
Southern Death Adder (*Acanthophis antarcticus*)	-	P3	Known. The species was recorded during the survey near granites near to Serpentine Dam and shown in Figure 4c, Appendix A. Suitable forest and rocky habitat occurs within Survey Area.
Dell's Skink (*Ctenotus Delli*)		P4	Likely. The species has previously been recorded in the region and habitat is present for the species.

Legend:
CD= Conservation dependent fauna
CR = Critically endangered under the EPBC Act or BC Act
EN = Endangered under the EPBC Act or BC Act
VU = Vulnerable under the EPBC Act or BC Act
SP (S7) = Schedule 7, Special Protection under BC Act
P3 = Priority 2 under DBCA, poorly known species.
P4 = Priority 4 under DBCA, rare, near threatened and other species in need of monitoring.

Fauna species recorded in the Survey Area

Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso)

The Forest Red-tailed Black Cockatoo is listed as Vulnerable under the EPBC Act and BC Act.

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and sub-humid zones of Western Australia (Mawson and Johnstone 1997). It inhabits the dense Jarrah, Karri (*E. diversicolor*) and Marri forests receiving more than 600 mm of annual average rainfall. The current distribution is north of Perth and east to Mount Helena, Christmas Tree Well, North Banister, Mt Saddleback, Rocky Gully and the upper King River (Johnstone 1997). More recently the species has been utilising and persisting on the northern portions of the Swan Coastal Plain and is now considered a regular sighting (Johnstone *et al* 2017). Habitats in which Forest Red-tailed Black Cockatoos occur at Bungendore Park and Jarrahdale, have an understorey of Bull Banksia (*Banksia grandis)*, Snottygobble (*Persoonia longifolia)*, Sheoak (*Allocasuarina fraseriana)* and *Banksia* spp., with scattered Blackbutt (*E. patens)* and Wandoo (*E. wandoo)* (Johnstone & Kirkby 1999). Forest Red-tailed Black Cockatoos roost in Jarrah-Marri-Blackbutt habitat on road-sides, paddocks or forest blocks. While the Forest Red-tailed Black Cockatoo feeds on the seeds of other species, around 90 per cent of its diet is made up of the seeds from Marri and Jarrah fruits.

Forest Red-tailed Black Cockatoos have been recorded breeding in both Myara and Myara North, particularly at the Yamba area at the west of Myara and near the Tuart/Acacia Road area at the north-west of Myara North (T. Kirby, pers. comm.). Breeding is recorded in Jarrah, Marri (majority), Bullich and Blackbutt. Breeding has been recorded from adjacent areas including Serpentine National Park, Wungong Catchment, 39 Mile Brook area and Monadnocks Nature Reserve.

Significant Forest Red-tailed Black Cockatoos roost sites are known from the Myara North region at Jarrahdale Road/Albany Highway (350 birds but usually 50-60) and Jarrahdale Road near Jarrahdale (100 birds) (Johnstone and Kirkby unpublished data).

Forest Red-tailed Black Cockatoos were recorded at 149 locations throughout the Survey Area with approximately 280 physical observations recorded during Phase 1 and 91 physical observations during Phase 2. Individuals were recorded in flight, feeding or calling throughout the Survey Area. Foraging evidence, predominantly chewed Marri and Jarrah pods, was recorded throughout the Survey Area. All observations have been mapped and are presented in Figure 4b and 4d, Appendix A.



Plate 1: Forest Red-tailed Black Cockatoo image captured during winter survey

Baudins Cockatoo (Calyptorhynchus baudinii)

Baudin's Cockatoo is listed as Endangered under the EPBC Act and BC Act.

Baudin's Cockatoo is endemic to the south-west of Western Australia. The range of Baudin's Cockatoo varies considerably between the breeding and non-breeding seasons. During the breeding season (from October to January), the species nests in the far south-west of WA within Jarrah, Marri and karri forests which receive an average of 750 mm of rainfall annually. Breeding generally occurs in woodland or forest, but may also occur in former woodland or forest now present as isolated trees. Breeding has been recorded at Perth Hills, Lowden (Johnstone & Storr 1998), Serpentine (hills area), and to the east at Kojonup (Johnstone & Kirkby 2008). Nesting occurs in hollows of live or dead karri, Marri, wandoo and tuart (*Eucalyptus gomphocephala*) trees (DSEWPaC 2012). During the breeding season feeding primarily occurs in native vegetation, particularly Marri (DSEWPaC 2012). The range then expands during the non-breeding season (from February) as flocks forage more widely, congregating on the central and northern parts of the Darling plateau, as far as Mundaring and Gidgegannup (DSEWPaC 2012; Saunders 1974 & 1979). Some pockets of breeding have also been recorded around Augusta, Northcliffe, Walpole, Denmark and Albany (DSEWPaC 2012).

Baudin's Cockatoo has been recorded breeding in both the Myara and Myara North regions, though only in low numbers. Most breeding appears to be in the Solus Road area at the border of the Myara and Myara North regions (Alcoa, T. Kirkby unpublished data). Limited breeding also occurs in Bullich and Marri at the border of the Wungong Catchment and 39 Mile Brook Catchment areas approximately 5 km to the north of the Survey Area.

Within close proximity of the Survey Area Baudin's Cockatoo are known to roost in Bullich at Dirk Brook Road and Gobby Road (up to 350 birds) at the west of Myara (Johnstone and Kirkby unpublished data). The species is known to roost in Bullich at the Karnet area north of Kingsbury Drive (100 birds) and in smooth white barked exotic eucalypts at Turner Road (150 birds) south of Jarrahdale at Myara North (Alcoa, T. Kirkby unpublished data).

Flocks of between one and 40 Baudin's Cockatoo were observed during the surveys, including some mixed Baudin's - Carnaby's Cockatoo flocks noted based on bill length. All observations have been mapped and are presented in Figure 4a and 4d, Appendix A.

Carnaby's Cockatoo (Calyptorhynchus latirostris)

Carnaby's Cockatoo is listed as Endangered under the EPBC Act and BC Act.

Carnaby's Cockatoo (*C. latirostris*) is endemic to the south-west of Western Australia with a wide-spread distribution. Carnaby's Cockatoo nest in hollows of live or dead eucalypts, primarily smooth-barked Salmon Gum and Wandoo (Saunders 1979, 1982) though breeding has been reported in other Wheatbelt tree species and some tree species on the Swan Coastal Plain and Jarrah forest (Saunders 1979, 1982; Storr 1991; Johnstone and Storr 1998). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Saunders 1977, 1986; Saunders and Ingram 1987). Along with the trees that provide nest hollows, the protection, management and increase of this feeding habitat that supports the breeding of Carnaby's Cockatoo is a critical requirement for the conservation of the species.

Carnaby's Cockatoos have been recorded breeding in the Myara region and two nests are present in Marri at the west of the area near Scarp Road. Breeding is expected to occur at the south of Myara North in the vicinity of Solus Road and Mountain Road based on seasonal observations (Alcoa, T. Kirkby unpublished data). Breeding has been recorded in Marri at the Wungong Catchment and 39 Mile Brook Catchment approximately 5 km to the north (Johnstone and Kirkby unpublished data). More breeding may be recorded with greater survey effort as there are records of lone males in a few areas during the breeding season which may indicate that females are at the hollow either incubating an egg or brooding a chick (T. Kirby, pers. comm.). Carnaby's Cockatoos foraging evidence was recorded with foraging activity observed throughout all forest and woodlands habitats. A range of plants in utilised including Eucalyptus, Corymbia, Banksia, and records of foraging on *Hakea undulata* and Jarrah, along Frollett Road and Albany Highway at Myara North (Alcoa/T.Kirkby unpublished data). Pine plantation (Pinus) within the Study Area also represent a high value seasonal foraging resource. Foraging resources across the site are of high value particularly given the presents of potential and known breeding trees present within and in proximity to the foraging habitat.

Carnaby's Cockatoo were recorded at several locations throughout the Survey Area with a total of approximately 443 birds observed during the winter survey. Observations of flocks ranging from 5 and 200 Carnaby's Cockatoo were recorded. More individuals were recorded in the northern portion of the Survey Area; however evidence of them was observed throughout the entire Survey Area. Their locations were present in pine trees (feeding, calling and flying to and from). All observations have been mapped and are presented in Figure 4b and 4d, Appendix A.



Plate 2: Carnaby's Cockatoo image captured during winter survey

Masked Owl (southwest) (Tyto novaehollandiae novaehollandiae)

The Masked Owl is listed as Priority 3 by DBCA.

The Masked Owl occurs in open forest and woodland, and roosts among dense foliage in gullies, or in caves or tree hollows (Peake *et al* 1993, Kavanagh & Murray 1996, Liddelow, Wheeler and Kavanagh, 2002). Habitat is known to be woodland or open forest with cleared agricultural land nearby. The Masked Owl occurs mainly in the woodland region or where agricultural land intrudes into the heavier forest (Liddelow, Wheeler and Kavanagh, 2002).

During the winter field survey, a total of 132 calls attributable to Masked Owls were recorded at two locations within the middle portion of the Survey Area. Their locations were present in Jarrah Marri forest associated to properties along Kingsbury Drive near to Serpentine Dam. One of the locations where the Masked Owl was detected (SM4-AC2 – Object ID 119) was near Serpentine Dam on the northern side. Due to the distance apart, timing of calls and numbers of calls the data is likely at least one pair of Masked Owl is present (see Appendix D). No other locations were recorded for the species despite the entire Survey Area being suitable for the species. All observations have been mapped and are presented in Figure 4c, Appendix A.

A detailed summary of the acoustic recordings of the Masked Owl is provided in Appendix D.

Quenda (Isoodon fusciventer)

The Quenda is listed as Priority 4 by DBCA.

The Quenda has patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain. Its habitat is generally dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses (Braithwaite, 1995).

Over the course of the surveys Quenda was recorded at 21 locations within the Survey Area via trapping, remote cameras and opportunistically. Three of these locations are within cage traps, 13 are on cameras and five are opportunistic sightings. Quenda locations are spread widely across the Survey Area; however almost half (ten) records are from the northwest portion. Habitat preference tends to be associated with areas of low dense vegetation along drainage lines and damplands. These areas are providing adequate cover from predators.

All observations have been mapped and are presented in Figure 4c, Appendix A.



Plate 3: Quenda recorded on a remote camera during the Phase 1 survey

Quokka (Setonix brachyurus)

The Quokka is listed as Vulnerable under the BC Act and the EPBC Act.

The current distribution of the mainland quokka includes areas through the south-west forests from Jarrahdale to Walpole. The mainland quokka lives in the Darling Range and south-west regions of Western Australia, mostly inhabiting densely vegetated swamps and sometimes tea-tree thickets on sandy soils along creek systems and dense heath on slopes. Mainland quokkas tend to hide in runs among vegetation during the day and forage along the swamp margins at night (Kitchener, D.J, 1995).

In the southern forest, quokkas occupy a range of forest, woodland and wetland ecotypes. The most commonly occupied sites comprise Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), karri (*E. diversicolor*) or tingle (*E. jacksonii* or *E. guilfoylei)* forest and riparian habitats with a sedge dominated understorey (DEC 2013). Habitat supporting a low density of near-surface fuel, a complex vegetation structure and burn patchiness are the factors favouring quokka occupancy in the southern forest (DEC 2013). The habitat critical to survival for the south coast subpopulation includes a wider range of vegetation types (floristically and structurally) than in the northern Jarrah forest, including swamps, riparian areas, incised gullies and dense coastal heath (de Tores *et al.* 2007). Habitat occupied at the Swan Coastal Plain site at Muddy Lakes consists of fringing wetland vegetation of dense bulrush (*Typha orientalis*)/pale rush (*Juncus pallidus*) sedgeland with other sedges including jointed rush (*Baumea articulata*), *Typha domingensis* and coast sword-sedge (*Lepidosperma gladiatum*) (Keighery *et al*. 2002) (DEC 2013).

During the surveys Quokkas were recorded at a total of 16 locations across the Survey Area, each associated with riparian vegetation or damplands (Figure 4a, Appendix A). This comprises the presence of Quokka from signs (scat, prints or runnels) at three locations and the recordings of Quokka on 13 remote cameras. During phase 1, 16 individual Quokka (from 20 hits) were recorded and Phase 2 20 individuals (from 76 hits) on camera based on camera independence, animal size, pouch young size, hair loss and ear damage. Some individuals can be seen below in Plate 4 and Plate 5. Between 1 and 6 individuals were recorded per site based on independent characteristics, with the number of individuals likely higher due to animals being similar. During both phases a number of females either had pouch young or young at foot suggesting recruitment across the Survey Area.

Quokka detection locations were widespread across the Survey Area but limited to areas of dense vegetation associated with drainage lines and damplands. These areas are providing sufficient cover for shelter from predators, food and are movement corridors through the landscape. It is likely Quokka are present in the region wherever drainage lines and damplands are present with long unburnt vegetation. During this survey it was found animals were persisting in dense regrowth of approximately 5-6 years old after fire. This is probably occurring due to baiting in the region under western shield as few foxes were recorded on camera.



Plate 4: Quokka adult and juvenile captured on camera during Phase 1 survey



Plate 5: Quokka adult and juvenile captured on camera during Phase 2 survey

Western Brush Wallaby (Notamacropus irma)

The Western Brush Wallaby is listed as Priority 4 by DBCA.

Western Brush Wallaby are locally common in dry sclerophyll forest and woodlands in the southwest of Western Australia (Menkhorst & Knight 2010). They are predominantly diurnal, grazing on grasses and forbs.

Western Brush Wallaby were recorded throughout much of the Survey Area with a total of 62 observations of individuals (predominantly opportunistic) recorded during the surveys. Sightings occurred mainly amongst the Jarrah Marri forest, the dominant fauna habitat type, and were more prevalent in the southern and mid portions of the Survey Area. Remote cameras recorded approximately 21 records of Western Brush Wallaby over the deployment period.

Locations of Western Brush Wallaby observations recorded during the survey are presented in Figure 4c, Appendix A.



Plate 6: Western Brush Wallaby recorded during Phase 1 survey

Southern Death Adder (Acanthophis antarticus)

The Southern Death Adder is listed as Priority 3 by DBCA.

The Southern Death Adder lives in forests and woodlands, grasslands and heath. The species is a highly cryptic generally only visible if active or sunbaking. Generally the species requires thick litter to hide.

During the Phase 1 survey two Southern Death Adders were opportunistically recorded by Mattiske Consulting at one location (or generally in the same region) within close proximity to each other during the vegetation and flora survey being undertaking for this Project. This observation have been mapped and are presented in Figure 4c, Appendix A. This species was not detected by any other method throughout either of the surveys.



Plate 7: Southern Death Adder recorded by Mattiske in winter 2020 (Image by Zac Sims)

Chuditch (Dasyurus geoffroii)

The Western Quoll or Chuditch is listed as Vulnerable under the BC Act and EPBC Act.

The Chuditch is Western Australia's largest carnivorous marsupial and is endemic to south-west Western Australia. It has mostly brown fur with distinctive white spots (40-70 white spots on its body but not on its tail). The tail is 21-35 cm long. The Chuditch is a carnivore and feeds mostly on large invertebrates. It also easts small lizards, birds and mammals. They are also known to consume the red pulp on Zamia seeds, small fruits and part of flowers. They utilise hollow logs or burrows during the day and hunt at night. It is an excellent climber, which makes it easier to catch tree-dwelling animals. Historically, Chuditch inhabited a wide range of habitats, but today it survives mostly in Jarrah *Eucalyptus marginata* forests and woodlands, mallee shrublands and heathlands (DBCA 2017a).

During the field survey the Chuditch was recorded on two remote cameras in the central north-eastern and central north-western portion of the Survey Area (Figure 4a, Appendix A). Despite the extensive survey effort (cages and cameras) no other individuals were recorded. The Survey Area contains suitable breeding and foraging/hunting habitat to support this species and a population of the species in the Survey Area.



Plate 8: Chuditch recorded on remote cameras during Phase 1 survey

Rakali (Hydromys chrysogaster)

The Rakali is listed as Priority 4 by DBCA.

Rakali live in the vicinity of permanent bodies of fresh, brackish, or marine water, lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. In the south-west of WA they have been shown to prefer areas with riparian vegetation, better water quality and a degree of habitat complexity. Woody debris, rock ledges and wetland islands are likely to be important areas for feeding and refuge (DEC 2012). It is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan 2008).

One Rakali was recorded during Phase 1 of the survey via remote camera along a flowing stream section of Big Brook that bisects the proposed conveyor alignment (Figure 4c, Appendix A). A 300 m portion of the stream (Big Brook) was actively searched for Carters Freshwater Mussel and Rakali. No Rakali middens were recorded however a small amount of Yabbi remains were discovered on a bank which indicates recent use by Rakali. Big Brook is a seasonal Brook but a main tributary of Serpentine Dam, which is likely the source origin of Water Rat in the Survey Area. A further 13 locations were assessed for Rakali (See Appendix D for Rakali Assessment results) with an additional three creeks identified as potentially suitable for Rakali. Two of these areas had cameras deployed but no additional animals were detected. No other creeks in the Survey Area were assessed as suitable for the species due to the lack of permanent water within upper sections of creeks.



Plate 9: Rakali recorded on a remote camera during Phase 1 survey

Peregrine Falcon (Falco peregrinus)

The Peregrine Falcon is listed as Special Protection (Schedule 7) under the BC Act.

The Peregrine Falcon is a large falcon species which predominantly preys aerially on medium sized birds such as Pigeon, Galah and ducks. The species prefers areas with deep gorges or large cliff faces with riparian or plain habitat surrounding. Within the south-west this species utilised forest trees as suitable nest habitat, foraging in surrounding forests and clearings. The Peregrine Falcon nests primarily on ledges of cliffs, shallow tree hollows, and ledges of buildings in cities (Morcombe 2004). The Peregrine Falcon is wide ranging, mobile and aerial in nature, and therefore is likely to utilise forest and woodland habitats within the Survey Area.

During the Phase 2 survey one Peregrine Falcon was recorded roosting in a tree at Trapline 3 (Figure 4c, Appendix A) in the south of the Survey Area. The Survey Area contains suitable breeding and hunting habitat to support this species.

Western False Pipistrelle (Falsistrellus mackenziei)

The Western False Pipistrelles is listed as Priority 4 under DBCA managed species list.

The Western False Pipistrelles is a vespertilionid bat that occurs in Southwest Australia. It is an insectivore associated with old growth forest that provides the species with its preferred foraging opportunities. Namely, flying insects are hunted around tall forest canopy in the valley between trees tops or the open areas above the mid-storey (Kitchener, Caputi & Jones, 1986). Their range is dominated by wet sclerophyll eucalypt forest and semi woodland of the southwest. Roosting sites are usually associated with old growth eucalypts containing hollows as well as within branches or tree stumps. The Western False Pipistrelle has been recorded on the Swan Coastal Plain in Banksia woodland (Kitchener, Caputi & Jones 1986).

The Western False Pipistrelle was recorded at 13 sites during both phases of the Survey Area (Figure 4c, Appendix A), suggesting a large portion of the Survey Area, including eucalyptus forest and woodland habitats are utilised for foraging and roosting.

Brush tailed Phascogale (Phascogale tapoatafa)

The Brush tailed Phascogale is listed as Conservation Dependent (CD) under the BC Act.

It occurs at low densities in the northern Jarrah forest with highest densities occurring in the Perup/Kingston area, Collie River valley and near Margaret River and Busselton. This species has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. Records are less common from wetter forests. They are most active between dusk and dawn (though emerging later in mid-winter) and forage almost exclusively among the tree canopy. Nest sites include hollow tree limbs, rotten stumps and even bird's nests. Lactating females show a preference for large tree cavities with small entrances. They are opportunistic feeders including invertebrates, nectar, small birds and small mammals (DBCA, 2017b).

The Brush-tailed Phascogale was detected during phase 2 of the survey via remote camera from Jarrah – Marri forest with Sheoak understory within the central portion of the Survey Area (Plate 10 and Figure 4c, Appendix A.). Three individuals were identified on the same camera and all appear to be sub adult and likely from the same litter. This indicates a breeding population is present in the Survey Area.



Plate 10: Brush-tailed Phascogale recorded on remote camera

4.3.1 Accumulation curve

An accumulation curve was run for the data collected during the field survey within 8 models in Primer V6 (Plate 11). Jacknife1, Chao 1, Chao2 and Jacknife2 curves demonstrate poor fit to the data, while the remaining curves reach a curve asymptote (very few new species were recorded) after trap night 10-12. For, Bootstrap, MM, Sobs and UGE somewhat model levelling is demonstrated by the end of the survey indicating that of the species active at the time of the survey a majority of them were sampled prior to the end of the project. This is also comparable to the raw data of which the known species in the region (of native reptile, small mammal and frogs) approximately 51 could utilise the habitats present in the Survey Area (based on NatureMap records) where this study recorded 41.

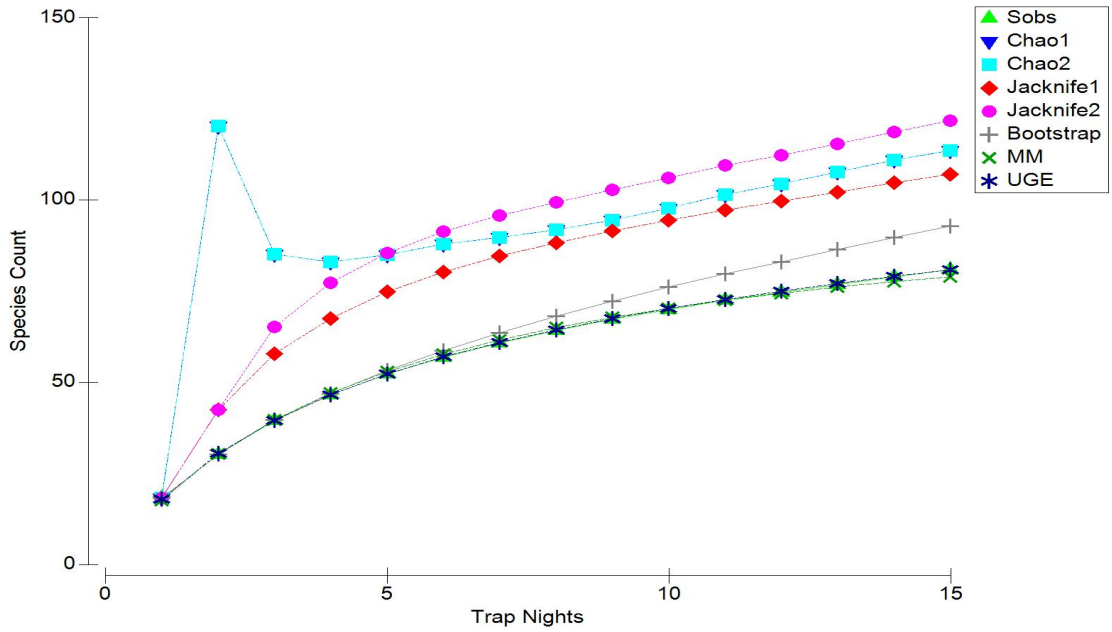


Plate 11: Species accumulation over time

4.3.2 Black cockatoo habitat assessment

The Black Cockatoo habitat assessment focussed on qualifying and quantifying the breeding habitat values for Black Cockatoo species occurring within the Survey Area. Due to the scale of the Survey Area, thirty one (31) three hectare habitat assessment plots were sampled to determine habitat usage and potential value for Baudin's, Carnaby's, and Forest Red-tailed Black Cockatoo as described in Section 2.3.7. Table 26 presents results on potential and actual usage of cockatoo breeding habitat within the Study Area. Table 27 provides a comparison of potential breeding habitat values for the fauna habitats across the Survey Area. Table 28 presents a quality assessment of the foraging habitat within the different habitat types.

4.3.2.1 Foraging habitat

In total 112 foraging sites were recorded consisting of 106 sites of Forest Red-tailed Black Cockatoo, nine sites of Carnaby's Cockatoo and one site from Baudin's Cockatoo. Throughout the six habitat types foraging quality is either low, medium or high depending on impacts of fire and dieback (Table 28). Melaleuca Damplands appears to be particularly impacted by recent fires in the region with few foraging species present at the time of the Survey. All six habitats are useable by either one or more Black Cockatoo species as a food source which is dominated by foraging species or has scattered foraging species present throughout the habitat type.

Table 28 presents a quality assessment of the foraging habitat within the different habitat types.

4.3.2.2 Breeding habitat

From this study and Alcoa's existing data from the Study Area it is known that two main areas appear to be where most of the current breeding activity has been recorded. These areas are within and around the Bullich habitat in the central northern western portion of the Study Area and central southern portion of the Study Area (see

Figure 4d). Several scattered other breeding trees are also known. The northern western portion appears to be more Forrest Red-tailed Black dominated breeding while the other region Baudin's Cockatoo. Breeding trees are mostly in Marri however Bullich and Blackbutt are also utilised in the Study Area.

Transect data undertaken within the Study Area identified that Flooded Gum Woodland and Jarrah/Marri Forest had the greatest number of trees per hectare with a DBH of >50cm at 12 and 9 respectively. Blackbutt Forest and Melaleuca Dampland had 7, while Granite Outcrop Association and Bullich Forest had 6 and 2 respectively (Table 27). The high density of trees in Melaleuca Damplands and Granite Outcrop Association is due to ecotone vegetation, that is Blackbutt fringing Melaleuca Dampland and Marri fringing granite outcrops. During the Survey at least four nests of Forest Red-tailed Black Cockatoo were lost to a prescribed burn in the northern western portion of the Study Area.

4.3.2.3 Roosting habitat

One roost site was recorded during the Survey Area in the vicinity of the Balmoral Anzac camp. The area had evidence of roosting.ie scat and leaf and twig clips and on nocturnal investigation identified at least 4 birds were roosting at the site. It is highly likely more roost locations are present in the Survey Area due to the large numbers of birds (854 consisting of 443 Carnaby's, 40 Baudin's and 371 Forrest Red-tailed Black Cockatoo) recorded in the Survey Area. It is likely that the location of roosting site is dependent on habitat quality in relation to fire history, timber harvesting, dieback or other anthropomorphic behaviour.

Table 26 Black Cockatoo habitat usage

Habitat usage	Presence within the Survey Area	Evidence
Foraging habitat	Yes, Marri, Jarrah and Banksia	Chewed Marri and/or Jarrah nuts, feeding evidence at Casuarina and Banksia trees at 112 locations however the entire Survey Area excluding granite outcrops (actual granite not supportive vegetation) is assessed as foraging habitat.
Actual Breeding Events	No	Historical breeding events were recorded at 8 locations (see Figure 4d). Two sites recorded with evidence of Baudin's Cockatoo breeding and six sites recorded with evidence of Forest Red-tailed Black Cockatoos breeding.
Potential breeding hollows	Yes, this data is based on transect surveys only	19 potential breeding trees > 500 mm DBH of either Jarrah, Marri, Flooded Gum, Blackbutt or Bullich in the Survey Area. Four large Jarrah with large hollows (>200 mm) suitable for breeding. Two of these had chews present however no actual breeding events were recorded.
Likely Breeding hollows	Yes, this data is based on transect surveys only	Ten trees in total were identified as being likely/suitable breeding hollows. Four large Marri trees, one large Jarrah tree with large hollows (>200 mm), two large blackbutt trees and three large Bullich trees with large hollows (>200mm). These trees identified had chews present at the entrance to the hollow however no actual breeding events were recorded.
Roosting habitat	Yes	One suspected roost location recorded in the Balmoral Anzac camp had evidence of roosting.
Potential breeding trees per hectare	Yes	Potential breeding trees identified derived from transect data (see Table 27 for further detail). Trees with hollows per habitat type per hectare: Jarrah-Marri forest: 3 Marri trees/ha, 6 Jarrah trees/ha Flooded Gum woodland: 12 Flooded Gum trees/ha Bullich forest: 2 Bullich trees/ha Blackbutt forest: 7 Blackbutt trees/ha:
Legend: Potential breeding hollow: breeding hollow of an adequate size for use. Likely breeding hollow: breeding hollow previously known/recorded to have been used, active chew marks present or other evidence hollow has been used.		

Table 27 Black Cockatoo potential breeding trees from transect data

	Area (ha) of habitat within Survey Area	Area (ha) of habitat within cockatoo assessment transects	Number of trees >50cm DBH within transects	Mean density trees >50cm DBH (trees/ha) within transects	Number of trees identified with potential hollows within transects	Number of trees identified with likely hollows within transects	Range of density potential breeding trees (DBH>50cm)/ha
Bullich Forest	267	0.66	1	2	0	0	0
Granite Outcrop Association	373	2.7	17	6	0	0	0
Blackbutt Forest	687	7.8	53	7	0	1	0-1
Flooded Gum Woodland	688	8.7	105	12	5	4	0-6
Melaleuca Dampland	130	2.5	17	7	0	0	0
Jarrah Marri Forest	14,722	81.7	723	9	5	14	0-2
Pine Plantation	162	0	0	<1	0	0	0
Cleared areas	259	0	0	<1	0	0	0
Rehabilitation areas	402	0.04	0	<1	0	0	0
Total	**17690**	**104.1**	**916**	**9**	**10**	**19**	**0**

Legend:
Potential breeding hollow: breeding hollow of an adequate size for use.
Likely breeding hollow: breeding hollow previously known/recorded to have been used, active chew marks present or other evidence hollow has been used.

Table 28 Black cockatoo foraging habitat assessment

Habitat type	Vegetation type	Baudin's Cockatoo			Carnaby's Cockatoo			Forest Red-tailed Black Cockatoo		
		Foraging species present	Evidence of foraging	Quality of foraging habitat	Foraging species present	Evidence of foraging	Quality of foraging habitat	Foraging species present	Evidence of foraging	Quality of foraging habitat
Bullich Forest	W, WA	Limited However scattered Marri proteaceous trees and shrubs	None	medium	Limited However scattered Marri proteaceous trees and shrubs	None	medium	Limited	None	medium
Granite Outcrop Association	R, G, RG, G1, G2	Limited However scattered Marri proteaceous trees and shrubs	None	low	High Associated proteaceous species	None	low	None	None	low
Blackbutt Forest	CW, AW, AW/AX, AX/CW, C	Limited	None	medium	Limited	Evidence of feeding in *Banksia littoralis*	medium	High Blackbutt	Numerous locations of the species feeding on Blackbutt seed	high
Flooded Gum Woodland	AC, AD, AX	Limited	None	medium	Limited	None	medium	None	None	medium
Melaleuca Dampland	A	Limited However scattered Marri proteaceous trees and shrubs	None	low	High Associated proteaceous species	None	low	None	None	none
Jarrah Marri Forest	D, DA, DG, E, J, M, P, PG, PJ, PT, PS, PW, S, SP, ST, T, SW, TP, TS, Q	High Dominant feeding habitat for this species, mainly Jarrah, Marri.	The species was recorded feeding in Marri nuts	high	High Jarrah, Marri, Banksia, and proteaceous species	The species was recorded feeding in Jarrah, Marri, Banksia, and records of foraging on *Hakea undulata*	high	High Dominant feeding habitat for this species, mainly Jarrah, Marri and Casuarina. Flowers of Banksia,	The species was recorded feeding in Marri, Jarrah, Casuarina nuts. A small flock was also observed feeding on nectar of Banksia grandis.	high
Mine rehabilitation	Rehab	Jarrah, Marri, exotic eucalyptus	none	high	Jarrah, Marri, exotic eucalyptus	none	high	Jarrah, Marri, exotic eucalyptus	none	high
Pine plantation	PL	Growing tips of mature pine trees (Pinus)	none	medium	Cones of mature pine trees (Pinus)	Chewed cones and cockatoos observed feeding	medium	none	none	none

Legend: Evidence of foraging- none (no feeding habitat present), limited (some species present but not dominant), high (habitat is dominated with feeding species).

4.3.3 Carter's Freshwater Mussel

Eleven locations (with between 9 and 11 transects per location) were searched for Carter's Freshwater Mussel within the Survey Area with no signs of mussels (alive or dead) recorded (see Appendix D for results). Of the surveyed transects, most were dry or reduced to small standing water puddles at the time of survey (November 2020) indicating that the waterways are dry for over four months of the year. The duration of dry streams is noted to be well outside of the five day exposure experiments undertaken in controlled conditions (Klunzinger 2012). However, under protected muddy conditions in a creek bed they are likely to survive longer.

Some transects also contained rocky substrate which may be sub-optimal for Carter's Freshwater Mussel as it requires sandy and clay substrate in which to bury. Three locations (of the 11) had water features suitable enough to maintain Carter's Freshwater Mussel; however none of the transects identified any live mussels or shell remains the species on banks. In these areas the species may be present albeit in very low numbers or below detectable numbers. When adequate stream water is present, the species may occasionally or sporadically be present following dispersal of young mussels up stream within host fish, however the dispersing mussels are unlikely to survive long term due to the dry nature of this portion of the forest. This is demonstrated by the lack of adult shells (dead animals) normally present when undertaking Carter Freshwater Mussel surveys, when they are present.

5. Conclusions

The Survey Area consists of eight broad fauna habitat types: Bullich forest, Granite outcrop, Blackbutt forest, Flooded Gum woodland, Jarrah -Marri forest, Melaleuca dampland. Mine rehabilitation and Pine plantation. Jarrah-Marri forest predominated at 83% of the Survey Area. A small portion of the Survey Area comprises rural cleared land.

The conservation value of each fauna habitat type is specific to the locally occurring conservation significant fauna species and the type of usage by those species. All three Black Cockatoos were recorded primarily throughout the Marri-Jarrah forest, however all habitat types will be utilised for foraging by either one or all of the species. Melaleuca Damplands and riparian areas comprising Bullich Forest, Blackbutt Forest and Marri-Jarrah Forest support a Quokka population with records scattered throughout the Survey Area. Chuditch are wide ranging and expected to use all habitat types at a relatively low density.

In total 13 conservation significant species were recorded in the Survey Area including the Quokka, Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Forrest Red-tailed Black Cockatoo, Baudin's Cockatoo, Carnaby's Cockatoo, Western False Pipistrelle, Southern Death Adder, Quenda, Rakali, Masked Owl and Peregrine Falcon. All species identified are likely to have significant populations and habitat present within the Survey Area.

The survey area was assessed in terms of habitat suitability for migratory shorebirds. No shorebirds were recorded during the survey. The survey area lacks open water bodies that feature shallow shorelines for foraging habitat. The creek lines and vegetated seasonal dampland areas within the survey area are not considered suitable foraging habitat due to the dense forest vegetation associated with these riparian areas, and the lack of extensive shallow shoreline. Therefore, they are unlikely to occur within the survey area, and any occurrence would be as rare vagrant.

Carter's Freshwater Mussel was targeted during the survey but no presence was recorded. This is expected given that the streams are seasonal and dry up for several months of the year. The species is known to reside in the Serpentine Dam on the southern edge of the Survey Area and while mussels may disperse upstream from the Dam during winter/spring flows, all streams are seasonal, and any dispersing mussels are unlikely to survive the extended dry summer period. Therefore, significant populations are unlikely in the Survey Area.

The DBCA NatureMap search identifies that 185 vertebrate fauna taxa previously recorded within 20 km radius of the Survey Area. This total included 28 mammals, 113 birds, 32 reptiles and 12 amphibians.

The detailed and targeted program recorded 132 vertebrate fauna species utilising the Survey Area, including 28 mammals, 76 birds, 26 reptiles and seven amphibians. Off these, eight introduced species (mammals and birds) were identified.

Fire was observed to cause substantial impact to fauna habitats of the Survey Areas. Large areas of the Survey Area had been burnt within the last 2 to 3 years impacting fauna habitat. During the survey the north west portion of the Survey Area was prescribed burned in October 2020.

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Appendices

Appendix A

Map figures

Figure 1 Location of Survey Area

Figure 2 Environmental constraints

Figure 3 Fauna survey methods

Figure 4a Threatened fauna

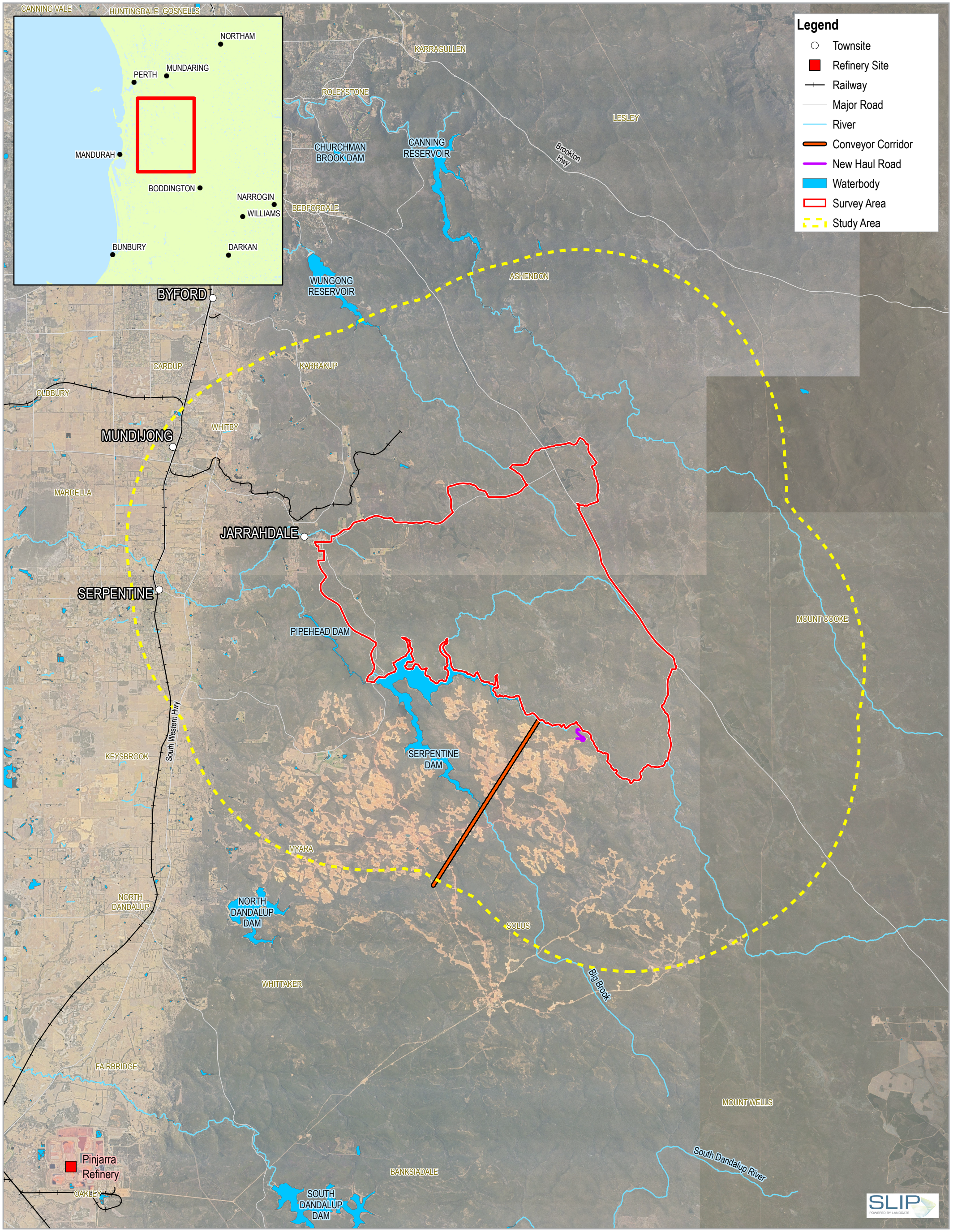
Figure 4b Forest Red tail black cockatoo recordings

Figure 4c Priority and other conservation dependent fauna

Figure 4d Black cockatoo results (*Calyptorhynchus spp.*)

Figure 5a Fauna habitats (Development Envelope)

Figure 5b Fauna habitats (Conveyor and Haul Road Corridor)



Paper Size ISO A3

0 1 2 3 4

Kilometres

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

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Pinjarra Alumina Refinery Revised Proposal

Location of Survey Area

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 1

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_001_LocationofSurveyArea_Rev0
Print date: 26 Aug 2021 - 17:56

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza

CHURCHMAN BROOK DAM
CANNING RESERVOIR
WUNGONG RESERVOIR
Albany Hwy
Brookton Hwy
BYFORD
MUNDIJONG
SERPENTINE
PIPEHEAD DAM
SERPENTINE DAM
South Western Hwy

Legend

- Townsite

Fauna Conservation Categories

- Critically Endangered Species (CR)
- Endangered Species (EN)
- Vulnerable Species (VU)
- Species of Special Conservation Interest (CD)
- Other Specially Protected Species (OS)
- Priority 3 (P3)
- Priority 4 (P4)
- Railway
- River
- Conveyor Corridor
- New Haul Road
- Waterbody
- Survey Area
- Regional Ecological Linkage
- Environmentally Sensitive Area

DBCA Legislated Lands and Water

- Conservation Park
- National Park
- Nature Reserve
- State Forest
- Section 5(1)(g) Reserve
- Section 5(1)(h) Reserve

Vegetation Complex

- Cooke
- Darling Scarp
- Dwellingup
- Goonaping
- Helena 1
- Murray 1
- Pindalup
- Swamp
- Yalanbee
- Yarragil 1
- Yarragil 2

Vegetation Association

- 3
- 4
- 128
- 946
- 968
- 1000
- 1001

SLIP POWERED BY LANDGATE

Paper Size ISO A3

0 1 2 3 4

Kilometres

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

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

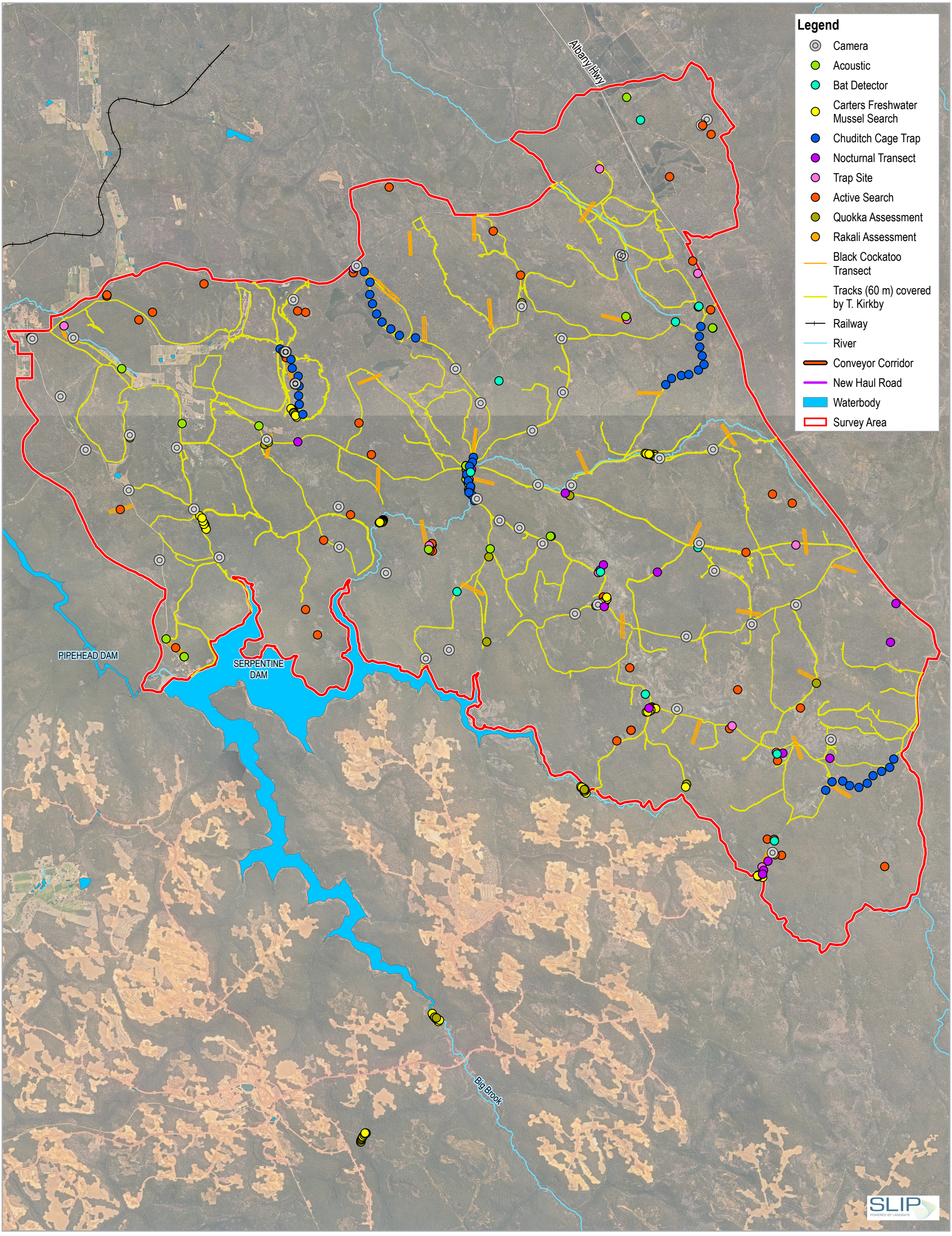
Environmental Constraints

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 2

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_002_EnvironmentalConstraints_Rev0
Print date: 26 Aug 2021 - 17:58

Data source: Myara North Boundary - 20200611; DBCA: Ecological Linkages, Environmentally Sensitive Areas - 20200710, Legislated Lands and Water - 20180606, Threatened and Priority Fauna - 20200612; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza



Paper Size ISO A3

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Kilometres

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

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Pinjarra Alumina Refinery Revised Proposal

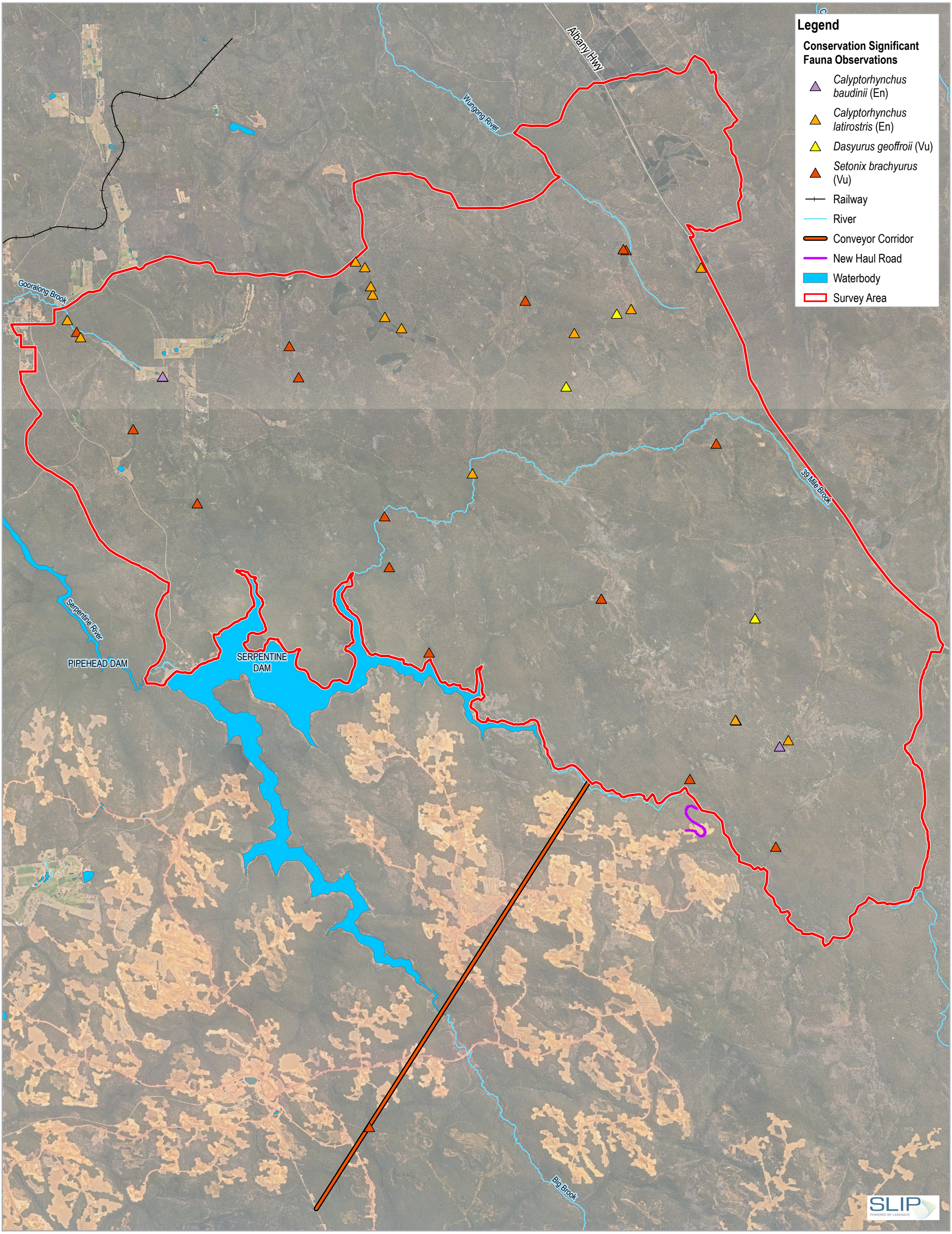
Fauna Survey Methods

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 3

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_003_FaunaSurveyMethods_Rev0
Print date: 26 Aug 2021 - 17:59

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza



Paper Size ISO A3

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Kilometres

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

N

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

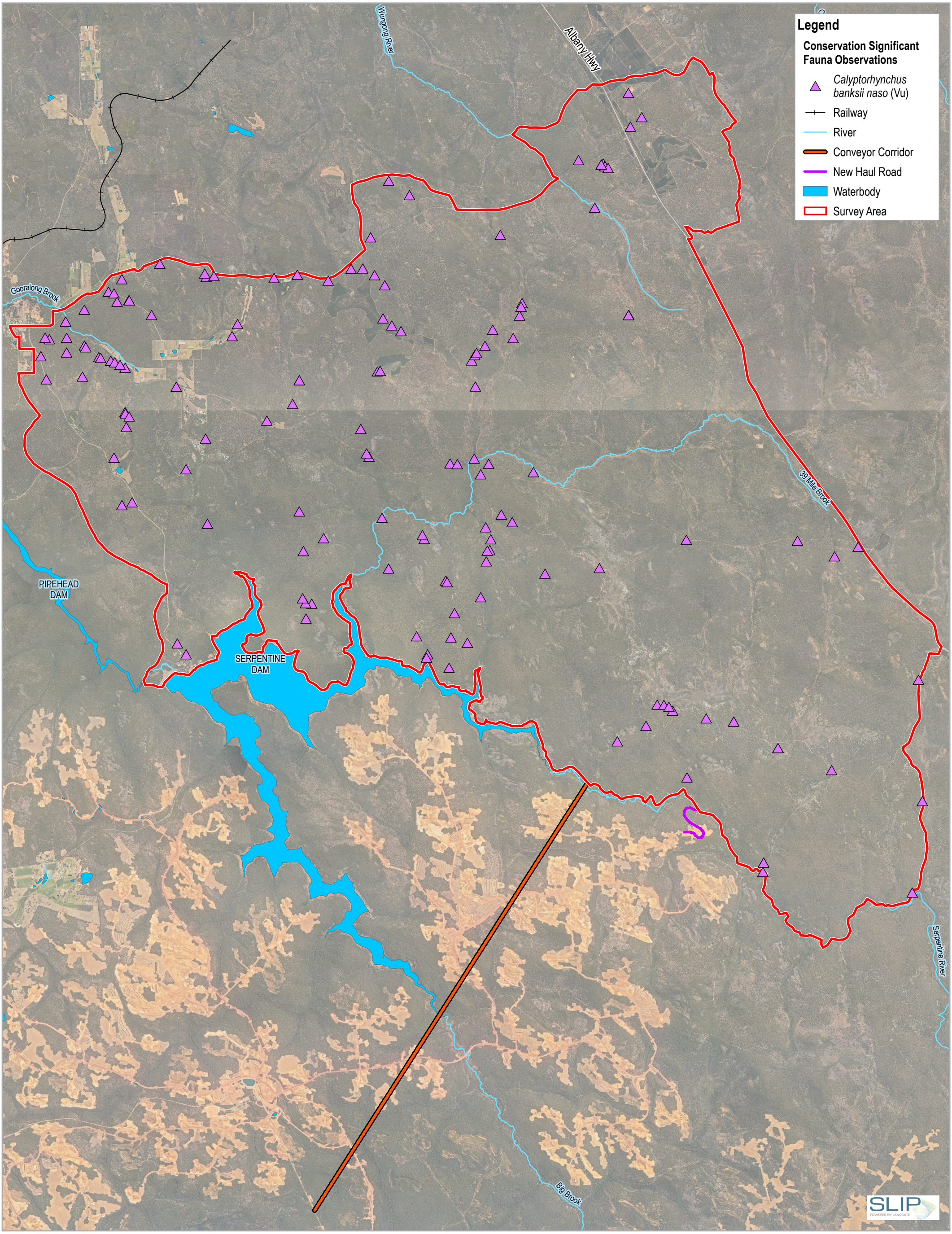
Threatened Fauna species

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 4A

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_004A_Threatened_Rev0
Print date: 26 Aug 2021 - 18:01

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza



Paper Size ISO A3

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Kilometres

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

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

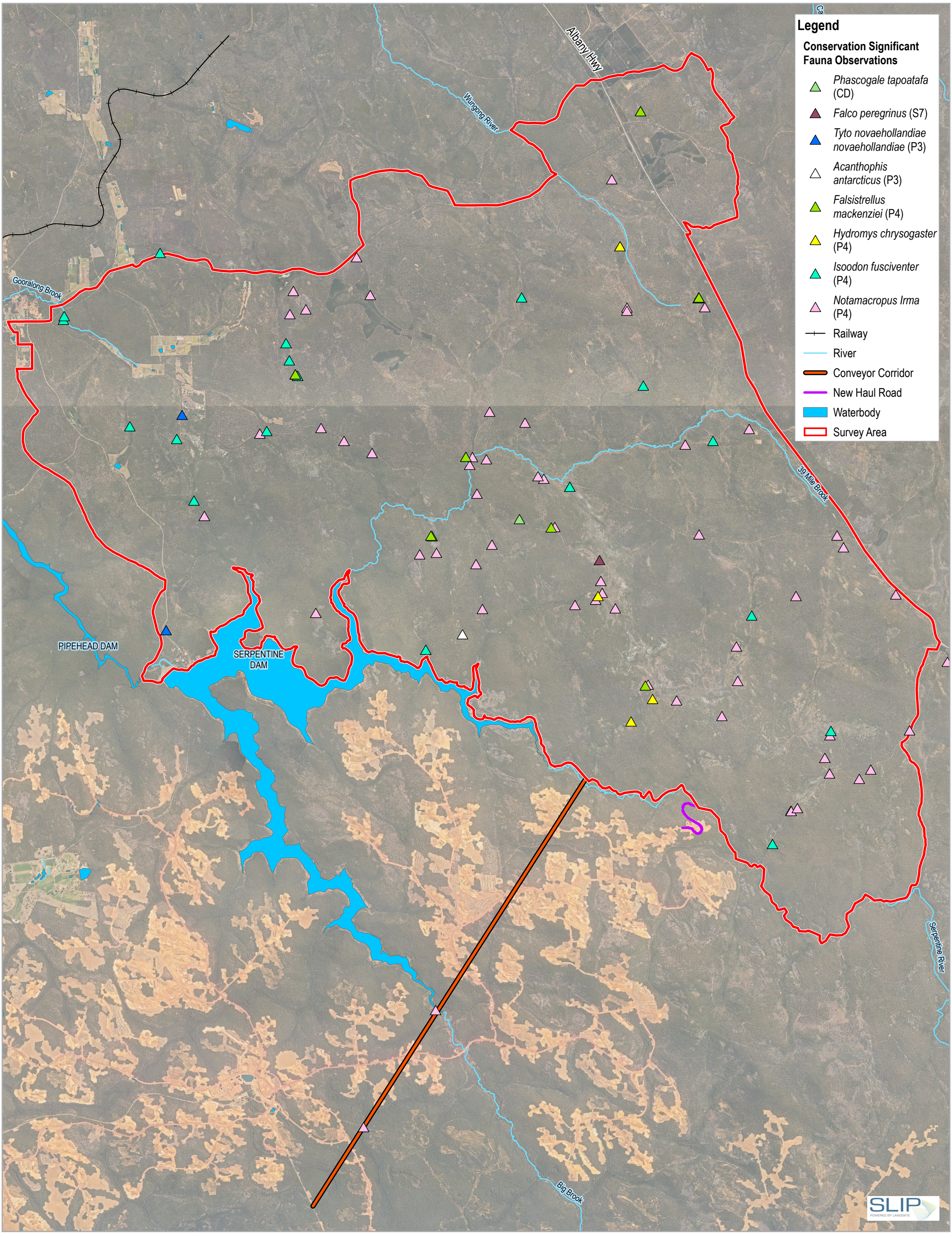
Forest Red-tailed Black Cockatoo recordings

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 4B

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_004B_FRtBC_Rev0
Print date: 26 Aug 2021 - 18:03

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza



Paper Size ISO A3

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Kilometres

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

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

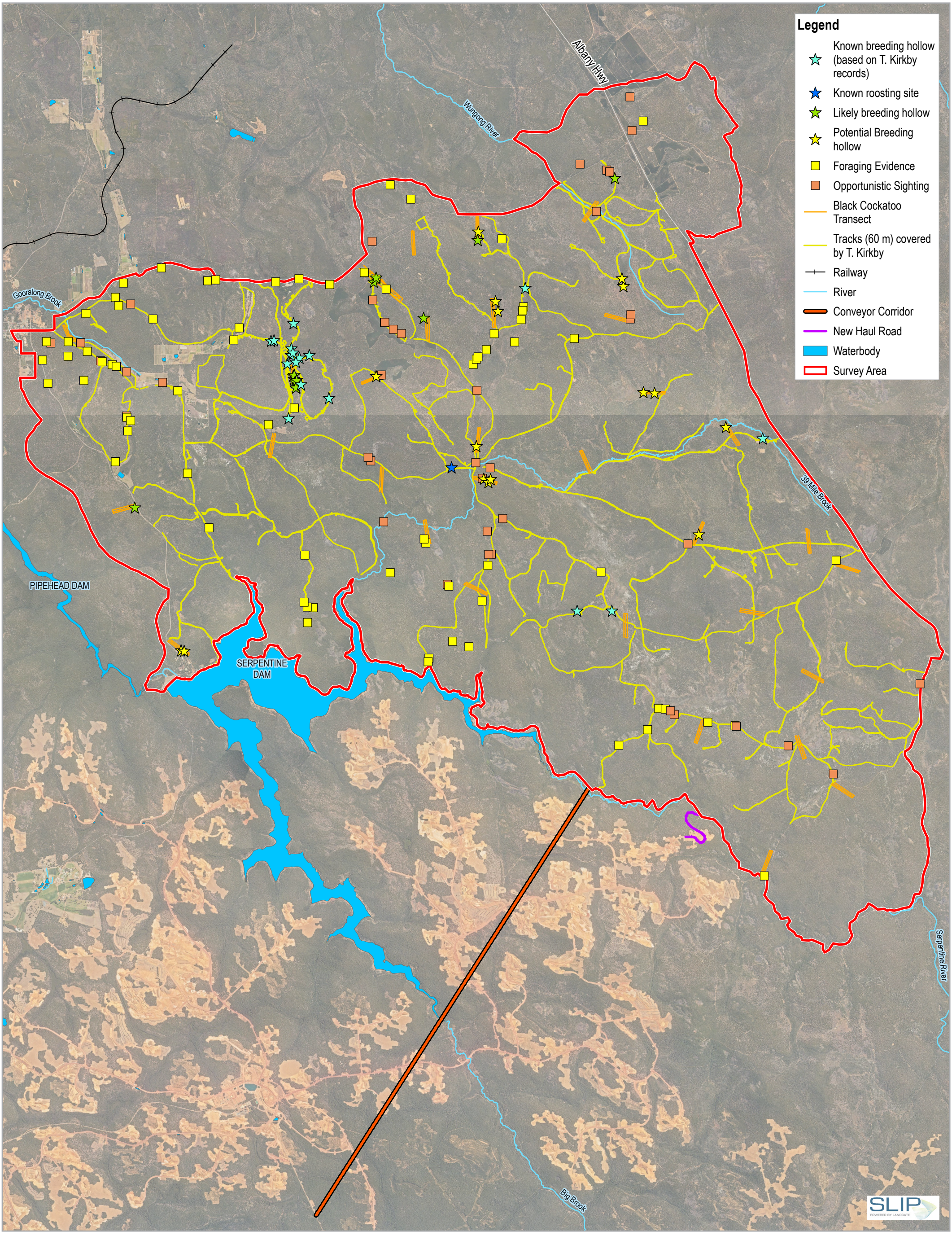
Priority and Other Conservation Dependent Fauna

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 4C

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_004C_Priority_Rev0
Print date: 26 Aug 2021 - 18:05

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza



Paper Size ISO A3

0 0.5 1 1.5 2

Kilometres

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

N

GHD

Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

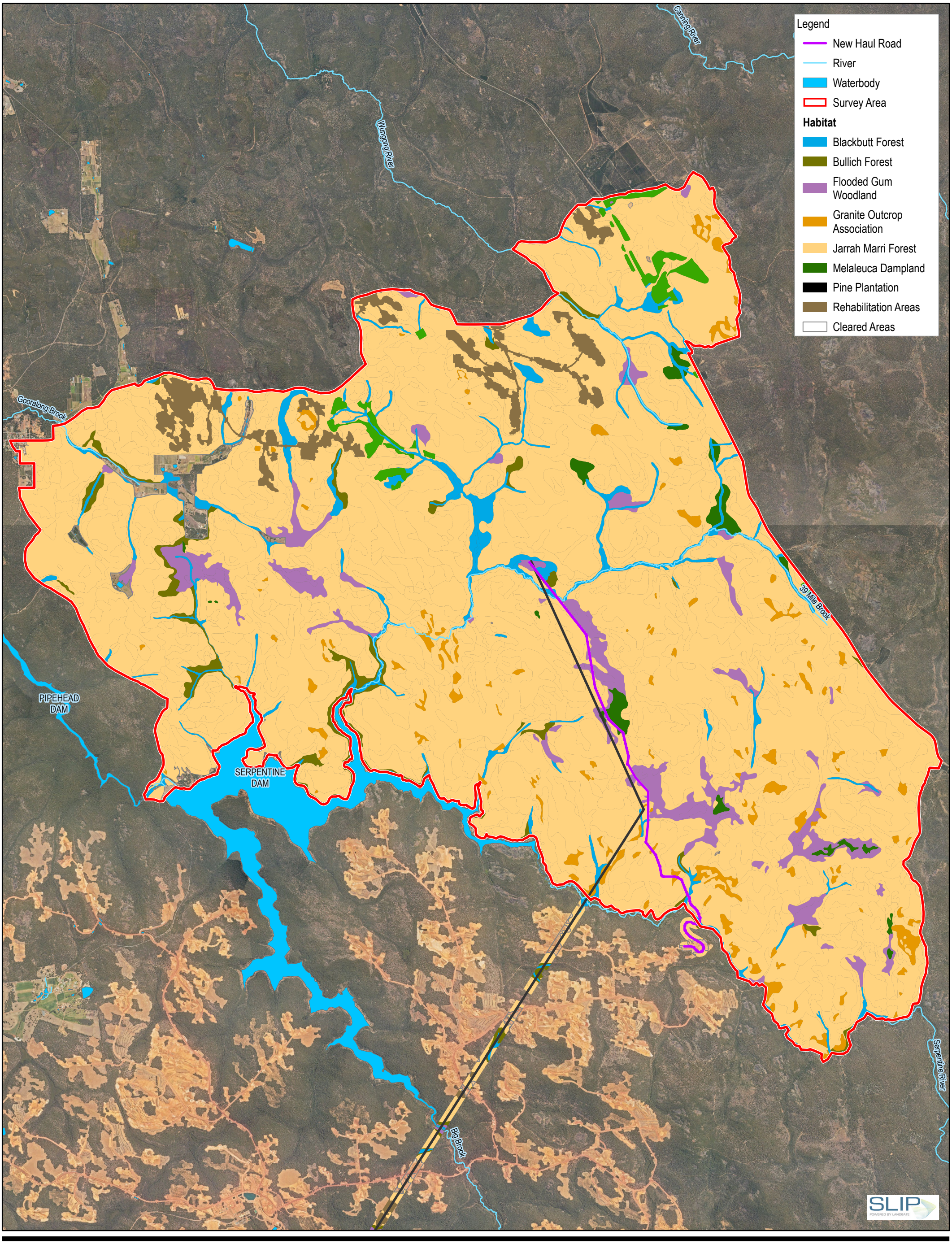
Black Cockatoo Results (Calyptorhynchus species)

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 4D

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_004D_BlackCockatoo_Rev0
Print date: 26 Aug 2021 - 18:06

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza



Paper Size ISO A3

0 1 2 3 4

Kilometres

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

N

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

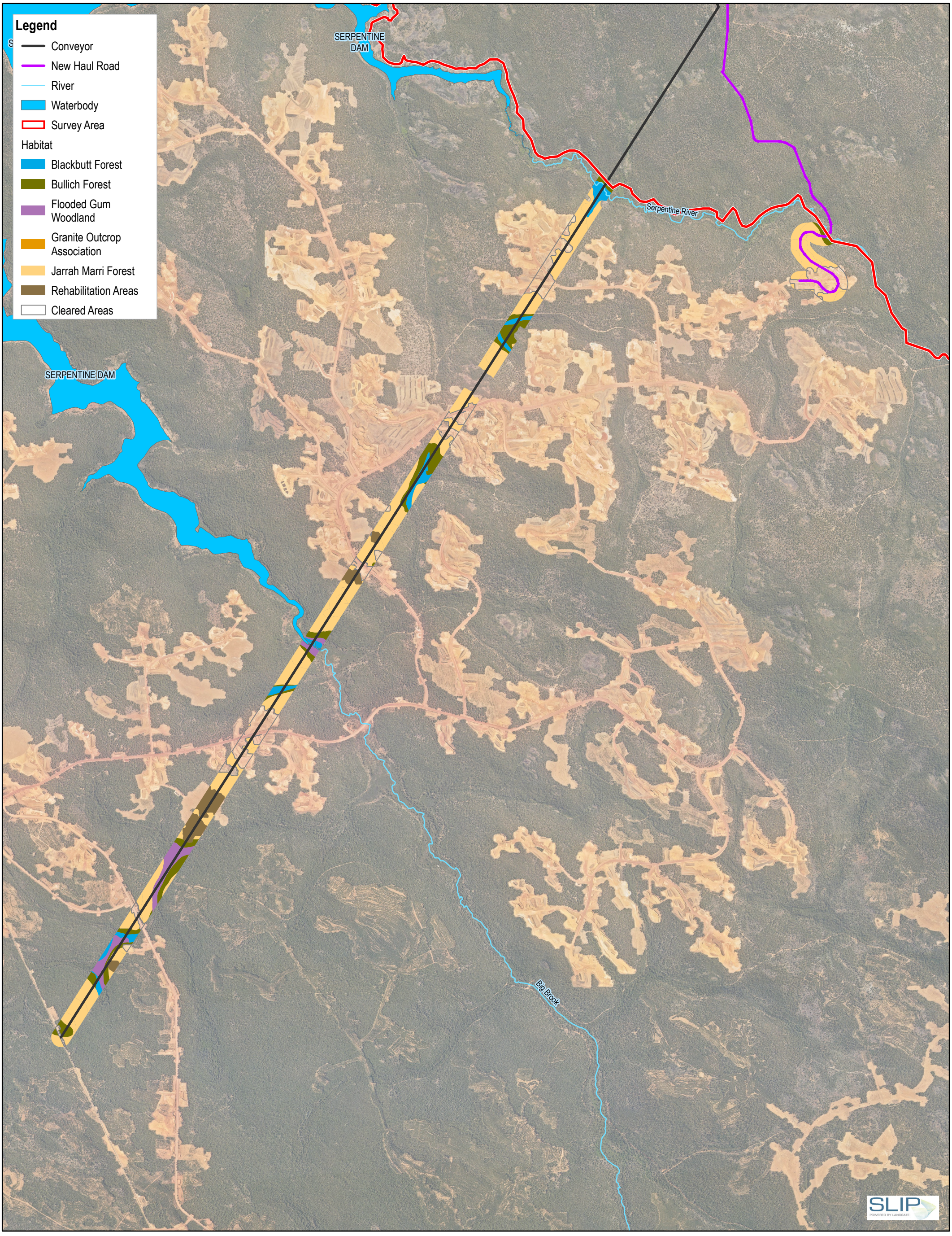
Fauna Habitats (Development Envelope)

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 5A

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_005A_Habitat_Rev0
Print date: 26 Aug 2021 - 18:07

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza



Paper Size ISO A3

0 1 2 3 4

Kilometres

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

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Fauna Habitats
(Conveyor and Haul Road Corridor)

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 5B

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591-MyaraNorthReport\12520591_MyaraNorthReport_rev2.aprx\12520591_005B_Habitat_Rev0
Print date: 26 Aug 2021 - 18:09

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza

Appendix B

Relevant legislation, background information and conservation codes

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

– Nationally threatened flora and fauna species and ecological communities
– Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of the Environment and Energy (DEE).

State *Environment Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a. Native vegetation should not be cleared if it comprises a high level of biodiversity.
b. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
c. Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
d. Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
e. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
f. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.
g. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.
h. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
i. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j. Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

– Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
– If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
– The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
– The conservation of biodiversity and ecological integrity should be a fundamental consideration indecision-making
– Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976*. The main purposes of the BAM Act and its regulations are to:

Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA Manage the impact and spread of those pests already present in the state

Safely manage the use of agricultural and veterinary chemicals

Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which is currently is free of that pest.

Fauna Conservation codes

Conservation significant fauna

The Federal conservation level of fauna species and their significance status is assessed under the EPBC Act. The significance levels for fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

– Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
– Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
– Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened or Extinct species under the BC Act cannot also be listed as Specially Protected species.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered conservation significant.

Conservation categories and definitions for EPBC Act and BC Act listed fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with criteria set out in section 20 and the ministerial guidelines.
Endangered (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines.
Vulnerable (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium term future as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.
Extinct species	
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalized population well outside its past range, and it has not been recorded in its known habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its lifecycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Specially protected species	
Migratory (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subsetof the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Conservation codes for DBCA listed Priority fauna

Priority category	Definition
Priority 1	Poorly-known taxa Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	Poorly-known taxa Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements andappear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	Poorly-known taxa Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could beif present circumstances change. These taxa are usually represented on conservation lands. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualifyfor Conservation Dependent, but that are close to qualifying for Vulnerable. Taxa that have been removed from the list of threatened taxa during the past five years for reasonsother than taxonomy.

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

References

ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.

EPA 2010, *Technical Guide – Terrestrial Fauna Surveys*, EPA, Perth, WA

Appendix C

Desktop searches

NatureMap Species Report

EPBC Act Protected Matter Search Tool Report

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 18/06/2020

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	116° 11' 35" E,32° 22' 24" S
Buffer	20km
Group By	Species Group

Species Group	Species	Records
Amphibian	12	235
Bird	115	5344
Fish	9	15
Invertebrate	360	1981
Mammal	30	509
Reptile	35	412
TOTAL	**561**	**8496**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25398	*Crinia georgiana (Quacking Frog)*			
2.	25399	*Crinia glauerti (Clicking Frog)*			
3.	25400	*Crinia insignifera (Squelching Froglet)*			
4.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
5.	25404	*Geocrinia leai (Ticking Frog)*			
6.	25409	*Heleioporus barycragus (Hooting Frog)*			
7.	25410	*Heleioporus eyrei (Moaning Frog)*			
8.	25411	*Heleioporus inornatus (Whooping Frog)*			
9.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
10.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
11.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
12.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
Bird					
13.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
14.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
15.	24262	*Acanthiza inornata (Western Thornbill)*			
16.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
17.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
18.	25536	*Accipiter fasciatus (Brown Goshawk)*			
19.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
20.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
21.	24312	*Anas gracilis (Grey Teal)*			
22.	24316	*Anas superciliosa (Pacific Black Duck)*			
23.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
24.	24561	*Anthochaera carunculata (Red Wattlebird)*			
25.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
26.	25670	*Anthus australis (Australian Pipit)*			
27.	24285	*Aquila audax (Wedge-tailed Eagle)*			
28.	24340	*Ardea novaehollandiae (White-faced Heron)*			
29.	24341	*Ardea pacifica (White-necked Heron)*			
30.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
31.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
32.		*Barnardius zonarius*			
33.	24319	*Biziura lobata (Musk Duck)*			
34.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
35.	24724	*Cacatua pastinator subsp. pastinator (Muir's Corella, Muir's Corella (Western Corella SW WA))*		S	
36.	25715	*Cacatua roseicapilla (Galah)*			
37.	25716	*Cacatua sanguinea (Little Corella)*			
38.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			

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39.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
40.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
41.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		T	
42.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo)*		T	
43.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
44.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
45.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
46.	25601	*Chrysococcyx lucidus (Shining Bronze Cuckoo)*			
47.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
48.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
49.	25592	*Corvus coronoides (Australian Raven)*			
50.	25595	*Cracticus tibicen (Australian Magpie)*			
51.	25596	*Cracticus torquatus (Grey Butcherbird)*			
52.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
53.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
54.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
55.	24470	*Dromaius novaehollandiae (Emu)*			
56.		*Egretta novaehollandiae*			
57.		*Elanus axillaris*			
58.		*Eolophus roseicapillus*			
59.	25692	*Eopsaltria australis (Yellow Robin)*			
60.	24651	*Eopsaltria australis subsp. griseogularis (Western Yellow Robin)*			
61.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
62.	25621	*Falco berigora (Brown Falcon)*			
63.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
64.	25623	*Falco longipennis (Australian Hobby)*			
65.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
66.	24616	*Falcunculus frontatus subsp. leucogaster (Western Shrike-tit, Crested Shrike-tit)*			
67.	25727	*Fulica atra (Eurasian Coot)*			
68.	42314	*Gavicalis virescens (Singing Honeyeater)*			
69.	25530	*Gerygone fusca (Western Gerygone)*			
70.	24443	*Grallina cyanoleuca (Magpie-lark)*			
71.	47965	*Hieraaetus morphnoides (Little Eagle)*			
72.	24491	*Hirundo neoxena (Welcome Swallow)*			
73.	24557	*Leipoa ocellata (Malleefowl)*		T	
74.	25661	*Lichmera indistincta (Brown Honeyeater)*			
75.		*Lophoictinia isura*			
76.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
77.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
78.	25654	*Malurus splendens (Splendid Fairy-wren)*			
79.	25758	*Megalurus gramineus (Little Grassbird)*			
80.	47997	*Melanodryas cucullata (Hooded Robin)*			
81.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
82.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
83.	24598	*Merops ornatus (Rainbow Bee-eater)*			
84.		*Microcarbo melanoleucos*			
85.	25693	*Microeca fascinans (Jacky Winter)*			
86.	24738	*Neophema elegans (Elegant Parrot)*			
87.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
88.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
89.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
90.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
91.	24625	*Pardalotus punctatus subsp. punctatus (Spotted Pardalote)*			
92.	25682	*Pardalotus striatus (Striated Pardalote)*			
93.	24630	*Pardalotus striatus subsp. westraliensis (Striated Pardalote)*			
94.	48061	*Petrochelidon nigricans (Tree Martin)*			
95.	48066	*Petroica boodang (Scarlet Robin)*			
96.	24659	*Petroica goodenovii (Red-capped Robin)*			
97.	24409	*Phaps chalcoptera (Common Bronzewing)*			
98.	25587	*Phaps elegans (Brush Bronzewing)*			
99.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
100.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
101.	25720	*Platycercus icterotis (Western Rosella)*			
102.	24745	*Platycercus icterotis subsp. icterotis (Western Rosella)*			
103.	24747	*Platycercus spurius (Red-capped Parrot)*			
104.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
105.	25703	*Podargus strigoides (Tawny Frogmouth)*			
106.	25722	*Polytelis anthopeplus (Regent Parrot)*			

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107.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
108.	24771	*Porzana tabuensis (Spotless Crake)*			
109.	24702	*Pterodroma brevirostris (Kerguelen Petrel)*			
110.		*Purpureicephalus spurius*			
111.	48096	*Rhipidura albiscapa (Grey Fantail)*			
112.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
113.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
114.	30948	*Smicrornis brevirostris (Weebill)*			
115.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
116.	25597	*Strepera versicolor (Grey Currawong)*			
117.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
118.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
119.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
120.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
121.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
122.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
123.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
124.	48147	*Turnix varius (Painted Button-quail)*			
125.	25764	*Tyto novaehollandiae (Masked Owl)*			
126.	24855	*Tyto novaehollandiae subsp. novaehollandiae (Masked Owl (southwest))*		P3	
127.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Fish

128.		*? ?*			
129.		*Acentrogobius bifrenatus*			
130.		*Aldrichetta forsteri*			
131.		*Bostockia porosa*			
132.	34028	*Galaxias occidentalis (Western Minnow)*			
133.	34030	*Geotria australis (Pouched Lamprey)*		P3	
134.		*Nannoperca vittata*			
135.		*Neosilurus hyrtlii*			
136.		*Tandanus bostocki*			

Invertebrate

137.		*Acariformes sp.*			
138.		*Acritoptila margaretae*			
139.		*Acritoptila sp.*			
140.		*Adoxotoma chionopogon*			
141.		*Adoxotoma embolica*			Y
142.		*Adoxotoma nitida*			Y
143.		*Adversaeschna brevistyla*			
144.		*Aeshnidae sp.*			
145.		*Agraptocorixa sp.*			
146.		*Ainudrilus nharna*			
147.		*Allodessus bistrigatus*			
148.		*Allothereua maculata*			
149.		*Alotanypus dalyupensis*			
150.		*Ambicodamus marae*			
151.		*Amblyomma triguttatum*			
152.		*Aname mainae*			
153.		*Aname tepperi*			
154.		*Anax papuensis*			
155.		*Anisops hackeri*			
156.		*Anisops hyperion*			
157.		*Antiporus gilberti*			
158.		*Antiporus sp.*			
159.		*Arachnura higginsi*			
160.		*Araneus amblycyphus*			Y
161.		*Araneus cyphoxis*			
162.		*Araneus eburneiventris*			
163.		*Araneus eburnus*			
164.		*Araneus senicaudatus*			
165.		*Araneus stolidus*			
166.		*Archaeosynthemis occidentalis*			
167.		*Archaeosynthemis spiniger*			
168.		*Archiargiolestes pusillus*			
169.		*Archichauliodes sp.*			
170.		*Argiope trifasciata*			
171.		*Arkys alticephala*			
172.		*Arkys walckenaeri*			
173.		*Arrenuridae sp.*			

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174.		*Artoria flavimana*			
175.		*Artoria flavimanus*			
176.		*Artoria schizocoides*			
177.		*Artoria taeniifera*			
178.		*Asadipus kunderang*			
179.		*Athericidae sp.*			
180.		*Aturidae sp.*			
181.		*Austracantha minax*			
182.		*Australomimetus aurioculatus*			
183.		*Australomimetus dunlopi*			
184.		*Australomimetus ovidi*			
185.		*Australopelopia prionoptera*			
186.		*Australotiphys barmutai*			
187.		*Austroagrion coeruleum*			
188.		*Austrochthonius muchmorei*			
189.		*Austrogomphus collaris*			
190.		*Austrolestes analis*			
191.		*Austrosynthemis cyanitincta*			
192.		*Backobourkia brounii*			
193.		*Backobourkia heroine*			
194.		*Baiami volucripes*			
195.		*Ballarra longipalpus*			
196.		*Berosus approximans*			
197.		*Berosus discolor*			
198.		*Bibulmena kadjina*			
199.		*Botryocladius bibulmun*			
200.		*Botryocladius freemani*			
201.		*Botryocladius petrophilus*			
202.		*Calanoida sp.*			
203.		*Carabidae sp.*			
204.		*Ceinidae sp.*			
205.		*Ceratopogonidae sp.*			
206.		*Cercophonius granulosus*			
207.		*Cercophonius sulcatus*			
208.		*Cethegus fugax*			
209.	33939	*Cherax cainii (Marron)*			
210.		*Cherax quinquecarinatus*			
211.		*Cheumatopsyche sp. AV2 (SAP)*			
212.		*Chironominae sp.*			
213.		*Chironomus aff. alternans (V24) (CB)*			
214.		*Chironomus tepperi*			
215.		*Chrysomelidae sp.*			
216.		*Cladocera (unident.)*			
217.		*Cladopelma curtivalva*			
218.		*Cladotanytarsus sp. A (SAP)*			
219.		*Cliotrombium antares*			Y
220.		*Cloeon sp.*			
221.		*Cloeon sp. 2 (SFM)*			
222.		*Clynotis albobarbatus*			
223.		*Clynotis severus*			
224.		*Coenagrionidae sp.*			
225.		*Condocerus aptus*			
226.		*Copepoda sp.*			
227.		*Corduliidae sp.*			
228.		*Corixidae sp.*			
229.		*Cormocephalus aurantiipes*			
230.		*Cormocephalus hartmeyeri*			
231.		*Cormocephalus michaelseni*			
232.		*Cormocephalus rubriceps*			
233.		*Cormocephalus turneri*			
234.		*Cricotopus 'brevicornis'*			
235.		*Cricotopus 'parbicinctus'*			
236.		*Crustulina bicruciata*			
237.		*Cryptochironomus aff griseidorsum*			
238.		*Cryptochironomus griseidorsum*			
239.		*Cryptoerithus melindae*			
240.		*Culicidae sp.*			
241.		*Curculionidae sp.*			
242.		*Cyclosa bacilliformis*			Y
243.		*Cyrtophora parnasia*			

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244.		*Demadiana cerula*			
245.		*Diaprograpta striola*			
246.		*Dicrotendipes conjunctus*			
247.		*Dicrotendipes jobetus*			
248.		*Dicrotendipes pseudoconjunctus*			
249.		*Dicrotendipes sp.*			
250.		*Dicrotendipes sp. A (V47) (SAP)*			
251.		*Dinocambala ingens*			
252.		*Diplacodes bipunctata*			
253.		*Dolichopodidae sp.*			
254.		*Dytiscidae sp.*			
255.		*Ecnomina F group*			
256.		*Empididae sp.*			
257.		*Enchytraeidae sp.*			
258.		*Ephydridae sp.*			
259.		*Erigone prominens*			
260.		*Eriophora biapicata*			
261.		*Ero aphana*			
262.		*Eucyrtops latior*			
263.	48579	*Euoplos inornatus (inornate trapdoor spider (northern Jarrah Forest))*		P3	
264.		*Exocelina ater*			
265.		*Geogarypus taylori*			
266.	34114	*Glacidorbis occidentalis (Jarrah forest freshwater snail, freshwater snail)*		P3	
267.		*Gomphidae sp.*			
268.		*Gripopterygidae sp.*			
269.		*Gymnometriocnemus sp. 1 (=V44 = ortho sp. C & R)*			
270.		*Gyrinidae sp.*			
271.		*Halacaridae sp.*			
272.		*Haliplidae sp.*			
273.		*Haliplus fuscatus*			
274.		*Haliplus gibbus*			
275.		*Haliplus sp.*			
276.		*Harrisius sp. A (SAP)*			
277.		*Harrisius sp. B (SFM)*			
278.		*Hellyethira litua*			
279.		*Hellyethira sp.*			
280.		*Helochares tenuistriatus*			
281.		*Hemicordulia australiae*			
282.		*Hemicordulia tau*			
283.		*Henicops dentatus*			
284.		*Hirudinea sp.*			
285.		*Histiosoma feroniarum*			Y
286.		*Hogna crispipes*			
287.		*Holoplatys dejongi*			
288.		*Hyderodes sp.*			
289.		*Hydrobiosella michaelseni*			
290.		*Hydrobiosidae sp.*			
291.		*Hydrodromidae sp.*			
292.		*Hydrophilidae sp.*			
293.		*Hydroptila losida*			
294.		*Hydroptilidae sp.*			
295.		*Hydryphantidae sp.*			
296.		*Hygrobatidae sp.*			
297.		*Hyphydrus elegans*			
298.		*Hypomegalopsalis tanisphyros*			
299.		*Idiommata blackwalli*			
300.		*Isometroides vescus*			
301.		*Isopeda leishmanni*			
302.		*Karaops ellenae*			
303.		*Kiefferulus intertinctus*			
304.		*Kiefferulus martini*			
305.		*Lampona brevipes*			
306.		*Lampona yanchep*			
307.		*Lamponella ainslie*			
308.		*Lamponusa gleneagle*			
309.		*Lancetes lanceolatus*			
310.		*Laperousea blattifera*			
311.		*Larsia albiceps*			
312.		*Latrodectus hasseltii*			
313.		*Lectrides parilis*			

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314.		*Lepidoptera (non-pyralid)*			
315.		*Leptoceridae sp.*			
316.		*Leptoperla australica*			
317.		*Leptophlebiidae sp.*			
318.		*Lestidae sp.*			
319.		*Limbodessus inornatus*			
320.		*Limbodessus shuckhardi*			
321.		*Limnesiidae sp.*			
322.		*Limnophyes vestitus (V41)*			
323.		*Limnoxenus zelandicus*			
324.		*Longepi woodman*			
325.		*Longrita insidiosa*			
326.		*Lopescladius? V35 (=SO3 sp. D)*			
327.		*Lycosa ariadnae*			
328.		*Macrogyrus angustatus*			
329.		*Macrogyrus sp.*			
330.		*Maratus pavonis*			
331.		*Maydenoptila baynesi*			
332.		*Maydenoptila sp.*			
333.		*Megaloptera sp.*			
334.		*Megapodagrionidae sp.*			
335.		*Megaporus sp.*			
336.		*Microctenonyx subitaneus*			
337.		*Micronecta gracilis*			
338.		*Micronecta robusta*			
339.		*Micronecta sp.*			
340.		*Missulena granulosa*			
341.		*Missulena hoggi*			
342.		*Missulena occatoria*			
343.		*Mituliodon tarantulinus*			
344.		*Miturga agelenina*			Y
345.		*Miturga catograpta*			
346.		*Molycria quadricauda*			
347.		*Muscidae sp.*			
348.		*Muziris carinatus*			
349.		*Myandra bicincta*			
350.		*Naididae sp.*			
351.		*Necterosoma darwini*			
352.		*Necterosoma penicillatus*			
353.		*Necterosoma regulare*			
354.		*Necterosoma sp.*			
355.		*Nematoda sp.*			
356.		*Nemertini sp.*			
357.		*Neostorena vituperata*			Y
358.		*Nephila edulis*			
359.		*Newmanoperla exigua*			
360.		*Nicodamus mainae*			
361.		*Notalina nr. sp. AV14*			
362.		*Notalina sp. AV15 (PSW)*			
363.		*Notalina sp. AV17 (RCM)*			Y
364.		*Notalina spira*			
365.		*Notoperata sp. AV1 (SFM)*			
366.		*Notoperata tenax*			
367.		*Nousia sp. AV16*			
368.		*Novakiella trituberculosa*			
369.		*Nunciella aspera*			
370.		*Nunciella karriensis*			Y
371.		*Nyungara bunni*			
372.		*Occiperipatoides gilesii*			
373.		*Oecetis sp.*			
374.		*Oecobius putus*			
375.		*Offadens soror (ex genus 1 WA sp. 1)*			
376.		*Oligochaeta sp.*			
377.		*Oniscidae sp.*			
378.		*Opisthopora sp.*			
379.		*Oribatida sp.*			
380.		*Orthetrum caledonicum*			
381.		*Orthocladiinae 'woodminer' (SAP)*			
382.		*Orthocladiinae SO3 sp. A (SAP)*			
383.		*Orthocladiinae SO3 sp. C (V31) (SAP)*			

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384.		*Orthocladiinae sp.*			
385.		*Ostearius melanopygius*			
386.		*Ostracoda (unident.)*			
387.		*Oxidae sp.*			
388.		*Oxyethira sp.*			
389.		*Oxyopes gracilipes*			
390.		*Ozarchaea harveyi*			
391.		*Ozarchaea westraliensis*			
392.		*Parachironomus sp. 1 (VSCL35) (SAP)*			
393.		*Paracladopelma M1 [SFM)*			
394.		*Paracymus pygmaeus*			
395.		*Parakiefferiella sp. S1*			
396.		*Parakiefferiella variegatus*			
397.		*Paralampona marangaroo*			
398.		*Paralimnophyes pullulus (V42)*			
399.		*Paramelitidae sp.*			
400.		*Paramerina levidensis*			
401.		*Paraplatoides nigrum*			
402.		*Parastacidae sp.*			
403.		*Penemideopsis pusilla*			Y
404.		*Pentaneurini genus V20*			
405.		*Pentasteron securifer*			
406.		*Perthiidae sp.*			
407.		*Phenasteron longiconductor*			
408.		*Phreodrilidae sp.*			
409.		*Phryganoporus nigrinus*			
410.		*Pinkfloydia harveii*			
411.		*Planorbidae sp.*			
412.		*Platorish gelorup*			
413.		*Platynectes sp.*			
414.		*Podonomopsis sp. 1*			
415.		*Poecilipta smaragdinea*			
416.		*Polypedilum nr. convexum (SAP)*			
417.		*Polypedilum nubifer*			
418.		*Polypedilum watsoni*			
419.		*Prionosternum nitidiceps*			
420.		*Prionosternum scutatum*			
421.		*Procladius DEC sp. P1 (formerly P.paludicola P1 no U-claws)*			
422.		*Procladius paludicola*			
423.		*Procladius sp.*			
424.		*Procordulia affinis*			
425.		*Pseudolampona jarrahdale*			
426.		*Pyralidae sp.*			
427.		*Raveniella cirrata*			
428.		*Raveniella peckorum*			
429.		*Rhantus suturalis*			
430.		*Rheotanytarsus juliae*			
431.		*Rheotanytarsus sp. (SFM)*			
432.		*Rheotanytarsus trivittatus*			
433.		*Rheotanytarsus underwoodi*			
434.		*Riekoperla occidentalis*			
435.		*Riethia v4*			
436.		*Riethia v5*			
437.		*Sandalodes scopifer*			
438.		*Scirtidae sp.*			
439.		*Scolopendra laeta*			
440.		*Sellnickiella biunguiculata*			
441.		*Simaetha thoracica*			Y
442.		*Simuliidae sp.*			
443.		*Siphonotus michaelseni*			Y
444.		*Skusella/"V12 ex-WA" (Cranston)*			
445.		*Sondra aurea*			
446.		*Sondra tristicula*			
447.		*Sternopriscus browni*			
448.		*Sternopriscus marginatus*			
449.		*Sternopriscus minimus*			
450.		*Sternopriscus sp.*			
451.		*Stictocladius occidentalis*			
452.		*Storena formosa*			
453.		*Storosa tetrica*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
454.		*Stratiomyidae sp.*			
455.		*Supunna funerea*			
456.		*Supunna picta*			
457.		*Symphytognatha picta*			
458.		*Synothele harveyi*			
459.		*Synothele longbottomi*			
460.		*Synothele michaelseni*			
461.		*Synsphyronus mimulus*			
462.		*Synthemistidae sp.*			
463.		*Tabanidae sp.*			
464.		*Tamopsis darlingtoniana*			
465.		*Tamopsis distinguenda*			
466.		*Tamopsis perthensis*			
467.		*Tanypodinae sp.*			
468.		*Tanytarsus aff manleyensis*			
469.		*Tanytarsus b1*			
470.		*Tanytarsus fuscithorax/semibarbitarsus*			
471.		*Tanytarsus nr K5*			
472.		*Tanytarsus palmatus*			
473.		*Tanytarsus sp. I (SAP)*			
474.		*Taschorema pallescens*			
475.		*Tasmanicosa leuckartii*			
476.		*Tasmanocoenis tillyardi*			
477.		*Temnocephalidea sp.*			
478.		*Tetragnatha maeandrata*			Y
479.		*Tetragnatha valida*			
480.		*Thienemanniella sp. (V19) (SAP)*			
481.		*Tinytrema yarra*			
482.		*Tipulidae sp.*			
483.		*Trachycosmus sculptilis*			
484.		*Trachytrema castaneum*			
485.		*Triplectides australis*			
486.		*Triplectides sp. AV1 (SFM)*			
487.		*Triplectides sp. AV21 (SFM)*			
488.		*Turbellaria sp.*			
489.		*Urodacus novaehollandiae*			
490.		*Urodacus planimanus*			
491.		*Venator immansueta*			
492.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		T	
493.		*Westrarchaea spinosa*			
494.		*Wheenyoides cooki*			
495.		*Xanthagrion erythroneurum*			
496.		*Zebraplatys fractivittata*			

Mammal

497.	25449	*Antechinus flavipes (Yellow-footed Antechinus)*			
498.	24088	*Antechinus flavipes subsp. leucogaster (Yellow-footed Antechinus, Mardo)*			
499.	47713	*Austronomus australis (White-striped Free-tailed Bat)*			
500.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		T	
501.	24086	*Cercartetus concinnus (Western Pygmy-possum, Mundarda)*			
502.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
503.	24187	*Chalinolobus morio (Chocolate Wattled Bat)*			
504.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
505.	24189	*Falsistrellus mackenziei (Western False Pipistrelle, Western Falsistrelle)*		P4	
506.	24041	*Felis catus (Cat)*	Y		
507.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
508.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
509.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
510.	24223	*Mus musculus (House Mouse)*	Y		
511.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
512.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
513.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
514.	24195	*Nyctophilus gouldi (Gould's Long-eared Bat)*			
515.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
516.	24166	*Pseudocheirus occidentalis (Western Ringtail Possum, ngwayir)*		T	
517.	24245	*Rattus rattus (Black Rat)*	Y		
518.	24145	*Setonix brachyurus (Quokka)*		T	
519.	24108	*Sminthopsis crassicaudata (Fat-tailed Dunnart)*			
520.	24111	*Sminthopsis gilberti (Gilbert's Dunnart)*			
521.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
522.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
523.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
524.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
525.	24206	*Vespadelus regulus (Southern Forest Bat)*			
526.	24040	*Vulpes vulpes (Red Fox)*	Y		
Reptile					
527.	25242	*Acanthophis antarcticus (Southern Death Adder)*		P3	
528.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
529.	24990	*Aprasia pulchella (Granite Worm-lizard)*			
530.	24980	*Christinus marmoratus (Marbled Gecko)*			
531.	30893	*Cryptoblepharus buchananii*			
532.	25020	*Cryptoblepharus plagiocephalus*			
533.	24883	*Ctenophorus ornatus (Ornate Crevice-Dragon)*			
534.	24884	*Ctenophorus pictus (Painted Dragon)*			
535.	25035	*Ctenotus delli (Dell's skink, Darling Range southwest Ctenotus)*		P4	
536.	25047	*Ctenotus impar*			
537.	25049	*Ctenotus labillardieri*			
538.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
539.	24939	*Diplodactylus polyophthalmus*			
540.	25096	*Egernia kingii (King's Skink)*			
541.	25100	*Egernia napoleonis*			
542.	25474	*Hemiergis initialis*			
543.	25115	*Hemiergis initialis subsp. initialis*			
544.	25131	*Lerista distinguenda*			
545.	25005	*Lialis burtonis*			
546.	41416	*Liopholis pulchra subsp. pulchra (South-western Rock Skink, Spectacled Rock Skink)*			
547.	25184	*Menetia greyii*			
548.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
549.	25191	*Morethia lineoocellata*			
550.	25192	*Morethia obscura*			
551.	25253	*Parasuta gouldii*			
552.	25255	*Parasuta nigriceps*			
553.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
554.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
555.	25511	*Pseudonaja affinis (Dugite)*			
556.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
557.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
558.	25519	*Tiliqua rugosa*			
559.	24983	*Underwoodisaurus milii (Barking Gecko)*			
560.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
561.	25225	*Varanus rosenbergi (Heath Monitor)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

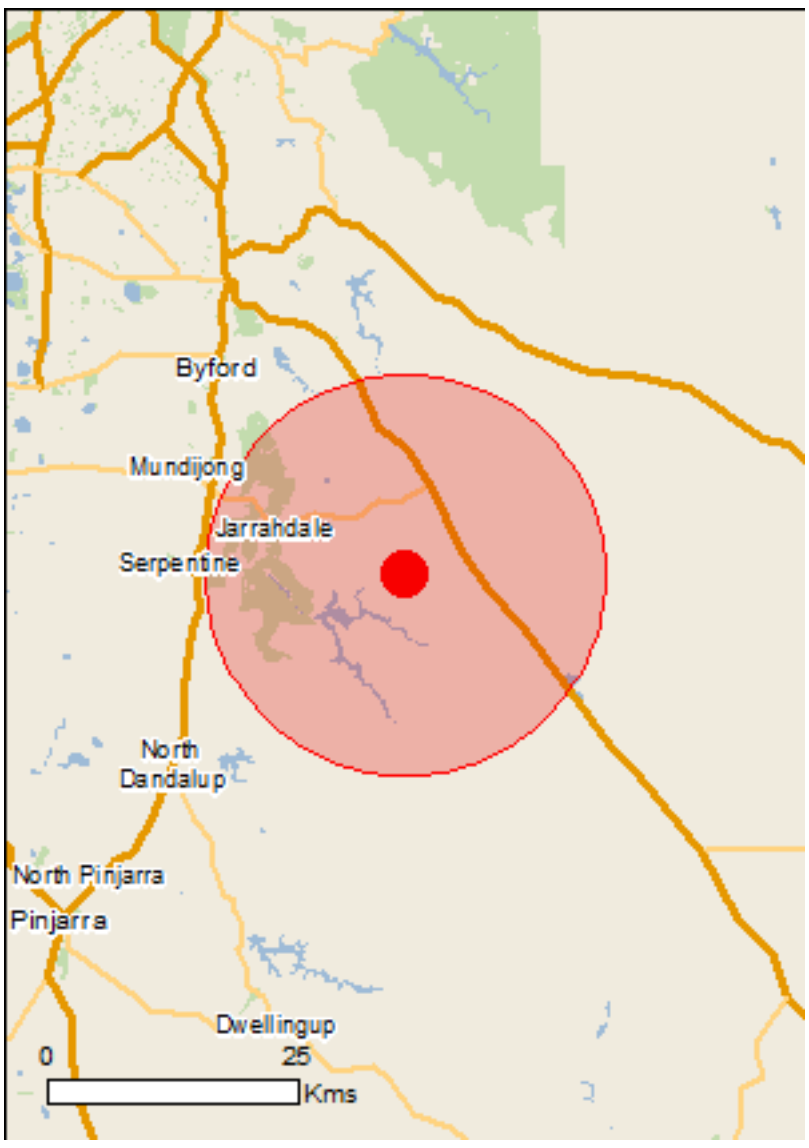
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 18/06/20 15:49:43

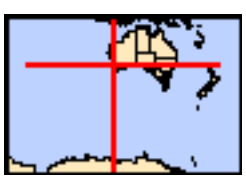
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	27
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	38
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Peel-yalgorup system	20 - 30km upstream

Listed Threatened Ecological Communities		[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
	Critically Endangered	Community may occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Breeding known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
[Dasyurus geoffroii](#) Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
[Pseudocheirus occidentalis](#) Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat may occur within area
[Setonix brachyurus](#) Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Other		
[Westralunio carteri](#) Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
[Anthocercis gracilis](#) Slender Tailflower [11103]	Vulnerable	Species or species habitat may occur within area
[Diuris micrantha](#) Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
[Diuris purdiei](#) Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
[Drakaea elastica](#) Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
[Eleocharis keigheryi](#) Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
[Eucalyptus x balanites](#) Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
[Grevillea flexuosa](#) Zig Zag Grevillea [2957]	Vulnerable	Species or species habitat likely to occur within area
[Lasiopetalum pterocarpum](#) Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat known to occur within area
[Synaphea sp. Fairbridge Farm (D. Papenfus 696)](#) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat likely to occur within area
[Synaphea sp. Serpentine (G.R. Brand 103)](#) [86879]	Critically Endangered	Species or species habitat may occur within area
[Tetraria australiensis](#) Southern Tetraria [10137]	Vulnerable	Species or species habitat likely to occur within area
[Thelymitra dedmaniarum](#) Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
[Thelymitra stellata](#) Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
[Verticordia fimbrilepis subsp. fimbrilepis](#) Shy Featherflower [24631]	Endangered	Species or species habitat known to occur

Name	Status	Type of Presence within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Gooralong	WA
Karnet	WA
Monadnocks	WA
NTWA Bushland covenant (0011)	WA
NTWA Bushland covenant (0076)	WA
Serpentine	WA
Unnamed WA50643	WA

Regional Forest Agreements	[Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple,		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Silverleaf-nettle, Trompillo [12323]		
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.37319 116.18017

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix D

Fauna field data

Fauna likelihood of occurrence assessment guideline and definitions

Fauna likelihood of occurrence assessment

Combined phase species list

Phase 1 survey data

Phase 2 survey data

Trap Line habitat assessment

Results from bird acoustic analysis

Results from bat acoustic analysis

Carters Freshwater Mussel transect data

Rakali transect data

Species recorded from studies and database searches

The table presents all vertebrate fauna species recorded in previous studies within or in proximity to the Survey Area, and database searches within a 20 kilometre radius of the Survey Area.

Fauna likelihood of occurrence assessment guidelines

Assessment outcome	Description
Known	Species recorded during the field survey or from recent, reliable records from within or close proximity to the Survey Area.
Likely	Species are **likely** to occur in the Survey Area where there is suitable habitat within the Survey Area and there are recent records of occurrence of the species in close proximity to the Survey Area. OR Species known distribution overlaps with the Survey Area and there is suitable habitat within the Survey Area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 40 km of the Survey Area however: There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the Survey Area. The suitable habitat within the Survey Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Survey Area. OR Those species that have a known distribution overlapping with the Survey Area however: There is limited habitat in the Survey Area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). The suitable habitat within the Survey Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Survey Area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the Survey Area include: Those species that have no suitable habitat within the Survey Area. Those species that have become locally extinct, or are not known to have ever been present in the region of the Survey Area.

Source information - desktop searches

NM – DBCA *NatureMap* (accessed May 2020)

PMST – DAWE Protected Matters Search Tool (PMST) to identify fauna listed under the EPBC Act potentially occurring within the Survey Area (accessed June 2020)

Definitions

Term	Description
Database search area	a 10 km buffer around the Survey Area
Survey Area	the area subject to the current survey
CR	Critically endangered under the EPBC Act or BC Act
EN	Endangered under the EPBC Act or BC Act
VU	Vulnerable under the EPBC Act or BC Act
IA	Migratory birds protected under an international agreement
MI, MA	Migratory, Marine
CD	Conservation dependent fauna
OS	Other specially protected fauna under the BC Act
P1	Priority 1: Poorly known fauna. Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	Priority 2: Poorly known species. Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	Priority 3: Poorly known species. Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	Priority 4: Rare, Near Threatened and other species in need of monitoring. (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Fauna likelihood of occurrence assessment of conservation significant species identified in the desktop assessment as potentially occurring within the Survey Area.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Birds								
Actitis hypoleucos	Common Sandpiper	MI	MI		X		Habitat for the Common Sandpiper is varied: coastal and interior wetlands – narrow muddy edges of billabongs, river pools, mangroves, among rocks and snags, reefs or rocky beaches. Avoids wide open mudflats. This species is widespread and scattered, common on the north and west coasts and uncommon in the south-east and interior (Morcombe 2004).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.
Apus pacificus	Fork-tailed Swift	MI	MI		X		In Western Australia, there are sparsely scattered records of the Fork-tailed Swift along the south coast, ranging from near the Eyre Bird Observatory and west to Denmark. They are widespread in coastal and subcoastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. They are scattered along the coast from south-west Pilbara to the north and east Kimberley region, near Wyndham. There are sparsely scattered inland records, especially in the Wheatbelt, from Lake Annean and Wittenoom. They are found in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley. They are also recorded in the Timor Sea, both at sea and around islands such as the Ashmore Reef. Isolated records occur at Neale Junction in the Great Victoria Desert and on the Nullarbor Plain (Higgins 1999).	**Unlikely** Suitable habitat is not available to support this species however the species may occasionally occur in the Survey Area as a vagrant.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Atrichornis clamosus	Noisy Scrub-bird	EN	EN	X			The Noisy Scrub-bird inhabits areas with dense understorey or lower stratum of sedges and shrubs, dense leaf litter and abundant litter-dwelling invertebrates. It mainly occurs in low closed forests 5–15 m in height that are dominated by *Eucalyptus* or *Agonis* and *Banksia littoralis*, and occur in the steep and wetter gullies, and drainage lines of hills and granite mountains (Eucalyptus), and on the margins of freshwater lakes (*Agonis* and *B. littoralis*). It is also common in low closed forests up to 5 m in height that are dominated by *Hakea elliptica*, *Eucalyptus* or *Agonis* and *B. littoralis* and occur around granite outcrops, in shallower and drier gullies and on the margins of freshwater lakes. It mostly occurs at sites that have not been burnt for 10 or more years. It occurs at two locations in the south west; on the mainland in coastal areas from Two Peoples Bay Nature Reserve to Cheyne Beach, and on Bald Island (DAWE 2021a).	**Unlikely** Previously known from small populations in the Jarrah Forest however this population is now considered locally extinct.
Botaurus poiciloptilus	Australasian Bittern	EN	EN		X		The Australasian Bittern occurs mainly in densely vegetated freshwater wetlands and, rarely, in estuaries or tidal wetlands. The species favours foraging in tall, dense vegetation in shallow permanent or seasonal fresh water. In the southwest of Western Australia the Bittern is now largely confined to coastal areas especially along the south coast where it is found in beds of tall rush mixed with or near short fine sedge or open pools (Burbidge 2004). It also occurs around swamps, lakes, pools, rivers and channels fringed with lignum Muehlenbeckia, canegrass Eragrostis or other dense vegetation (Marchant & Higgins 1990). It occasionally ventures into areas of open water or onto banks.	**Unlikely** Suitable habitat such as expansive wetland with emergent native reeds is not available to support this species however the Survey Area boarders habitat which may be suitable (Serpentine Dam) and the species may occur in the Survey Area as a vagrant.
Cacatua pastinator pastinator	Muir's Corella	CD		X		X	Muir's Corella lives in woodland on the drier, eastern side of the main forest block in the south west, in woodlands that are dominated by Wandoo (E. wandoo), Marri, (*Corymbia calophylla*), or Jarrah, (*Eucalyptus marginata*). Most suitable habitat for this species now consists of remnant patches that occur in or adjacent to farmland, or along roadsides, paddock boundaries or watercourses, and sometimes as a few, isolated shade trees in otherwise cleared paddocks (Garnett & Crowley 2000). The bird nests in large hollows in trees at least 160 years old. Its now has a restricted distribution in the Tone Bridge, Rocky Gully, Frankland River and Lake Muir area (TSSC 2016).	**Highly unlikely** This species is not known from the region.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI		X		In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Sometimes they occur on rocky shores (DAWE 2021b). They are found throughout many wetlands on the Swan Coastal Plain, in Perth lakes with wet grassed margins and receding waters, Vasse and Harvey Estuaries, and the Busselton wetlands, but are less common on the south coast until the Esperance region (Nevill 2013).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.
Calidris canutus	Red Knot	EN, MI	EN, MI		X		In Australasia the Red Knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (DAWE 2021b). They are found near mudflats and estuaries from Murchison to Bunbury but are then uncommon from Wilson Inlet to Esperance. In the Perth region they are mainly found in Alfred Cove and Peel Inlet (Nevill 2013).	**Unlikely**. Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Calidris ferruginea	Curlew Sandpiper	MI	MI		X		Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (DAWE 2020).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.
Calidris melanotos	Pectoral Sandpiper	MI	MI		X		In Australia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum (DAWE 2021e). The bird can be seen on the Swan Coastal Plain but is rare to scarce on Lake Thompson, and as well on any freshwater wetland in the southwest with shallow, well-grassed margins. They are seen at Lake Warden, Esperance, and at Lake McLarty (Nevill 2013).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU	X	X	X	The Forest Red-tailed Black Cockatoo inhabits the dense Jarrah, karri, and Marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt (*E. staeri*), Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DAWE 2021c). Habitats tend to have an understorey of balga (Xanthorrhoea spp.), kingia (*Kingia australis*), snottygobble (*Persoonia* spp.), parrot bush (*Banksia sessillis*), holly-leaved mirbelia (*Mirbelia dilatata*), bull banksia (*B. grandis*), bullich (*Taxandria* spp.) and sheoak (*Allocasuraina fraseriana*). They are most common in the Jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the Swan Coastal Plain, mainly in search of food the exotic white cedar (*Melia azedarach*). There are also several small isolated populations in the eastern parts of its range (DAWE 2021c).	**Known** This species was recorded during both phases of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.
Calyptorhynchus baudinii	Baudin's Black Cockatoo	EN	EN	X	X	X	Baudin's Black Cockatoo mainly occurs in eucalypt forests, especially Jarrah, Marri and karri forest that receives 750 mm of annual rainfall. The species is less frequently in woodlands of wandoo (*Eucalyptus wandoo*), blackbutt (*E. patens*), flooded gum (*E. rudis*), yate (*E. cornuta*), partly cleared farmlands and urban areas. The range of the species extends from Albany northward to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Kojonup. Preferred roosts are in areas with a dense canopy close to permanent sources of water (DAWE 2021d).	**Known** This species was recorded during both phases of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	EN	EN	X	X	X	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum, wandoo, Marri, Jarrah and karri, and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior, from Kalbarri in the north, Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning. The species has expanded its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain, including the Yanchep area, Lake Clifton and near Bunbury. It ness in trees older than 120-150 years (DAWE 2021e).	**Known** This species was recorded during both phases of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Falco peregrinus	Peregrine Falcon	OS		X		X	The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2004; Pizzey & Knight 2012). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013).	**Known** One individual of this species was recorded during the Phase 2 survey and suitable habitat is available within the Survey Area.
Leipoa ocellata	Malleefowl	VU	VU & MI	X	X	X	The Malleefowl generally occurs in semi-arid areas of Western Australia, in shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine Callitris woodlands, Acacia shrublands, paperbark, sheoak, Broombush *Melaleuca uncinata* vegetation, eucalypt woodlands, or coastal heathlands. Mostly they are found where there are sandy or gravel soils. The nest is a large mound of sand or soil and organic matter (Jones & Goth 2008; Morcombe 2004; Nevill 2013). In WA they are found from the southwest Nullarbor to Albany, north, and then west from Moore River up to Shark Bay, past Cue, across to Wiluna and east to the northern Victoria Desert south of the Blackstone Ranges (Nevill 2013; Pizzey & Knight 2012).	**Highly unlikely** The Survey Area does not contain suitable habitat to support this species.
Motacilla cinerea	Grey Wagtail	MI	MI		X		The Grey Wagtail is strongly associated with water, particularly rocky substrates along water courses but also lakes and marshes. It breeds from Western Europe to Asia, migrates to Africa, Malaysia, Indonesia and New Guinea. In the nonbreeding season the species may visit northern Australia and Christmas Island (Pizzey & Knight 2012)	**Highly Unlikely** This species des not frequent southern Australia and is not considered likely to be vagrant within the Survey Area.
Numenius madagascariensis	Eastern Curlew	CR	CR & MI	X	X		The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, sometimes within the mangroves, and in coastal saltworks and sewage farms. In the south west, Eastern Curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet (Marchant & Higgins 1993). They are uncommon further south of	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
							Geraldton, but can be spotted in Alfred Cove, Peel Inlet and the Albany region (Nevill 2013).	Survey Area would be as a vagrant at best.
Pandion haliaetus	Osprey	MI	MI		X		Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range but may also occur on low sandy, muddy or rocky shores and over coral cays. They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging (DSEWPaC 2016)	**Unlikely** Suitable habitat such as open estuarine inlets or lakes is not available to support this species however the Survey Area boarders habitat which may be suitable (Serpentine Dam) and the species may occur in the Survey Area as a vagrant.
Rostratula australis	Australian Painted Snipe	EN	EN		X		The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. The species rarely occurs in south-western Australia, where it was once more common (Marchant & Higgins 1993; Garnett & Crowley 2000).	**Unlikely** Suitable habitat is not available to support this species however the Survey Area boarders habitat which may be suitable (Serpentine Dam) and the species may occur in the Survey Area as a vagrant.
Tyto novaehollandiae subsp. novaehollandiae	Masked Owl (southern subsp)	P3		X		X	The Masked Owl is found in forests (wet and dry sclerophyll, non-eucalypt dominated), open woodlands, farmlands or scrub with large trees (12-20 m) and adjacent cleared country, timbered watercourses, paperbark woodlands, and caves (Pizzey & Knight 2012). It requires large hollows in old growth eucalypts or bare sand or the earth of a cave for nesting, and often favours areas with dense understorey or ecotones comprising dense and sparse ground cover. It is often recorded foraging within 100-300 m of the boundary of two vegetation types (Bell & Mooney 2002). The bird is restricted to the thicker humid forests of the south west region, particularly in the Pemberton and Manjimup area and along the Murray River in the Lane Poole area. It nests in hollows in large Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*) and Jarrah (*E. marginata*) trees (Nevill 2013).	**Known** This species was detected at two locations within the Survey Area during the Phase 1 survey.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Mammals								
Falsistrellus mackenziei	Western False Pipistrelle	P4		X		X	The Western False Pipistrelle occurs in wet sclerophyll forest dominated by Karri (*Eucalyptus diversicolor*), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) dry sclerophyll forests. The species is restricted to areas in or adjacent to stands of old growth forest. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*Corymbia calophylla*), Sheoak (*Casuarina heugeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities (Churchill 2008; McKenzie & Start 1999).	**Known** This species was recorded on bat detectors during both Phase 1 and Phase 2 surveys and suitable habitat is available to support this species.
Bettongia penicillata ogilbyi	Woylie	CR	EN	X	X	X	Preferred habitat for the Woylie includes dense undergrowth, logs and rock-cavities and occasionally in burrows (Burbidge 2004). Scattered Woylie populations may be found throughout the Jarrah forest in the south-west corner of WA. Extant naturally occurring populations of the species are restricted to three small wheatbelt reserves – Dryandra Woodland, Tutanning Nature Reserve and Perup Forest. All are characterised by the presence of thickets of the plant *Gastrolobium* (Van Dyck and Strahan 2008). The species is now restricted to forests and areas where predation has been controlled (or excluded). It rests during the day in a well-concealed nest, built over a shallow depression. The nest is most commonly built using long strands, of grasses, but other material such as strips of bark are also used (in the forest) or dried seagrass and/or triodia (in arid coastal areas) (Freegard 2007).	**Unlikely** Suitable habitat is present within the Survey Area however the species is not expected to occur within, or vagrant to, the Survey Area due to the presence of predators such as foxes and cats.
Dasyurus geoffroii	Chuditch	VU	VU	X	X	X	The Chuditch inhabits eucalypt forest (especially Jarrah, *Eucalyptus marginata*), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2011b). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck & Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented.	**Known** This species was recorded during the survey on two remote cameras. The Survey Area provides suitable denning and foraging/hunting habitat to support this species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Hydromys chrysogaster	Rakali, Water-rat	P4		X		X	The Water Rat lives in the vicinity of permanent bodies of fresh, brackish, or marine water, lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. In the south-west of WA they have been shown to prefer areas with riparian vegetation, better water quality and a degree of habitat complexity. Woody debris, rock ledges and wetland islands are likely to be important areas for feeding and refuge (DEC 2012). It is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan 2008).	**Known** This species was recorded on one remote camera deployed on a flowing stream section of Big Brook that bisects the proposed conveyor location.
Phascogale calura	Red-tailed Phascogale	CD	VU		X		The Red-tailed Phascogale inhabits Wandoo (Eucalyptus wandoo) and dense Sheoak (Allocasuarina huegeliana) woodland associations, with populations being most dense in the latter vegetation type. The species prefers vegetation that is unburnt for a long time, which provides continuous canopy cover to assist their arboreal habits. Trees need to be of a sufficient age to provide hollows for nesting in limbs or logs, and grass trees need to have ample skirts to provide cover. Small, scattered populations still occur in remnant vegetation in the Wheatbelt (DEC 2007).	**Unlikely**. Not recorded during the survey. The Survey Area is beyond the known range of this species.
Phascogale tapoatafa	Brush Tailed Phascogale	CD				X	The Brush-tailed Phascogale is sparsely distributed outside the semi-arid zone in dry sclerophyll forest and monsoonal forest and woodland. The species is generally rare and threatened by habitat fragmentation in the south west of Western Australia.	**Known** This species was detected at one remote camera within the south-eastern portion of the Survey Area and suitable habitat is available to support this species.
Pseudocheirus occidentalis	Western Ringtail Possum	CR	CR	X	X		The Western Ringtail Possum occurs in coastal and near coastal and Peppermint Tree (*Agonis flexuosa*) forest and Tuart (*Eucalyptus gomphocephala*) dominated forest with a Peppermint Tree understorey from Bunbury to Albany. Also occurs in Jarrah (*E. marginata*) forest and Jarrah-Marri *(Corymbia calophylla*) forest associated with Peppermint Tree (Van Dyck & Strahan 2008).	**Unlikely** Suitable habitat Tuart over peppermint understory is not present to support this species and the Study Area is beyond the current natural range of the species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Isoodon fusciventer	Quenda (Southern Brown Bandicoot)	P4		X		X	The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck & Strahan 2008).	**Known** This species was recorded during the survey via both remote cameras, diggings and trapping. The Survey Area provides suitable breeding and foraging habitat to support this species.
Myrmecobius fasciatus	Numbat	EN	EN	X		X	Current Numbat populations occupy several different habitat types: upland Jarrah forest, open eucalypt woodland, banksia woodland and tall closed shrubland. The only remaining original subpopulations are at Dryandra Woodland and the Upper Warren area (including Tone Perup Nature Reserve, Greater Kingston National Park and adjoining State Forest). In WA there are nine translocation sites, including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve (see DPaW 2015 for complete list and details). At Dryandra, numbats inhabit brown mallet (*Eucalyptus astringens*) plantations. Habitats usually have an abundance of termites in the soil, and hollow logs, tree hollows, burrows and branches for shelter (DAWE 2021e; Van Dyck & Strahan 2008).	**Highly unlikely** Suitable habitat is not available to support this species. The Survey Area is outside the current known range of the Numbat however it has previously been recorded at Jarrahdale.
Notamacropus irma	Western Brush Wallaby	P4		X		X	The Western Brush Wallaby is found primarily in open forest or woodland, particularly favouring open, seasonally- wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland and is uncommon in karri forest (DEC 2011b; Van Dyck & Strahan 2008).	**Known** This species was recorded numerously during the survey. The Survey Area provides suitable breeding and foraging habitat to support this species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Setonix brachyurus	Quokka	Vu	Vu	X	X	X	The current distribution of the Quokka includes Rottnest and Bald Islands, and at least 25 sites on the mainland, including Two Peoples Bay Nature Reserve and Torndirrup, Mt Manypeaks and Walpole-Nornalup National Parks, and swamp areas through the south-west forests from Jarrahdale to Walpole. The last known population on the Swan Coastal Plain occurs in Muddy Lakes near Bunbury. Quokkas have also been reintroduced to Karakamia Sanctuary (DEC 2013). They occupy dense forests and thickets, streamside vegetation, heaths, shrublands, *Agonis linearifolia*-dominated swamps in the Jarrah (*Eucalyptus marginata*) forest, and sometimes tea-tree thickets on sandy soils along creek systems. The northern extent on the mainland is in the Jarrah forest immediately south-east of the Perth metropolitan area, from where it extends southward through the southern Jarrah, Marri and Karri forests to the south coast, but largely confined throughout to areas receiving an annual rainfall of 1,000 mm or more (DEC 2013; Van Dyck & Strahan 2008).	**Known** This species was recorded during the survey on remote cameras. The Survey Area provided suitable breeding and foraging habitat to support this species.
Reptiles								
Acanthophis antarcticus	Southern Death Adder	P3		X		X	The Southern Death Adder habitat ranges from rainforest to shrublands and heaths. This species is declining in many areas, probably due to habitat destruction and altered fire regimes (Wilson & Swan 2013).	**Known** Two individuals were recorded during the Mattiske vegetation and flora survey (2020).
Ctenotus delli	Dell's Skink	P4		X		X	Dell's Skink is associated with Jarrah-Marri woodland that has a shrub-dominated understorey, on laterite, sandy or clay soils. It is found in the north Darling Range and inhabits dry sclerophyll forest on granite outcrops, stony hills and ranges. It is absent from the Swan Coastal Plain (Cogger 2014; Wilson & Swan 2013).	**Likely** The Survey Area contains suitable breeding and foraging habitat to support this species however it was not detected during the surveys.
Geotria australis	Pouched Lamprey	P3		X			This species utilises freshwater streams in the south west (Perth to Albany) to breed and grow before migrating to the ocean to mature (Allen *et al*. 2002). Dams and weirs are the main obstacles for the species. Sporadic records exist throughout the South West Coast Drainage Division between Perth and Albany including the Swan, Canning, Serpentine, Margaret, Donnelly, Warren and Goodga rivers.	**Highly Unlikely** Permanent suitable habitat was not recorded during the survey and no creeks are linked to coastal water due to Serpentine Dam.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Westralunio carteri	Carter's Freshwater Mussel	Vu	Vu		X		Carter's Freshwater Mussel is usually found in freshwater river pools. They are most common in areas with muddy, silty and sandy bottoms and flowing permanent water. Environmental tolerances of W. carteri are not precisely known but they can be found where water temperatures range from 4° C to over 30° C. Formerly this species occurred widely through the southwest including interior rivers of southwest such as Avon, Murray and Blackwood, however Salination of many waterways has severely reduced this species distribution.	**Known.** Occurs in the adjacent Serpentine Reservoir however the Survey Area lacks adequate permanent streams to provide suitable aquatic habitat.

Combined Phase Species List

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Mammals						
Canidae	*Vulpes vulpes*	Fox	Int	Int	X	X
Dasyuridae	*Sminthopsis gilberti*	Gilberts Dunnart			X	X
Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale		CD		X
Dasyuridae	*Antechinus flavipes*	Mardo			X	X
Dasyuridae	*Dasyurus geoffroii*	Chuditch	Vu	Vu	X	X
Felidae	*Felis catus*	Feral Cat	Int	Int	X	X
Leporidae	*Oryctolagus cuniculus*	European Rabbit	Int	Int	X	X
Macropodidae	*Notamacropus irma*	Western Brush Wallaby		P4	X	X
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo			X	X
Macropodidae	*Setonix brachyurus*	Quokka	Vu	Vu	X	X
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat				X
Molossidae	*Ozimops kitcheneri*	South-western Free-tailed Bat			X	X
Muridae	*Hydromys chrysogaster*	Rakali		P4	X	
Muridae	*Mus musculus*	House Mouse	Int	Int	X	X
Muridae	*Rattus rattus*	Black Rat	Int	Int	X	X
Peramelidae	*Isoodon fusciventer*	Quenda		P4	X	X
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum			X	X
Suidae	*Sus scrofa*	Feral Pig	Int	Int	X	X
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna			X	X
Vespertilionidae	*Chalinolobus gouldii*	Gould’s Wattled Bat			X	X
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat			X	X
Vespertilionidae	*Falsistrellus mackenziei*	Western False Pipistrelle		P4	X	X
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat			X	X
Birds						
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill			X	X

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Acanthizidae	*Smicrornis brevirostris*	Weebill			X	X
Acanthizidae	*Gergoyne fusca*	Western Gerygone			X	X
Acanthizidae	*Acanthiza inornata*	Western Thornbill			X	X
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren			X	X
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill				X
Accipitridae	*Aquila audax*	Wedge-tailed Eagle			X	X
Accipitridae	*Accipiter fasciatus*	Brown Goshawk				X
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar				X
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra		Int	X	X
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher				X
Anatidae	*Chenonetta jubata*	Australian Wood Duck			X	X
Anatidae	*Anas superciliosa*	Pacific Black Duck			X	
Artamidae	*Cracticus torquatus*	Grey Butcherbird			X	X
Artamidae	*Strepera versicolor*	Grey Currawong			X	X
Artamidae	*Cracticus tibicen*	Australian Magpie			X	X
Artamidae	*Artamus cinereus*	Black-faced Wood Swallow				X
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow				X
Cacatuidae	*Calyptorhynchus baudinii*	Baudin’s Cockatoo	En	En	X	X
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	En	En	X	X
Cacatuidae	*Calyptorhynchus banksii*	Forest Red-tailed Black Cockatoo	Vu	Vu	X	X
Cacatuidae	*Eolophus roseicapilla*	Galah				X
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			X	X
Casuariidae	*Dromaius novaehollandiae*	Emu			X	X
Charadriidae	*Vanellus tricolor*	Banded Lapwing			X	
Climacteridae	*Climacteris rufus*	Rufous Tree Creeper			X	X
Climacteridae	*Climacteris affinis*	White-browed Treecreeper				X
Columbidae	*Phaps elegans*	Brush Bronzewing			X	

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Columbidae	*Phaps chalcoptera*	Common Bronzewing			X	X
Corvidae	*Corvus coronoides*	Australian Raven			X	X
Corvidae	*Corvus bennetti*	Little Crow			X	
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo			X	
Cuculidae	*Chrysococcyx lucidus*	Shining Bronze-cuckoo				X
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird			X	
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail Finch				X
Falconidae	*Falco peregrinus*	Peregrine Falcon		OS		X
Hirundinidae	*Petrochelidon ariel*	Fairy Martin			X	
Hirundinidae	*Petrochelidon nigricans*	Tree Martin			X	X
Locustellidae	*Megalurus cruralis*	Brown Songlark			X	
Maluridae	*Malurus elegans*	Red-winged Fairywren			X	X
Maluridae	*Malurus splendens*	Splendid Fairywren			X	X
Maluridae	*Stipiturus malachurus*	Southern Emu-wren			X	
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater			X	X
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird			X	X
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill			X	X
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater				X
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater				X
Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater				X
Meliphagidae	*Anthochaera lunulata*	Western Wattlebird				X
Meliphagidae	*Melithreptus lunatus*	White-napped Honeyeater				X
Meropidae	*Merops ornatus*	Rainbow Bee-eater				X
Monarchidae	*Myiagra inquieta*	Restless Flycatcher			X	
Monarchidae	*Grallina cyanoleuca*	Magpie-lark				X
Neosittidae	*Daphoenositta chrysoptera*	Varied Sitella				X
Pachycephalidae	*Pachycephala occidentalis*	Western Whistler			X	X

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Pachycephalidae	*Colluricincla harmonica*	Grey Strike Thrush			X	X
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler			X	X
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote				X
Pardalotidae	*Pardalotus striatus*	Striated Pardalote				X
Petroicidae	*Petroica boodang*	Scarlet Robin			X	X
Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin			X	X
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin			X	X
Podargidae	*Podargus strigoides*	Tawny Frogmouth			X	X
Psittaculidae	*Platycercus zonarius*	Australian Ringneck Parrot			X	X
Psittaculidae	*Purpureicephalus spurius*	Red-capped Parrot			X	X
Psittaculidae	*Platycercus icterotis*	Western Rosella			X	X
Psittaculidae	*Neophema elegans*	Elegant Parrot				X
Psittaculidae	*Parvipsitta porphyrocephala*	Purple-crowned Lorikeet				X
Psittaculidae	*Trichoglossus moluccanus*	Rainbow Lorikeet		Int		X
Rallidae	*Fulica atra*	Eurasian coot			X	
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail			X	X
Strigidae	*Ninox boobook*	Southern Boobook			X	X
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis				X
Turnicidae	*Turnix varius*	Painted Button Quail			X	X
Tytonidae	*Tyto novaehollandiae*	Masked Owl		P3	X	
Zosteropidae.	*Zosterops lateralis*	Silvereye			X	X
Reptiles						
Agamidae	*Ctenophorus ornatus*	Ornate Crevice-dragon			X	X
Agamidae	*Pogona minor*	Western Bearded Dragon				X
Boidae	*Morelia spilota*	Carpet Python			X	X
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko			X	
Elapidae	*Acanthophis antarcticus*	Southern Death Adder		P3	X	

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Elapidae	*Pseudonaja affinis*	Dugite				X
Elapidae	*Parasuta gouldii*	Gould's Hooded Snake			X	X
Elapidae	*Suta nigriceps*	Mallee Black-backed Snake				X
Elapidae	*Notechis scutatus*	Tiger Snake				X
Gekkonidae	*Christinus marmoratus*	Marbled Gecko				X
Gekkonidae	*Diplodactylus lateroides*	Speckled stone gecko			X	X
Pygopodidae	*Aprasia pulchella*	Pretty Worm-lizard				X
Scincidae	*Tiliqua rugosa*	Bobtail			X	
Scincidae	*Cryptoblepharus buchananii*	Buchanan's Snake-eyed Skink			X	X
Scincidae	*Menetia greyii*	Common Dwarf Skink			X	X
Scincidae	*Ctenotus labillardieri*	Common south-west Ctenotus			X	X
Scincidae	*Egernia kingii*	King's Skink				X
Scincidae	*Egernia napoleonis*	Napoleon Skink				X
Scincidae	*Morethia obscura*	Shrubland Skink			X	X
Scincidae	*Acritoscincus trilineatus*	South-western cool-skink			X	X
Scincidae	*Hemiergis initialis*	South-western earless skink			X	X
Scincidae	*Lerista distinguenda*	South-western Orange-tailed Slider			X	X
Typhlopidae	*Anilios australis*	Southern Blind Snake				X
Varanidae	*Varanus tristis*	Black-headed Monitor			X	
Varanidae	*Varanus gouldii*	Gould's Monitor			X	X
Varanidae	*Varanus rosenbergi*	Rosenburg's Monitor			X	X
Amphibians						
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog			X	X
Myobatrachidae	*Crinia pseudinsignifera*	Bleating Froglet			X	
Myobatrachidae	*Crinia georgiana*	Quacking Frog			X	X
Myobatrachidae	*Crinia glauerti*	Rattling Froglet				X
Myobatrachidae	*Crinia pseudinsignifera*	False western froglet			X	

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Myobatrachidae	*Geocrinia leai*	Leas (ticking) frog			X	X
Pelodryadidae	*Litoria adelaidensis*	Slender Tree Frog			X	X

Phase 1 (June/July 2020): Species recorded during the trapping program including bat detection, bird acoustic, bird census, opportunistic observations, active searches and remote cameras

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	TL10	TL11	TL12	Cage Line 1	Cage Line 2	Cage Line 3	Cage Line 4	Cage Line 5	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Mammals																								
Canidae	*Vulpes vulpes*	Fox	0	0	0	0	0	0	0	0	0	0	0	0						0			3	3
Dasyuridae	*Sminthopsis gilberti*	Gilberts Dunnart	0	0	0	0	0	0	0	0	0	0	0	0						1			6	7
Dasyuridae	*Antechinus flavipes*	Mardo	2	2	0	0	4	5	5	21	0	5	4	1						0			287	336
Dasyuridae	*Dasyurus geoffroii*	Chuditch	0	0	0	0	0	0	0	0	0	0	0	0						1			1	2
Felidae	*Felis catus*	Domestic Cat	0	0	0	0	0	0	0	0	0	0	0	0						0			2	2
Leporidae	*Oryctolagus cuniculus*	European Rabbit	0	0	0	0	0	0	0	0	0	0	0	0						0			1	1
Macropodidae	*Notamacropus irma*	Western Brush Wallaby	0	0	0	0	0	0	0	0	0	0	0	0						47			18	65
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo	0	0	0	0	0	0	0	0	0	0	0	0						19			76	95
Macropodidae	*Setonix brachyurus*	Quokka	0	0	0	0	0	0	0	0	0	0	0	0						0			54	54
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat	0	0	0	0	0	0	0	0	0	0	0	0								4		4
Molossidae	*Ozimops kitcheneri*	South-western Free-tailed Bat	0	0	0	0	0	0	0	0	0	0	0	0								20		20
Muridae	*Hydromys chrysogaster*	Rakali	0	0	0	0	0	0	0	0	0	0	0	0									1	1
Muridae	*Mus musculus*	House Mouse	0	0	0	0	0	0	0	0	0	0	0	0						0			38	38
Muridae	*Rattus rattus*	Black Rat	0	0	0	0	0	0	0	0	0	0	0	0						2			61	63
Peramelidae	*Isoodon fusciventer*	Quenda	0	0	0	0	0	0	0	0	0	0	0	1						7			81	89
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	0	0	0	0	0	0	0	0	0	0	0	0						1			19	20
Suidae	*Sus scrofa*	Feral Pig	0	0	0	0	0	0	0	0	0	0	0	0						2			22	24
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	0	0	0	0	0	0	0	0	0	0	0	0						1			30	31
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	0	0	0	0	0	0	0	0	0	0	0	0								6		6
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	0	0	0	0	0	0	0	0	0	0	0	0								2		2
Vespertilionidae	*Falsistrellus mackenziei*	Western False Pipistrelle	0	0	0	0	0	0	0	0	0	0	0	0								3		3
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	0	0	0	0	0	0	0	0	0	0	0	0								28		28
Birds																								
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill	0	2	0	3	0	0	0	0	0	0	0	0						4	X			9
Acanthizidae	*Smicrornis brevirostris*	Weebill	2	0	0	1	0	4	0	0	6	4	1	0						9	X			27
Acanthizidae	*Gerygone fusca*	Western Gerygone	1	0	0	0	0	0	0	0	0	0	0	0						2	X			3
Acanthizidae	*Acanthiza inornata*	Western Thornbill	1	0	0	0	0	0	0	0	0	0	0	0						2	X			3
Acanthizidae	*Sericornis frontalis*	White-browed Scrub-wren	0	0	0	0	0	0	0	0	0	0	1	0						2			5	3
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	0	0	0	0	1	0	0	0	0	0	0	0						0				1
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	0	0	0	0	1	0	0	0	0	1	0	0						10	X		8	20
Anatidae	*Chenonetta jubata*	Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0						0	X		3	3
Anatidae	*Anas superciliosa*	Pacific Black Duck	0	0	0	0	0	2	0	0	0	0	0	0						2			2	6
Artamidae	*Cracticus torquatus*	Grey Butcherbird	0	1	0	0	0	0	0	0	0	0	0	0						0			0	1
Artamidae	*Strepera versicolor*	Grey Currawong	0	0	0	0	0	0	1	4	2	0	1	1						10			1	20
Artamidae	*Cracticus tibicen*	Magpie	1	0	0	0	0	0	0	0	0	0	0	2						9			8	20
Cacatuidae	*Calyptorhynchus baudinii*	Baudin's Cockatoo	0	0	0	0	0	0	0	0	0	0	0	0						49	X			49
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	2	0	0	0	0	0	0	0	0	0	0	0						524	X			526
Cacatuidae	*Calyptorhynchus banksii*	Forest Red-tailed Black Cockatoo	10	2	1	0	0	0	0		25	0	1	4						233			4	280

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	TL10	TL11	TL12	Cage Line 1	Cage Line 2	Cage Line 3	Cage Line 4	Cage Line 5	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Casuariidae	*Dromaius novaehollandiae*	Emu	0	0	0	2	0	0	0	0	0	0	0	0						4	X		2	8
Charadriidae	*Vanellus tricolor*	Banded Lapwing	0	0	0	0	0	0	0	0	0	0	0	0						0	X		1	1
Climacteridae	*Climacteris rufus*	Rufous Tree Creeper	0	1	2	1	0	0	0	0	0	0	0	0						1			0	5
Columbidae	*Phaps elegans*	Brush Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0						0			1	1
Columbidae	*Phaps chalcoptera*	Common Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0						3	X		1	4
Corvidae	*Corvus coronoides*	Australian Raven	0	1	15	1	1	0	1	2	5	0	0	2						6			15	49
Corvidae	*Corvus bennetti*	Little Crow	0	0	0	0	0	0	0	0	0	0	0	0						0	X		4	4
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	0	1	0	0	0	0	0	0	0	0	1	0						1	X		0	3
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird																		1				1
Hirundinidae	*Petrochelidon ariel*	Fairy Martin	0	0	0	0	0	0	0	0	0	0	0	0						4	X		0	4
Hirundinidae	*Petrochelidon nigricans*	Tree Martin																		1				1
Locustellidae	*Megalurus cruralis*	Brown Songlark	0	0	0	0	0	0	0	0	0	0	0	0						0	X		3	3
Maluridae	*Malurus elegans*	Red-winged Fairywren	0	0	0	0	0	0	0	0	0	0	0	0						0	X		2	3
Maluridae	*Malurus splendens*	Splendid Fairywren	2	2	0	0	0	0	0	0	1	0	6	0						1	X		76	88
Maluridae	*Sericornis maculatus*	Spotted Scrubwren	0	0	0	0	0	0	0	0	0	0	0	0						0			2	2
Maluridae	*Malurus lamberti*	Variegated Fairy Wren	0	0	0	0	0	0	0	0	0	0	0	0						0	X		23	23
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0						1			1	2
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	2	0	0	0	1	0	0	0	0	2	1	0						5	X		0	11
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill	0	0	1	0	0	0	0	0	0	0	0	0						0	X		1	2
Monarchidae	*Myiagra inquieta*	Restless Flycatcher	0	0	0	1	0	0	0	0	0	0	0	0						0	X		0	1
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	0	0	0	0	0	0	0	0	0	1	0	0						3	X		0	4
Pachycephalidae	*Colluricincla harmonica*	Grey Strike Thrush	2	0	1	0	0	0	0	0	0	0	2	1						5			0	11
Pachycephalidae	*Pachycephala occidentalis*	Western Whistler	0	0	0	0	0	0	0	0	0	0	0	0						0	X		1	1
Petroicidae	*Petroica boodang*	Scarlet Robin	0	0	0	1	0	0	0	0	0	0	1	0						9			17	28
Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin	2	0	0	0	0	0	0	0	0	0	0	0						6			0	8
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin	0	0	0	0	0	0	0	0	0	0	1	0						2			1	4
Podargidae	*Podargus strigoides*	Tawny Frogmouth																		2				2
Psittaculidae	*Platycercus zonarius*	Australian Ringneck Parrot	0	1	1	0	0	3	0	4	2	2	5	0						4			1	23
Psittaculidae	*Purpureicephalus spurius*	Red-capped Parrot	0	0	0	0	0	0	0	0	1	0	0	0						4			1	6
Psittaculidae	*Platycercus icterotis*	Western Rosella	0	0	0	0	0	0	0	0	0	0	0	0						6	X		5	11
Rallidae	*Fulica atra*	Eurasian coot	0	0	0	0	0	0	0	0	0	0	0	0						0	X		1	1
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	0	2	0	3	0	0	0	0	2	0	1	1						3			0	12
Strigidae	*Ninox boobook*	Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0						0	X		2	2
Turnicidae	*Turnix varius*	Painted Button Quail	0	0	0	0	0	0	0	0	0	0	0	0						0	X		7	7
Tytonidae	*Tyto novaehollandiae*	Masked Owl	0	0	0	0	0	0	0	0	0	0	0	0						0			2	2
Reptiles																								
Agamidae	*Ctenophorus ornatus*	Ornate Crevice-dragon	0	0	0	0	5	0	0	0	0	0	0	0						15			0	20
Boidae	*Morelia spilota imbricata*	Carpet Python	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko	0	0	0	0	2	0	0	0	0	0	5	0						45			0	52

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	TL10	TL11	TL12	Cage Line 1	Cage Line 2	Cage Line 3	Cage Line 4	Cage Line 5	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Elapidae	*Acanthophis antarcticus*	Southern Death Adder	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Elapidae	*Suta gouldii*	Gould's hooded snake	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Gekkonidae	*Diplodactylus lateroides*	Speckled stone gecko	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Scincidae	*Tiliqua rugosa*	Bobtail	0	0	0	0	0	0	0	0	0	0	0	0						0			5	5
Scincidae	*Cryptoblepharus buchananii*	Buchanan's Snake-eyed Skink	0	0	0	0	0	0	0	0	0	0	0	0						2				2
Scincidae	*Menetia greyii*	Common Dwarf skink	0	0	0	0	0	0	0	0	0	0	1	0						0			0	1
Scincidae	*Ctenotus labillardieri*	Common south-west Ctenotus	0	0	0	0	0	0	0	0	0	0	0	0						4			0	4
Scincidae	*Morethia obscura*	Shrubland Skink	0	0	0	0	0	0	0	0	1	1	0	0						0			0	2
Scincidae	*Acritoscincus trilineatus*	South western cool-skink	0	0	0	0	0	0	0	0	0	0	0	3						0			0	3
Scincidae	*Hemiergis initialis*	Southwestern earless skink	0	0	0	0	0	0	0	0	1	1	0	0						5			0	7
Scincidae	*Lerista distinguenda*	South-western Orange-tailed Slider	0	0	0	0	0	0	0	0	0	0	0	0						1				1
Varanidae	*Varanus gouldii*	Gould's Monitor	0	0	0	0	0	0	0	0	0	0	0	0						0			1	1
Varanidae	*Varanus tristis*	Black-headed Monitor	0	0	0	0	0	0	0	0	0	0	0	0						1				1
Varanidae	*Varanus rosenbergi*	Rosenberg's Monitor	0	0	0	0	0	0	0	0	0	0	0	0						0			1	1
Amphibians																								
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog	0	0	0	0	1	0	0	0	0	0	1	0						0			0	2
Myobatrachidae	*Crinia pseudinsignifera*	Bleating Froglet	1	0	0	0	2	0	0	0	0	0	0	1						0			0	4
Myobatrachidae	*Crinia georgiana*	Quacking Frog	0	1	0	0	2	2	0	0	0	0	1	3						54			0	63
Myobatrachidae	*Crinia glauerti*	Glauert’s Froglet	0	0	0	0	0	0	0	0	0	0	0	0						51			0	51
Myobatrachidae	*Geocrinia leai*	Lea’s (ticking) frog	0	0	0	0	0	0	0	0	0	0	0	0						22			0	22
Pelodryadidae	*Litoria adelaidensis*	Slender Tree Frog	0	0	0	0	0	0	0	0	0	0	0	1						0			0	1

*Note: numbers per trap line include animals physically captured in traps as well as those detected via active search, bird census or opportunistically at that trap site.

X – indicates the presence of a species detected either by signs (scat, tracks, feathers, etc.) as well as those detected on an acoustic recorder where number of individuals could not be determined however presence of species could be confirmed.

Trap Line habitat assessment summary

Trap Line I.D	Location		Habitat type/structure	Veg condition	Aspect	Slope	Soil type	Soil colour	Drainage	Bare ground cover	Litter cover	Last fire	Disturbance
	Easting	Northing											
Trap Line 1	426987	6413519	Upland Jarrah Marri forest over mid storey shrubland. Mid to upper slope areas on gravel-lateritic clay loam soil.	Excellent	North/ East	none	gravel sandy clay	orange/ brown	Good	2-10%	31-70%	Moderate (3 to 5 yr) but for phase 2 the site was burnt 3 weeks prior	road
Trap Line 2	424252	6425012	Blackbutt forest over sparse *Banksia littoralis*.	Excellent	south	gentle	clay loam	brown	Good	2-10%	31-70%	Moderate (3 to 5 yr)	frequent fire
Trap Line 3	427900	6412972	Melaleuca dampland - with isolated Jarrah over sparse isolated *Banksia littoralis* low shrubs on grey clay loam.	Excellent	Flat	none	clay	pale brown	poor	2-10%	50-10%	Moderate (3 to 5 yr)	negligible
Trap Line 4	426279	6422853	Upland Jarrah Marri forest over mid storey shrubland. Mid to upper slope areas on gravel-lateritic clay loam soil.	Excellent	Flat	none	gravel sandy clay	orange/ brown	Good	2-10%	31-70%	Old (6+ yr)	road
Trap Line 5	419173	6422951	Granite Outcrop with *Banksia* woodland - *Melaleuca pressiana*, Jarrah Marri forest, over mid shrubland.	Very Good	Flat	none	Sand	grey	Good	2-10%	31-70%	Moderate (3 to 5 yr)	fire
Trap Line 6	420734	6417238	Flooded Gum woodland - tall open forest associated with drainage lines. Low sparse woodland over long low shrub/sedgeland	Very Good	Flat	none	Clay	brown	Seasonal wet	2-10%	11-30%	Moderate (3 to 5 yr)	negligible
Trap Line 7	421559	6418605	Jarrah Marri forest with Sheoak over low closed shrub	Excellent	Flat		Gritty sand	yellow/ brown	Good	11-30%	11-30%	Moderate (3 to 5 yr)	negligible

Trap Line 8	428302	6417251	Upland Jarrah Marri forest with Sheoak.	Excellent	West	gentle	Gritty sand	yellow	Good	2-10%	31-70%	Old (6+ yr)	road
Trap Line 9	427604	6410609	Jarrah Marri forest with Sheoak over low open woodland and shrubland	Excellent	North/ East	none	Gritty sand	orange	Good	11-30%	31-70%	Old (6+ yr)	negligible
Trap Line 10	413197	6421772	Jarrah Marri forest Low Hills - occasional Sheoak, over *Banksia grandis*, low-mid shrubland.	Excellent	East	gentle	Gritty sand	yellow	Good	2-10%	31-70%	Old (6+ yr)	negligible
Trap Line 11	424815	6421905	Granite Outcrop amongst Jarrah Marri forest with Sheoak	Excellent	North/ East	moderate	Gritty sand	yellow	Good	<2%	31-70%	Old (6+ yr)	Dieback (?) uphill
Trap Line 12	418020	6420561	*Banksia littoralis* Riparian, Jarrah Marri forest, with Sheoak over shrubs	Very Good	Flat	gentle	Gritty sand	orange	Seasonal wet	2-10%	11-30%	Old (6+ yr)	road

Results from bird acoustic analysis

Bat call analysis summary report

Call identification was assisted by consulting distribution information for potential species (Armstrong 2011; Churchill 2008; Van Dyck *et al.* 2013) and records from NatureMap (2020). No reference calls were collected during the survey.

Data was processed and analysed using a combination of manual review and automated processes using Kaleidoscope Pro (Wildlife Acoustic, version 5.3.6) and Anabat Insight (Titley Scientific, version 1.9.2) using the following process:

1. Files were downloaded from the units and saved to an external hard drive (back up copy) following the survey for later processing and analysis
2. For compressed .wav4 and .wac files (full spectrum) collected using the Song Meter units, files were converted to standard .wav using the conversion function in Kaleidoscope Pro
3. For each night data was manually reviewed for bat calls using Kaleidoscope Pro or Anabat Insight from sunset onwards for approximately 30 minutes by visually comparing the time-frequency graph and call characteristics (e.g. peak frequency, characteristic frequency and call shape) with species call descriptions from published guidelines (e.g. Webala *et al*. 2010, Burgar *et al* various dates)
4. Data was then processed using Wildlife Acoustic Kaleidoscope Pro signal parameter batch processing, then cluster analysis features
5. Data from the cluster analysis process was then labelled and reviewed against the data labelled during step 3 for validation purposes to accurately identify species.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but may be used as part of the activity count for the Survey Area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al*. 2000) during the manual validation process as summarised in the table below.

Confidence rating applied to calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap, particularly poor quality calls or mixed species calls making it difficult to distinguish between species.

Bat detector effort and site location

Bat detector site	Phase	Detector name	Start Date	End Date	Easting	Northing	Location details
1	1	sm4-1	24/06/20	30/06/20	426282	6417199	Along cage line 41-50
2	1	sm4-5	24/06/20	29/06/20	419249	6423008	TL1
3	1	sm2-3	24/06/20	30/06/20	417973	6420593	Drainage line
4	1	sm4-4	24/06/20	30/06/20	417931	6422315	Drainage line
5	1	sm4-5	29/06/20	2/07/20	421589	6418754	Near TL2 in blackbutt
6	1	sm4-1	30/06/20	2/07/20	427915	6412940	TL5
7	1	sm4-4	30/06/20	3/07/20	425197	6414173	open Jarrah between tl2 and tl3
8	1	sm2-3	30/06/20	2/07/20	424270	6416696	near TL3 - melaleuca lowland/Jarrah
9	1	sm4-5	2/07/20	6/07/20	427860	6411147	on granite boulder, surface water present, near tl6
10	1	sm4-1	2/07/20	4/07/20	425818	6421856	upland Jarrah/Marri woodland
11	1	sm4-4	3/07/20	6/07/20	421309	6416290	Jarrah woodland
12	2	SM4-4	3/11/20	5/11/20	415676	6414950	Granite
13	2	SM4-1	3/11/20	6/11/20	420798	6417251	Granite
14	2	SM4-4	3/11/20	6/11/20	420771	6417263	Serpentine Dam carpark
15	2	SM4-1	6/11/20	9/11/20	426302	6422178	Near eastern survey boundary
16	2	SM4-2	6/11/20	9/11/20	425097	6426021	Northern Survey Area
17	2	SM2-3	6/11/20	9/11/20	423254	6417433	Undulating low hills
18	2	SM4-4	6/11/20	9/11/20	421492	6418891	TL2
19	2	SM4 -1	9/11/20	11/11/20	422176	6420640	Central north - drainage line?

Results

Approximately 59,516 full spectrum .wav files were analysed (all sites all nights combined) of which approximately 68% were identified as bat call of some description. At least seven species were positively (Definite) identified of the 11 or so species that are known to occur from the locality of the Study Area. As many as two other species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species. Table 3, 4, 5 and 3 provides a list of definite and probable species recorded for each night.

No threatened species listed under the *Biodiversity Conservation Act 2016* and *Environment Protection and Biodiversity Conservation Act 1999* were recorded (Definite) as a result of call analysis.

Myara North Phase 1 bat call analysis results per site

Site / date	White-striped Free-tailed Bat *Austronomus australis*	South-Western Free-tailed Bat *Ozimops kitcheneri*	Gould's Wattled Bat *Chalinolobus gouldii*	*C. gouldii/O. kitcheneri*	Western False Pipistrelle *Falsistrellus mackenziei*	Southern Forest Bat *Vespadelus regulus*	Chocolate Wattled Bat *Chalinolobus morio*	Long-eared Bat sp *Nyctophilus geoffroyi/gouldi/major*
SM2-3								
24/06/2020	D					D		
25/06/2020						D		
26/06/2020	D				D	D		
27/06/2020					D	D		
SM4-1								
26/06/2020		D				D		
27/06/2020		D		SG		D		
28/06/2020				SG				
30/06/2020		D	D			D		
1/07/2020		D	D		PR	D		SG
3/07/2020						D		
SM4-4								
24/06/2020		D		SG		D		
25/06/2020	D					D		
26/06/2020		D		SG		D	PR	
27/06/2020			D	SG		D		
28/06/2020						PR		
30/06/2020		PR	PR					
1/07/2020		PR				D		
3/07/2020						D		SG
4/07/2020		D		SG		D		
5/07/2020		D	D		D	D		
6/07/2020						PR		
SM4-5								
24/06/2020						D		
25/06/2020		PR				PR		
27/06/2020	D					D	PR	
28/06/2020						D		SG
29/06/2020				SG				
30/06/2020						D		SG
1/07/2020						D		
2/07/2020						D		
3/07/2020						D		
4/07/2020		D	D			D		

Myara North Phase 2 bat call analysis results per site

Site / date	White-striped Free-tailed Bat *Austronomus australis*	South-Western Free-tailed Bat *Ozimops kitcheneri*	Gould's Wattled Bat Chalinolobus gouldii	C. gouldii/ F. mackenzie	Western False Pipistrelle *Falsistrellus mackenziei*	Southern Forest Bat *Vespadelus regulus*	Chocolate Wattled Bat *Chalinolobus morio*
SM2-3							
6/11/2020	D	PR	D	SG		D	D
7/11/2020	D	D	D	SG	PR	D	D
8/11/2020	D	D	D	SG	PR	D	D
9/11/2020		PR	D	SG		D	
SM4-1A							
3/11/2020		D				D	
4/11/2020	D	PR				D	
5/11/2020	D	D		SG		D	
6/11/2020	D	D	D	SG	D	D	D
7/11/2020		PR	D	SG	D	D	D
8/11/2020	D	D	D	SG	D	D	PR
9/11/2020	D					PR	
SM4-2							
6/11/2020	D	PR		SG	PR	D	
7/11/2020	D		D	SG	D	D	
8/11/2020	D	D	D	SG		D	
9/11/2020	D	PR	D	SG	PR	D	
SM4-4							
3/11/2020	D	PR				D	
4/11/2020		D				D	
5/11/2020	D	PR		SG	D	D	
6/11/2020	D	D	D	SG	D	D	D
7/11/2020	D	D	D	SG	PR	D	D
8/11/2020	D	D	D	SG	D	D	D
9/11/2020		PR				D	PR

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Rakali transcript data

Myara North Rakali												Rakali evidence			Other evidence							Suitability	
Plot	date	Lats	Long	type	size	bank	substrate	vegetation	TsFire	water prnt/ size	condition	shtig	print	midn.	tdpls	frogs	Crust.	fish	Roo	Pig	water plant	Rakali	Comments
					(width)	(height)	(type)	(Broad type)	(years)														
R1	11/11/20	423939	6412164	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri, Jarrah, Blackbutt	3-5y	yes-pool 4x1.5m x 15cm	Excellent						burrow, shells			trots		Potential seasonally	Mid Serpentine River
R2	11/11/20	427580	6410417	creek	4m	1.6m	mud	mixed shrubs/sedge over *E. rudis* and Blackbutt	3-5y	yes-pool 6x0.5m x 10cm	Excellent						burrow				yes	Too seasonal	Upper reaches Serpentine River
R3	10/11/20	425302	6413889	creek	3.5m	1m	mud	Low mixed shrubs over Marri, Jarrah, Melaleuca	3-5y	yes-pool 15x3m x 20cm	excellent				2		burrow					Too seasonal	
R4	10/11/20	424314	6416065	creek	2m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent									digs		Too seasonal	
R5	10/11/20	425384	6419120	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah, Marri	3-5y	dry, damp soil	excellent				3	3					yes	Too seasonal	
R6	10/11/20	421498	6418609	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt, Marri	5-10y	dry	excellent											Too seasonal	
R7	10/11/20	416107	6417671	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent				2							Too seasonal	
R8	10/11/20	417942	6420003	creek	3m	0.6m	bauxite	nothing	1y	yes-pool 3x10mx20cm	burnt					2						Too seasonal	
R9	11/11/20	420847	6407516	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent					2	shells		scat	trot		suitable, large water body, specimen recorded on camera	Section of Big Brook
R10	11/11/20	419328	6404941	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1			scat			suitable	
R11	5/11/20	419780	6417774	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine				6				2			suitable	
R12	4/11/2020	424220	6416019	creek	2m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent											Too seasonal	
R13	4/11/2020	425346	6413895	creek	4m	1.2m	rock/sand	mixed shrubs on granite	3-5y	yes-pool 4x3mx 40 cm	excellent											Too seasonal	
R14	5/11/2020	424902	6413431	creek	5m	1.5m	rock/sand	mixed shrubs on granite	3-5y	yes-pool 6 x 5mx 50 cm	excellent				4		burrow					Too seasonal	

Carters Freshwater Mussel transect data

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
CFM1																						
1	11/11/20	423939	6412164	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	water 4x1.5m x 15cm	Excellent						burrow					Not suitable, too seasonal
2	11/11/20	423959	6412148	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
3	11/11/20	423965	6412141	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
4	11/11/20	423973	6412134	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
5	11/11/20	423948	6412176	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
6	11/11/20	423953	6412203	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
7	11/11/20	423934	6412229	creek	4m	1.8m	mud/rock	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
8	11/11/20	423906	6412241	creek	4m	1.8m	mud/rock	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent						shells					Not suitable, too seasonal
9	11/11/20	423887	6412256	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent									trot		Not suitable, too seasonal
10	11/11/20	423867	6412273	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
CFM2																						
1	11/11/20	427580	6410417	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	water 6x0.5m x 10cm	Excellent						burrow				yes	Not suitable, too seasonal and small
2	11/11/20	427593	6410412	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
3	11/11/20	427612	6410413	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent						burrow					Not suitable, too seasonal and small
4	11/11/20	427620	6410395	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
5	11/11/20	427556	6410443	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
6	11/11/20	427531	6410448	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
7	11/11/20	427532	6410420	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
8	11/11/20	427519	6410412	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	water 15x4m x 50cm	Excellent						burrow					Not suitable, too seasonal and small
9	11/11/20	427511	6410427	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	water 15x4m x 50cm	Excellent						burrow					Not suitable, too seasonal and small
CFM3																						

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
1	10/11/20	425302	6413889	creek	3.5m	1m	mud	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	water 15x3m x 20cm	excellent											Not suitable, too seasonal and small
2	10/11/20	425328	6413913	creek	3.5m	1m	mud	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	water 4x3m x 10cm	excellent				2		burrow					Not suitable, too seasonal and small
3	10/11/20	425349	6413897	creek	3.5m	1m	granite	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	water 12x3m x 30cm	excellent						burrow					Not suitable, too seasonal and small
4	10/11/20	425383	6413884	creek	3.5m	1m	granite	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry	excellent											Not suitable, too seasonal and small
5	10/11/20	425411	6413878	creek	3.5m	1m	granite	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry	excellent											Not suitable, too seasonal and small
6	10/11/20	425306	6413865	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
7	10/11/20	425312	6413842	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
8	10/11/20	425283	6413823	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
9	10/11/20	425246	6413809	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
10	10/11/20	425217	6413809	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
CFM4																						
1	10/11/20	424314	6416065	creek	2m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
2	10/11/20	424340	6416092	creek	2m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
3	10/11/20	424368	6416108	creek	3m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
4	10/11/20	424404	6416136	creek	2m	0.6m	sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
5	10/11/20	424400	6416176	creek	2m	0.6m	sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
6	10/11/20	424291	6416034	creek	2m	0.6m	sand damp	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
7	10/11/20	424269	6416056	creek	2m	1m	sand damp	regrowth mixed shrub	2y	dry	excellent									digs		Not suitable, too seasonal and small

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
8	10/11/20	424231	6416035	creek	2m	1m	sand damp	regrowth mixed shrub	2y	dry	excellent									digs		Not suitable, too seasonal and small
9	10/11/20	424197	6416010	creek	2m	1m	rock/sand	regrowth mixed shrub	2y	dry	excellent									digs		Not suitable, too seasonal and small
10	10/11/20	424176	6416000	creek	2m	1m	rock/sand	regrowth mixed shrub	2y	dry	excellent									digs		Not suitable, too seasonal and small
CFM5																						
1	10/11/20	425384	6419120	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
2	10/11/20	425343	6419098	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	water 6x4mx40cm	excellent				3	3					yes	Not suitable, too seasonal and small
3	10/11/20	425316	6419108	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
4	10/11/20	425381	6419083	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
5	10/11/20	425414	6419077	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
6	10/11/20	425292	6419119	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	water 6x4mx30cm	excellent				1	1					yes	Not suitable, too seasonal and small
7	10/11/20	425271	6419130	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	water 3x3mx20cm	excellent				1	1					yes	Not suitable, too seasonal and small
8	10/11/20	425247	6419119	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
9	10/11/20	425218	6419138	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	water 35x2mx30cm	excellent				2						yes	Not suitable, too seasonal and small
10	10/12/20	425193	6419143	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
CFM6																						
1	10/11/20	421498	6418609	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
2	10/11/20	421539	6418540	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
3	10/11/20	421557	6418506	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
4	10/11/20	421592	6418460	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
5	10/11/20	421580	6418419	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
6	10/11/20	421549	6418394	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry, moist	excellent											Not suitable, too seasonal and small
7	10/11/20	421559	6418365	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
8	10/11/20	421573	6418340	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
9	10/11/20	421585	6418327	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
10	10/11/20	421596	6418303	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
CFM7																						
1	10/11/20	416107	6417671	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
2	10/11/20	416107	6417651	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
3	10/11/20	416114	6417626	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
4	10/11/20	416122	6417597	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
5	10/11/20	416133	6417579	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	water 3x1mx20cm	excellent				2							Not suitable, to seasonal and small
6	10/11/20	416093	6417700	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
7	10/11/20	416086	6417680	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, to seasonal and small
8	10/11/20	416068	6417739	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
9	10/11/20	416047	6417809	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
10	10/11/20	416002	6417853	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
CFM8																						
1	10/11/20	417942	6420003	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
2	10/11/20	417924	6420010	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
3	10/11/20	417913	6420038	creek	3m	0.6m	bauxite	nothing	1y	puddle 30x 30cm	burnt											Not suitable, too seasonal and rocky
4	10/11/20	417906	6420057	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
5	10/11/20	417883	6420068	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
6	10/11/20	417937	6419988	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt											Not suitable, too seasonal and rocky
7	10/11/20	417946	6419970	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt											Not suitable, too seasonal and rocky
8	10/11/20	417969	6419946	creek	3m	0.6m	bauxite	nothing	1y	water 3x10mx20cm	burnt					2						Not suitable, too seasonal and rocky
9	10/11/20	417977	6419923	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
10	10/11/20	417998	6419892	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
CFM9																						
1	11/11/20	420847	6407516	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent					2						Possibly suitable
2	11/11/20	420834	6407529	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent											Possibly suitable
3	11/11/20	420821	6407540	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent						shells			trot		Possibly suitable
4	11/11/20	420811	6407555	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent											Possibly suitable
5	11/11/20	420799	6407589	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent											Possibly suitable
6	11/11/20	420855	6407510	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent											Possibly suitable
7	11/11/20	420884	6407472	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent					1						Possibly suitable
8	11/11/20	420914	6407469	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	dry bit	excellent									digs		Possibly suitable
9	11/11/20	420949	6407450	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	dry bit	excellent									digs		Possibly suitable
10	11/11/20	420927	6407421	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	dry bit	excellent									digs		Possibly suitable
CFM10																						
1	11/11/20	419328	6404941	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
2	11/11/20	419327	6404972	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
3	11/11/20	419339	6404993	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
4	11/11/20	419344	6405002	creek	3m	0.8m	clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
5	11/11/20	419356	6405027	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
6	11/11/20	419364	6405047	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1			scat			suitable
7	11/11/20	419391	6405078	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
8	11/11/20	419407	6405105	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
9	11/11/20	419411	6405121	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1			scat			suitable
10	11/11/20	419431	6405120	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
CFM11																						
1	5/11/20	419780	6417774	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine								2			suitable
2	5/11/20	419781	6417765	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
3	5/11/20	419787	6417750	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
4	5/11/20	419782	6417742	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine				2							suitable
5	5/11/20	419777	6417730	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine				2							suitable
6	5/11/20	419767	6417730	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
7	5/11/20	419754	6417719	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine				2							suitable
8	5/11/20	419729	6417721	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
9	5/11/20	419717	6417721	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
10	5/11/20	419711	6417717	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
11	5/11/20	419705	6417709	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes - ends granite	pristine											suitable

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The Power of Commitment

Appendix 7 – Pre-Clearance Survey – Autumn, Myara North (GHD, 2023)

Pre-clearance fauna survey - Autumn

Myara North

Alcoa of Australia Limited

30 October 2023

→ **The Power of Commitment**



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1. Introduction

1.1 Project background

Alcoa of Australia Limited (Alcoa) operate the Huntly Mine within mining lease ML1sa, in the Northern Jarrah Forest Interim Biogeographic Regionalisation for Australia (IBRA) subregion. Alcoa propose to transition the Huntly Mine operations from the current Myara mine region into the Myara North mine region, as early as 2023 pending the granting of legislative approvals.

The Huntly Mine transition into the Myara North mine region is a component of the Pinjarra Alumina Refinery Revised Proposal (the Alcoa Proposal). The Alcoa Proposal will be assessed by the Environmental Protection Authority (EPA) under Part IV of the Environmental Protection Act 1986 (EP Act) and the Mine component is a controlled action (EPBC 2022/09204) to be assessed and approved under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).

GHD has prepared, on behalf of Alcoa, a comprehensive Environmental Review Document for the Alcoa Proposal, which includes commitments for environmental management, including pre-clearance surveys. The pre-clearance surveys will inform the following:

– Amendment of preliminary infrastructure or facility designs to avoid, where practicable, populations or key habitat features for conservation significant species
– Construction management
– Preparation of EPA or EPBC Act compliance reports regarding impacts, management or offsets for conservation significant species.

1.2 Purpose of this report

The purpose of the survey was to identify the presence of significant fauna and significant fauna habitat features in the survey area.

The outcome of the survey and information supplied in this biological survey report will be used to inform the environmental assessment and approvals process, and the results will be used to assist in the preparation of Environmental Impact Assessment documentation. The survey findings may also assist in developing appropriate environmental management strategies to avoid and minimise environmental impacts.

1.3 Location

The survey area is located at the Alcoa mining lease, Myara North. The start of the survey area is approximately 7 km east of Jarrahdale, WA. The survey location is presented in Figure 1, Appendix A.

1.4 Scope of works

The general scope of works required for the project is summarised in Table 1 below. This report only pertains to the fauna component of the Summer/Autumn 2023 surveys.

Table 1 Pre-clearance survey scope overview

Season	Survey area	Survey	Deliverable
Summer / Autumn 2023	- Haul Road network (50m buffer) - Myara North & Kisler facilities areas	- Targeted survey for Black Cockatoos and conservation significant mammal species, for all areas	- Summer/Autumn 2023 survey report suitable for submission to EPA.

In addition to the report, figures including field survey results (fauna records, tree records and habitat features), appendices including field data, photographs and species inventory, and the survey spatial data (ArcGIS shapefiles) provided in GDA94 datum consistent with IBSA requirements is to be provided.

1.5 Relevant legislation, conservation codes and background information

In WA some fauna are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this fauna survey are provided in Appendix B.

1.6 Report limitations and assumptions

This report: has been prepared by GHD for Alcoa of Australia Limited and may only be used and relied on by Alcoa of Australia Limited for the purpose agreed between GHD and Alcoa of Australia Limited as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Alcoa of Australia Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

2. Methodology

2.1 Desktop assessment

A short review of GHD (2021) results has been provided for the desktop component of the survey.

2.2 Field survey

2.2.1 Survey timing and personnel

Field surveys comprised of a pre-clearance fauna survey. Two site visits were undertaken to complete the survey, these are detailed in Table 2. The field survey was led by Zoologist, Jack Eastwood and assisted by other GHD Zoologists. The experience of these staff members is presented in Table 3.

Table 2 Field survey timing, type and details

Survey type	Date	Tasks	Personnel
Pre-clearance survey	20th – 25th February 2023	Black Cockatoo tree assessment, significant fauna habitat assessment, significant fauna records and camera deployment.	Jack Eastwood Brad Maryan
Remote equipment collection and finalised pre-clearance survey	20th – 23rd March 2023	Remote equipment collection and Black Cockatoo tree assessment, significant fauna habitat assessment, significant fauna records	Brad Maryan Dylan Goldspink

Table 3 Personnel experience

Name	Years of experience	Role	Survey conducted
Jack Eastwood	5+	Zoologist	Survey
Brad Maryan	20+	Senior Zoologist	Survey and remote equipment collection
Dylan Goldspink	5+	Graduate Zoologist	Finalised survey and remote equipment collection

2.2.2 Guiding documents and data collection

The survey methodology and data collection GHD employed was consistent with relevant aspects of:

EPA Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA2020)

– Survey guidelines for Australia's Threatened Mammals (Commonwealth of Australia, 2011)

– Referral guideline for 3 WA threatened black cockatoo species: Carnaby's Cockatoo (*Zanda latirostris)* Baudin's cockatoo (*Zanda baudinii)* Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso)* (Commonwealth of Australia, 2022). At the time of the survey the 2022 guidelines were most current.

Field data collection for the biological survey was undertaken using Global Positioning System (GPS) enabled Samsung tablets using electronic forms in Collector and tailored to IBSA spatial data requirements. Data was synced to the cloud at the conclusion of each field day. GPS devices were used to capture survey effort (track logs). Field photographs were stored and where applicable have been provided as part of the deliverables.

2.2.3 Pre-clearance fauna survey

GHD Zoologists undertook fauna surveys, targeting the conservation significant fauna identified as likely to occur in the Myara North region (GHD 2021). From this work thirteen conservation significant fauna species were identified as known to occur (i.e. recorded) in the region. These thirteen recorded species are the focus of the pre-clearance survey and are:

- Chuditch (*Dasyurus geoffroii*) – Vulnerable
- Quokka (*Setonix brachyurus)* – Vulnerable
- Water Rat, Rakali (*Hydromys chrysogaster*) – Priority 4
- Western False Pipistrelle (*Falsistrellus mackenziei*) – Priority 4
- South-Western Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*) – Conservation Dependent
- Western Brush Wallaby (*Notamacropus irma*) – Priority 4
- Quenda (*Isoodon fusciventer*) – Priority 4
- Masked Owl (*Tyto novaehollandiae novaehollandiae)* – Priority 3
- Peregrine Falcon (*Falco peregrinus*) – Other Specially Protected
- Carnaby's Cockatoo (*Zanda latirostris*) - Endangered
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) - Vulnerable
- Baudin's Cockatoo (*Zanda baudinii*) - Endangered
- Southern Death Adder (*Acanthophis antarcticus*) – Priority 3

The survey area was traversed on foot and where appropriate vehicle to identify and record signs of significant fauna and presence of suitable habitat and habitat features. Specifically, this included the assessment of hollow-bearing trees with respect to Black Cockatoos and other conservation significant mammals (i.e. Western False Pipistrelle and Brush tailed Phascogale), and inspection of suitable ground habitat features (e.g. hollow fallen logs) with respect to Chuditch, Western Brush Wallaby and Quenda. The survey also included the deployment of remote cameras across suitable habitat to confirm mammal occupation. The survey effort including staff GPS tracklogs, and remote camera locations have been mapped in Figure 2, Appendix A.

Habitat tree assessment

Visual inspections of relevant suitable habitat features (i.e. tree hollows) suitable for the target significant fauna species including the Western False Pipistrelle, Brush-tailed Phascogale and Masked owl was undertaken and mapped.

Diurnal searches

The survey area was traversed on foot, in a continuous transect through the survey area, to identify suitable habitat, and habitat features suitable for use by significant fauna species. Where the survey area increased in size, transects were undertaken at approximately 50 m apart to search the area adequately. Diurnal searches of potential shelter/ denning sites for significant species (i.e logs for Chuditch) and dense vegetation (i.e. suitable for Quenda) dictated the deployment of remote cameras in these areas to confirm use by the species.

Diurnal searches also detect fauna through identification of secondary evidence, in the form of scats, tracks, feathers, diggings, and burrows.

Remote cameras

Remote cameras (Reconyx-Hyperfire ® and Reconyx-Pro ®) were deployed in suitable habitat to detect relevant target significant fauna, including Damplands and Drainage lines (Bullich, Flooded Gum, Melaleuca), Granite outcrops, Jarrah-Marri Forest, and Sheoak dominated patches of Jarrah-Marri Forest. Cameras were baited with universal animal bait (a combination of peanut butter, oats and sardines) to attract fauna species within the survey area. For each camera location the number of nights deployed, and the GPS coordinates were recorded. Cameras were used in this instance to supplement other trapping techniques.

The camera placement was altered to maximise possibility of capture for certain significant fauna. In Sheoak dominated forest, cameras would be placed facing a tree trunk in order to target South-western Western Brush-tailed Phascogale, as they are arboreal. Cameras targeting Chuditch and Western Brush Wallaby were placed on the ground or on fallen logs in Jarrah-Marri Forest for these species. Cameras were placed in damplands and drainage lines to target Quokka, Quenda, and Water Rat. Although not present in the survey area, Granite outcrops would be the target habitat for the Southern Death Adder.Data from the cameras were downloaded to a computer and manually analysed for the presence of fauna following the field survey.

A total of sixteen remote cameras were deployed in the survey area and remained between the 20th February and 21st March. In total, 30 trap nights were recorded over the survey.

All remote cameras have been mapped on Figure 2, Appendix A. and data presented in Appendix C.

Fauna species identification

Identification of fauna species was made in the field using available field guides and electronic guides (e.g. Morcombe 2004, Menkhorst and Knight 2010, Neville 2013 and Wilson and Swan 2020). Where identification was not possible, photographs of specimens were collected to be later identified. The Chuditch recorded on camera were analysed using spot arrangement as per Hohnen et al (2012) for the purposes of identifying and counting the number of individuals. The results of this analyses is presented in Appendix C.

Fauna nomenclature

Nomenclature used in this report for all faunal groups follows that used by the Western Australian Museum and the DBCA NatureMap database (DBCA 2007–).

2.2.4 Black Cockatoo tree assessment

A targeted Black Cockatoo tree assessment was undertaken in conjunction with the pre-clearance survey. The survey was carried out in accordance with the Referral guideline for 3 WA threatened black cockatoo species:: Carnaby's Cockatoo (*Zanda latirostris*) Baudin's cockatoo (*Zanda baudinii*) Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) (Commonwealth of Australia, 2022). The assessment included:

– Survey of hollow bearing trees for signs of use or suitability for use at ground-level, including photography, coordinates, tree diameter at breast height (DBH), estimated hollow height-from-ground/ entrance sizeand location
– Verification of GHD (2021) assessment of foraging and roosting habitat within the survey area
– Recording of foraging evidence and visual or aural observation of black cockatoos.

Hollow suitability for Black Cockatoo breeding is assessed using parameters based on studies conducted and adopted by Johnstone and Storr (1998) and Groom (2011). On average, Carnaby's Cockatoos are known to nest in hollows with an entrance diameter greater than 20 - 30 cm (Johnstone and Storr 1998; Groom 2011). While the Forest Red-tailed Black Cockatoo is known to nest in hollows with an entrance of greater than 12 cm (Johnstone and Storr 1998).

In addition to the hollow diameter, the presence of chewing around the hollow or other evidence of use, such as feeding evidence on the ground provides an indicator of a suitable and potentially used or currently used hollow. The general accessibility of a hollow is also assessed in the field, as branches can sometimes be covering hollows, or hollows may be occupied by other bird species (Corrella or Galah) or bees.

2.3 Limitations

2.3.1 Field survey limitations

The EPA (2020) Technical Guidance states that fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 4. Based on this assessment, the survey effort has not been subject to any constraints, which affect the thoroughness of the assessment or conclusions formed.

Table 4 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Contextual information was derived from previous studies and desktop assessment completed by GHD (2021) with relevance to the survey.

Aspect	Constraint	Comment
Scope (what life forms were sampled etc.)	Nil	Terrestrial vertebrate fauna were sampled during the survey.
Proportion of fauna collected and identified (based on sampling, timing and intensity)	Nil	A pre-clearance fauna (or targeted fauna) survey was conducted over two periods (20th – 25th February 2023 and 20th – 23rd March 2023). As the survey targeted suitable habitats using cameras, mammals are expected to have been captured during this time, and seasonality would not have impacted the results with this method. The target species were captured using the cameras. Eight survey days and 16 person days were employed for the surveys. A total of 17 cameras were deployed over the survey area and remained between the 20th February and 21st March. In total, 30 trap nights were recorded over the survey. Of the fauna species recorded during the survey, all were identified to species level.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Nil	The survey area was accessed by vehicle and on foot. The survey area was adequately surveyed during the field survey in line with the scope.
Mapping reliability	Minor	No habitat mapping was undertaken for the survey. The survey was conducted using high-resolution aerial imagery obtained from Landgate, topographical features, previous vegetation mapping (Mattiske and/or Beard) and field data. Data was recorded in the field using hand-held GPS tools (e.g. Samsung tablet, and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers, including tree canopies. The Garmin GPS units used for this survey are accurate to within ±5 metres on average, therefore the data points consisting of coordinates recorded from the GPS may contain minor inaccuracies.
Timing/weather/ season/cycle	Nil	The field survey was undertaken in February – March. In the four months prior to the survey (November 2022 – February 2023), the Jarrahdale (#9023) radar (BoM 2023) recorded 46.4 mm rainfall. This is below the long-term average rainfall for the same period (83.1 mm). The conditions during the survey were clear, with no rainfall. The nearest weather station for temperature data is Karnet (#9111) A summary of the climatic conditions are provided for February: - Daily maximum temperature: 35.2 °C - Daily minimum temperature: 24.0 °C - Daily rainfall: 0.2 mm The weather conditions did not appear to impact the results of the survey. Rainfall and cold conditions can impact fauna detectability. It would also have reduced the accessibility and time available to survey, if rainfall were to exceed the threshold for a stop-work.
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	Historical and ongoing clearing is present in the survey area. This disturbance did not impact the survey effort and aim of the survey. Fauna that are present in the area and potentially utilising the remaining uncleared habitat are detectable, or a reasonable likelihood is placed on their occurrence through the distinction of available habitat for these species, noted in the field, if they are not detected during the field survey.
Intensity (in retrospect, was the intensity adequate)	Nil	The survey area was sufficiently covered by the field staff. Walk transects covering the entire length of the survey area, was conducted, which is considered adequate for the survey requirements. As the survey area was narrow, the survey team were able to visibly inspect all the fauna habitat present within the survey timeframe through walk transects.
Resources	Nil	Adequate resources were employed during the field survey. Eight survey days and 16 person days were spent undertaking the

Aspect	Constraint	Comment
		survey utilising 3 experienced zoologists. The entirety of the survey area was walked through transects, and a team of two allows for suitable coverage to visibly inspect the approximately 100 m wide corridor, as the team walk apart at a distance to record information across the corridor.
Access restrictions	Nil	All areas were able to be accessed during the survey.
Experience levels	Nil	The relative experience levels of the junior zoologists are 5 years, and the senior zoologist is 20 plus years.

3. Desktop assessment

3.1 Previous surveys

GHD (2021) Myara North Terrestrial Fauna Survey and Black Cockatoo

GHD (2021) conducted a Terrestrial Vertebrate Fauna Survey and Black Cockatoo Habitat Assessment in the Myara North region for Alcoa's Huntly Mine expansion. The survey was located in Jarrahdale State Forest and bordered Jarrahdale town and Serpentine National Park to the west, Modnadnocks Conservation Park to the east, and the existing Myara mine region to the south. The survey area covered approximately 18,000 ha.

The 2021 survey included a desktop assessment, a consolidation of previous fauna studies, and a detailed and targeted vertebrate fauna survey undertaken in the Myara North region in winter (June/July) and spring (November) of 2020. The Survey included a black cockatoo habitat assessment in accordance with Revised Draft referral guidelines for three threatened black cockatoo species (Commonwealth of Australia, 2017), and a targeted assessment of Carter's Freshwater Mussel.

The survey area recorded eight broad fauna habitat types: Bullich forest, Granite outcrop, Blackbutt forest, Flooded Gum woodland, Jarrah -Marri forest, Melaleuca dampland. Mine rehabilitation and Pine plantation. Jarrah-Marri forest was the predominant habitat type, consisting of 83% of the survey area. A small portion of the survey area comprised rural cleared land.

The conservation value of each fauna habitat type is specific to the locally occurring conservation significant fauna species and the type of usage by those species. All three Black Cockatoos were recorded primarily throughout the Marri-Jarrah forest, however all habitat types will be utilised for foraging by either one or all of the species. Melaleuca Damplands and riparian areas comprising Bullich Forest, Blackbutt Forest and Marri-Jarrah Forest support a Quokka population with records scattered throughout the Survey Area. Chuditch are wide ranging and expected to use all habitat types at a relatively low density.

In total 13 conservation significant species were recorded in the survey area including the Quokka, Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Forrest Red-tailed Black Cockatoo, Baudin's Cockatoo, Carnaby's Cockatoo, Western False Pipistrelle, Southern Death Adder, Quenda, Rakali, Masked Owl and Peregrine Falcon. All species identified are likely to have significant populations (number of individuals) and key habitat present within the survey area.

With regard to migratory shorebirds, the survey area lacks open water including shallow shorelines for foraging habitat. The creek lines and vegetated dampland areas within the survey area are not suitable for migratory shorebirds.

Carter's Freshwater Mussel was targeted during the survey, but it was not recorded. This is expected given that the streams are seasonal, and dry up for several months of the year. The species is known to reside in the Serpentine Dam downstream and while mussels may disperse upstream from the Dam during winter/spring flows, the dispersing mussels are unlikely to survive the extended dry period and significant populations are unlikely within the survey area.

The DBCA NatureMap search identifies that 192 vertebrate fauna taxa previously recorded within 20 km radius of the survey area. This total included 30 mammals, 115 birds, 35 reptiles and 12 amphibians.

The detailed and targeted program recorded 132 vertebrate fauna species utilising the survey area, including 23 mammals, 76 birds, 26 reptiles and seven amphibians. Of these, eight introduced species (mammals and birds) were identified. Based on the database search, the program produced good diversity of species for the survey area. It is likely that a different suite of faunal groups would be present in other times in the year (e.g. amphibians in autumn and seasonally moving species).

The location of previously recorded suitable DBH Black Cockatoo trees recorded by GHD (2021) either in the survey area or nearby have been mapped in Figure 4, Appendix A. This represents survey effort in the area and provides an indication of potential impact to trees for the current alignment (survey area).

4. Results

4.1 Significant fauna

Six significant fauna species were recorded within the survey area during the surveys. These are:

– Baudin's Cockatoo (*Zanda baudinii*) – listed as Endangered under the BC Act and Endangered under the EPBC Act.
– Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act.
– Chuditch (*Dasyurus geoffroii*) listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act.
– Quenda (*Isoodon fusciventer*) – listed as Priority 4 by the DBCA.
– Western Bush Wallaby (*Notamacropus irma*) – listed as Priority 4 by the DBCA.
– South-Western brush-tailed phascogale (*Phascogale tapoatafa wambenger*) – listed as Conservation Dependent by the DBCA.

All locations of these fauna (camera results and visual observations/secondary evidence) and trees suitable for use by significant fauna, have been mapped on Figure 3, Appendix A with raw data presented in Appendix C.

Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso)

Forest Red-tailed Black Cockatoos were recorded at 6 locations throughout the survey area with approximately 6 physical flock observations recorded during the survey. Individuals were observed in flight, feeding or calling throughout the areas assessed. The location of these sightings are presented in Figure 4, Appendix A and in Appendix C.

Baudin's Cockatoo (Calyptorhynchus baudinii)

Baudin's Cockatoo has been recorded breeding in both the Myara and Myara North regions, though only in low numbers. Most breeding appears to be in the Solus Road area at the border of the Myara and Myara North regions (Alcoa, T. Kirkby unpublished data).

Baudin's Cockatoo were recorded in flight, feeding and calling throughout the survey area. In total Baudin's Cockatoo were recorded at 10 locations, with 3 physical flock observations recorded during surveys. Individuals were observed in flight, feeding or calling throughout the areas assessed. The location of these sightings are presented in Figure 4, Appendix A and in Appendix C

Quenda (Isoodon fusciventer)

The Quenda was recorded at one location within the survey area via remote camera (see Plate 1). Camera B1 is located in the small portion of the survey area alignment in the southwest of the survey area. Habitat preference tends to be associated with areas of low dense vegetation along drainage lines and damplands. The camera which recorded the Quenda was setup in Blackbutt forest, which was nearby a drainage line. The location of the Quenda are presented in Figure , Appendix A and in Appendix C.



Plate 1: Quenda captured on camera during Pre-clearance survey

Chuditch (Dasyurus geoffroii)

During the field survey Chuditch were recorded on 4 remote camera devices (Plate 2). The location of these records is on Figure 3, Appendix A. Image assessments were conducted, by analysing camera trap images of individuals using the unique pattern and spots each individual displays (see Appendix C). This assessment identified that 9 different individuals were recorded in the survey area. This included 5 individuals recorded on Camera 11, one individual recorded on Camera 42, one individual on Camera “no name” and two individuals on Camera 43. There is a degree of uncertainty surrounding Chuditch 5, as the images do not show the full spot pattern for that individual, suggesting it could be Chuditch 1, as it has a similar pattern.

Nine individuals is a high number and may represent that the survey area is within several individual’s home-ranges and that suitable breeding and foraging habitat is available. GHD (2021) states that *the survey area contains suitable breeding and foraging/hunting habitat to support the species and a population.* This distinction can be made for the results in the pre-clearance survey, especially as only two camera captures of the Chuditch were recorded by GHD in 2021 and extensive targeted cage trapping was undertaken for the species, with no trapped individuals. (GHD 2021).



Plate 2: Chuditch captured on camera during Pre-clearance survey’

Western Brush Wallaby (Notamacropus irma)

Western Brush Wallaby were recorded throughout much of the survey area with a total of 11 observations of individuals (predominantly opportunistic) recorded during the surveys. Sightings occurred mainly amongst the Jarrah-Marri Forest, the dominant fauna habitat type, and were more prevalent in the southern and central portions of the survey area. The location of these records is on Figure 3, Appendix A.

South-Western Brush-Tailed Phascogale (Phascogale tapoatafa wambenger)

During the field survey The South-Western Brush-tailed Phascogale was recorded on one remote camera (Plate 3) at one location in the Jarrah/Marri forest habitat in the survey area (Figure 3, Appendix A). Trees identified as suitable for use by this species (containing suitable hollows) were identified in the survey area. A total of 16 trees, containing 23 hollows were observed as suitable for this species. This total included 12 Jarrah trees, and 4 Marri. These trees are presented on Figure 3, Appendix A.



Plate 3: South-Western Brush-tailed Phascogale captured on camera during Pre-clearance survey

Masked Owl (Tyto novaehollandiae novaehollandiae)

The Masked Owl has been previously recorded with acoustic recorders at Myara North near Serpentine Dam (GHD 2021). One tree hollow in a Jarrah tree was identified as suitable for the Masked Owl in the survey area (Figure 3, Appendix A and Appendix C). This species was not recorded during the survey. Nocturnal surveys or bird acoustic recorders would be required to detect this species.

4.2 Black Cockatoo tree assessment

The location of suitable DBH trees for all Black Cockatoo species, identified in the survey area have been mapped in Figure 4, Appendix A and provided in tabular format in Appendix C.

The survey area was observed to be dominated by Forest Red-tailed Black and Baudin's Cockatoo, while Carnaby's Cockatoo's were not observed at the time of the survey.

Transect data recorded within the survey area identified Jarrah as the dominant tree species supporting breeding habitat, followed by Marri and Blackbutt (Figure 4, Appendix A) represented by the yellow and labelled symbols. Both the composition and relative number of habitat trees per hectare is likely dictated by dual factors; including historic logging practices and deliberate felling of Marri to provide better resources to promote faster growth to Jarrah timber assets. Habitat tree counts (trees identified with potential breeding suitability (i.e. containing hollows)) in the survey area comprise of 15 Jarrah, 9 Marri, and 1 Blackbutt (25 habitat trees in total). The total number of suitable hollows recorded for Black Cockatoos is 33. The hollows were assessed as suitable as they were the appropriate size, and were accessible (not occupied by bees or other birds and no branches in front of entrance).

Breeding activity has been recorded at Myara North in the past for Forest Red-tailed Black Cockatoos, Baudin's Cockatoo and Carnaby's Cockatoo (GHD, 2021). The pre-clearance survey recorded hollows suitable for breeding for Black Cockatoo, and evidence of use (chew marks around hollow) at 8 of the 33 hollows identified (Appendix C). Three of these hollows were in Marri, and the remaining 5 were in Jarrah. The trees are labelled in Figure 4, Appendix A with an identifying number that is provided in the table in Appendix C.

In total 12 foraging sites were recorded consisting of 7 Baudin's Cockatoo and 5 Forest Red-tailed Black Cockatoo sites. These sites are mapped on Figure 3, Appendix A. Throughout the survey area foraging quality was observed medium to high quality, depending on habitat type and the requirements for each cockatoo species. The areas

representing high quality foraging habitat consist of primary foraging species including Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Blackbutt (*Eucalyptus patens*), Sheoak (*Allocasuarina fraseriana*), Bull Banksia (*Banksia grandis*), and Snottygobble (*Persoonia longifolia*).

No roosting sites were recorded within the survey area. Additionally, no evidence of roosting was observed. It is likely roost locations may be present within or nearby the survey area, for both Baudin's Cockatoo and Forest Red-tailed Black Cockatoo with moderate flock numbers of up to 20 individuals observed flying over the survey area.

5. Conclusion

The pre-clearance survey targeted thirteen significant fauna species known or considered likely to occur in the survey area as per GHD (2021). Six of these significant fauna species were recorded within the survey area during the Autumn surveys. Three of these species, Chuditch (*Dasyurus geoffroii*), the Quenda (*Isoodon fusciventer*), South-Western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) were recorded on remote camera. The remaining three species, the Western Brush Wallaby (*Notamacropus irma*), Baudin's Cockatoo (*Zanda baudinii*) Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) were visually observed occupying the survey area. Secondary evidence of Black Cockatoos was recorded through foraging on Marri and Jarrah nuts.

Hollow bearing habitat trees were identified and assessed as providing suitable refugia for South-Western Brush-tailed Phascogale and Masked owl across the survey area. A total of 17 hollow bearing trees were observed to be suitable habitat trees, which includes16 trees containing hollows suitable for South-Western Brush-tailed Phascogale and one tree for the Masked owl.

Potential breeding habitat trees were identified in the survey area for Black Cockatoos. A total of 25 suitable trees were identified in the survey area, containing a total of 33 hollows. A total of 8 hollows with evidence of use by Black Cockatoos (chew marks around hollow) were recorded in the survey area. Three of these hollows were in Marri, and the remaining 5 were in Jarrah.

In line with GHD's (2021) assessment, no evidence of Woylie (*Bettongia penicillata ogilbyi*) or Numbat (*Myrmecobius fasciatus*) were observed during the survey. These species have the potential to occur, although unlikely. Scattered Woylie populations may be found throughout the Jarrah forest in the southwest corner of WA. Extant naturally occurring populations of the species are restricted to three small wheatbelt reserves – Dryandra Woodland, Tutanning Nature Reserve and Perup Forest. However, GHD recently recorded the Woylie at the O'Neil survey area, which is approximately 20 km southeast of the Myara North survey area. The Myara survey area has received much more disturbance than the O'Neil area, in the form of clearing, and may be impacting the presence of this species. The suitability of habitat (dense myrtaceous shrubland and thickets of the plant *Gastrolobium*) for Woylie in the survey area is limited.

The only remaining original subpopulations for the Numbat are at Dryandra Woodland and the Upper Warren area (including Tone Perup Nature Reserve, Greater Kingston National Park and adjoining State Forest). and preferred habitat being outside the region. There was however a camera record of a single individual at Boddington recorded in 2021 by a landholder, which is approximately 50 km away from the extant populations, and an additional 50 km from the Myara survey area. It is highly unlikely the Numbat are utilising the survey area based on known distribution, and the existing habitat clearing/disturbance at Myara, as Numbats require large areas with sufficient densities of termites present in logs/hollows for food, and hollow logs, tree hollows, burrows and branches for shelter.

GHD (2021) recorded the Quokka on camera in Phase 1 and Phase 2 of the survey at 16 locations across the survey area. GHD determined the species is likely widespread in the area but are limited to areas of dense vegetation associated with drainage lines and damplands. No evidence of Quokka was recorded during the 2023 survey at Myara North, however, previous records from GHD (2021) are close to the area and Quokka is likely to occur. This is particularly in the southern arm of the haul road network, where it crosses the drainage line (from the Serpentine Reservoir) running northwest – east, and in the centre of the network, just south of the Myara North Facilities area, where it intersects a few drainage lines. GHD (2021) recorded Quokka near these areas.

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Appendices

Appendix A

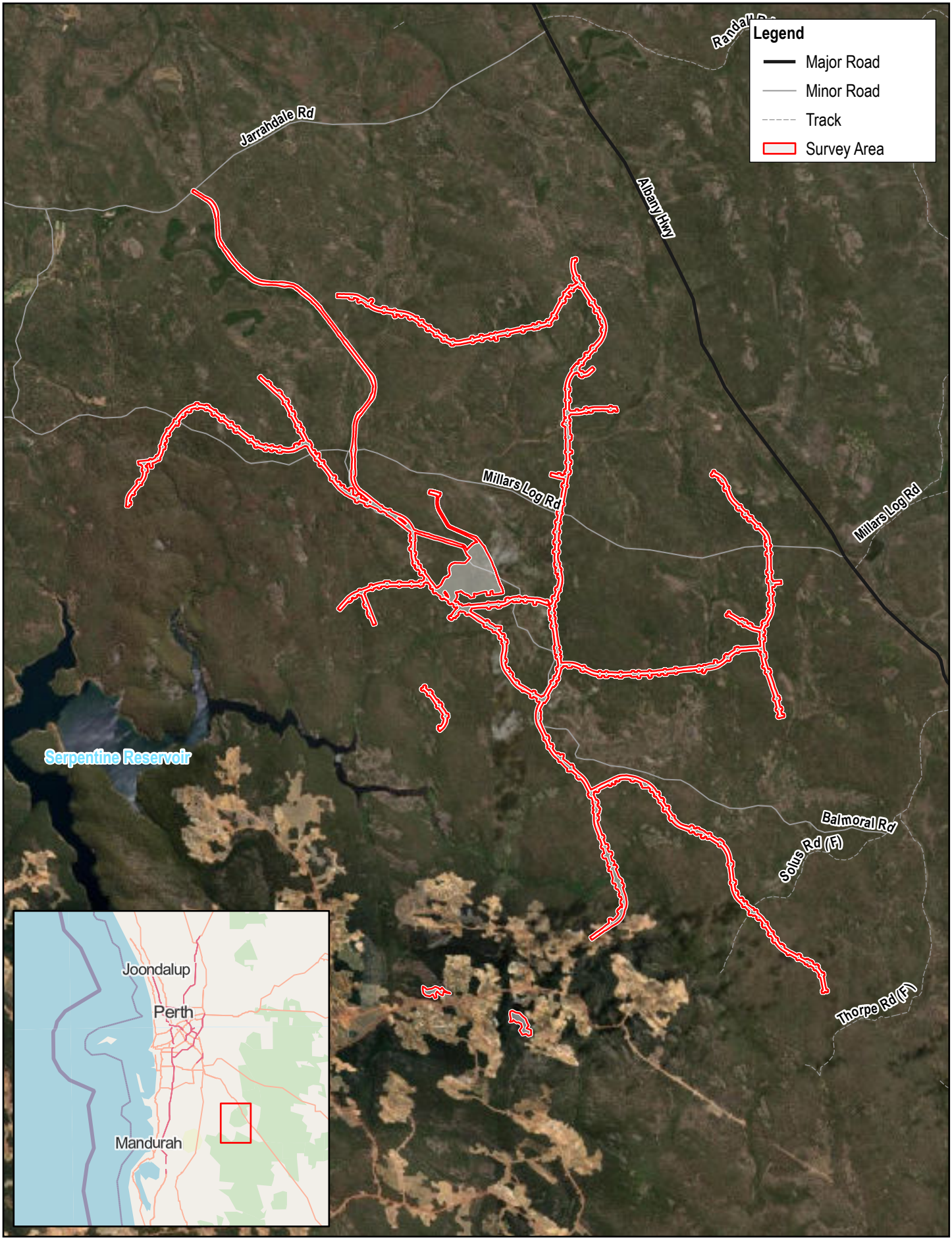
Figures

Figure 1 Project location

Figure 2 Survey effort

Figure 3 Significant fauna locations

Figure 4 Black Cockatoo Assessment



Paper Size ISO A4

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Kilometers

Map Projection: Transverse Mercator
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GHD

Alcoa
Myara North 2022/23 Pre Clearance Surveys

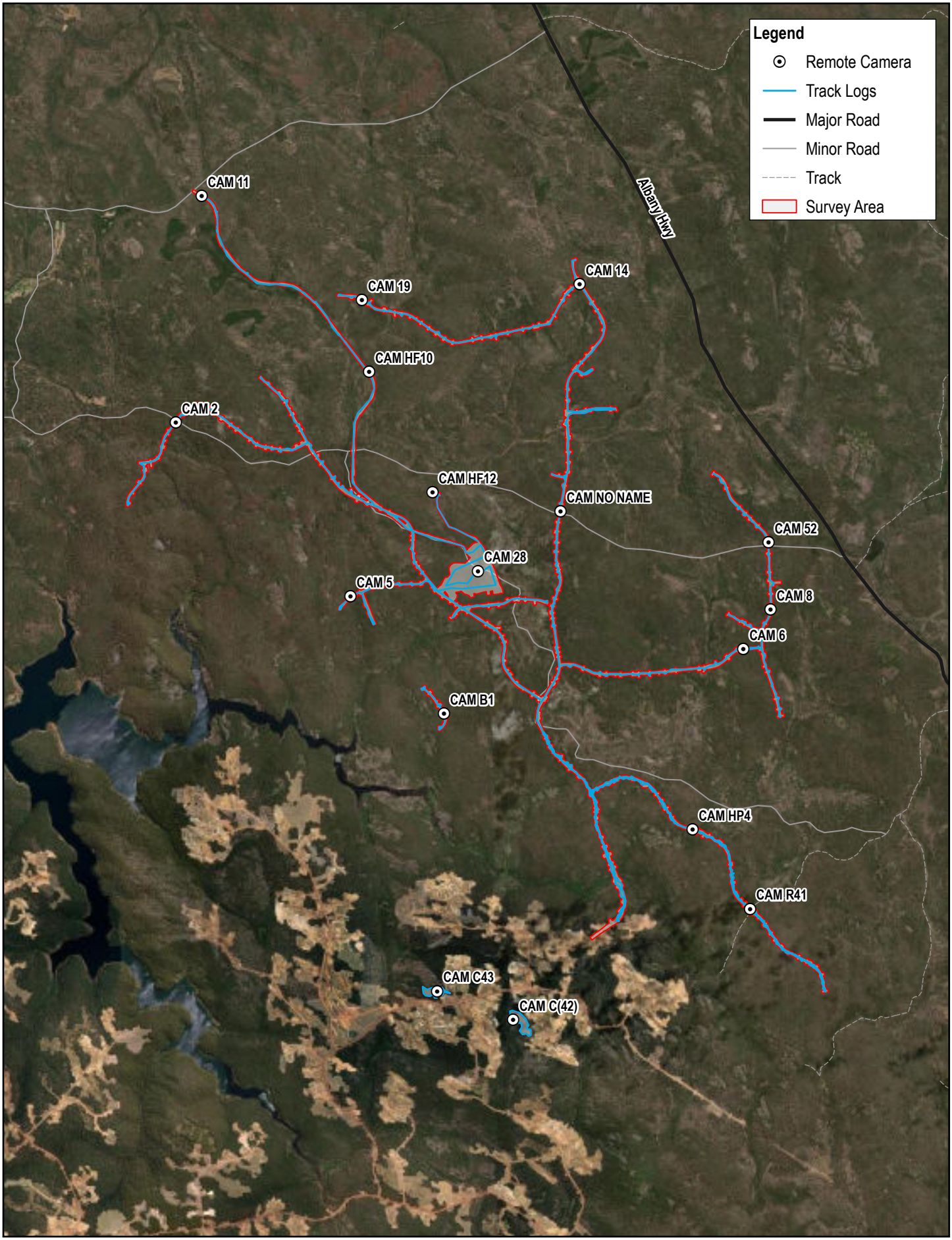
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Revision No. **0**
Date **4/10/2023**

Project Location

FIGURE 1

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Data source: World Imagery: Earthstar Geographics
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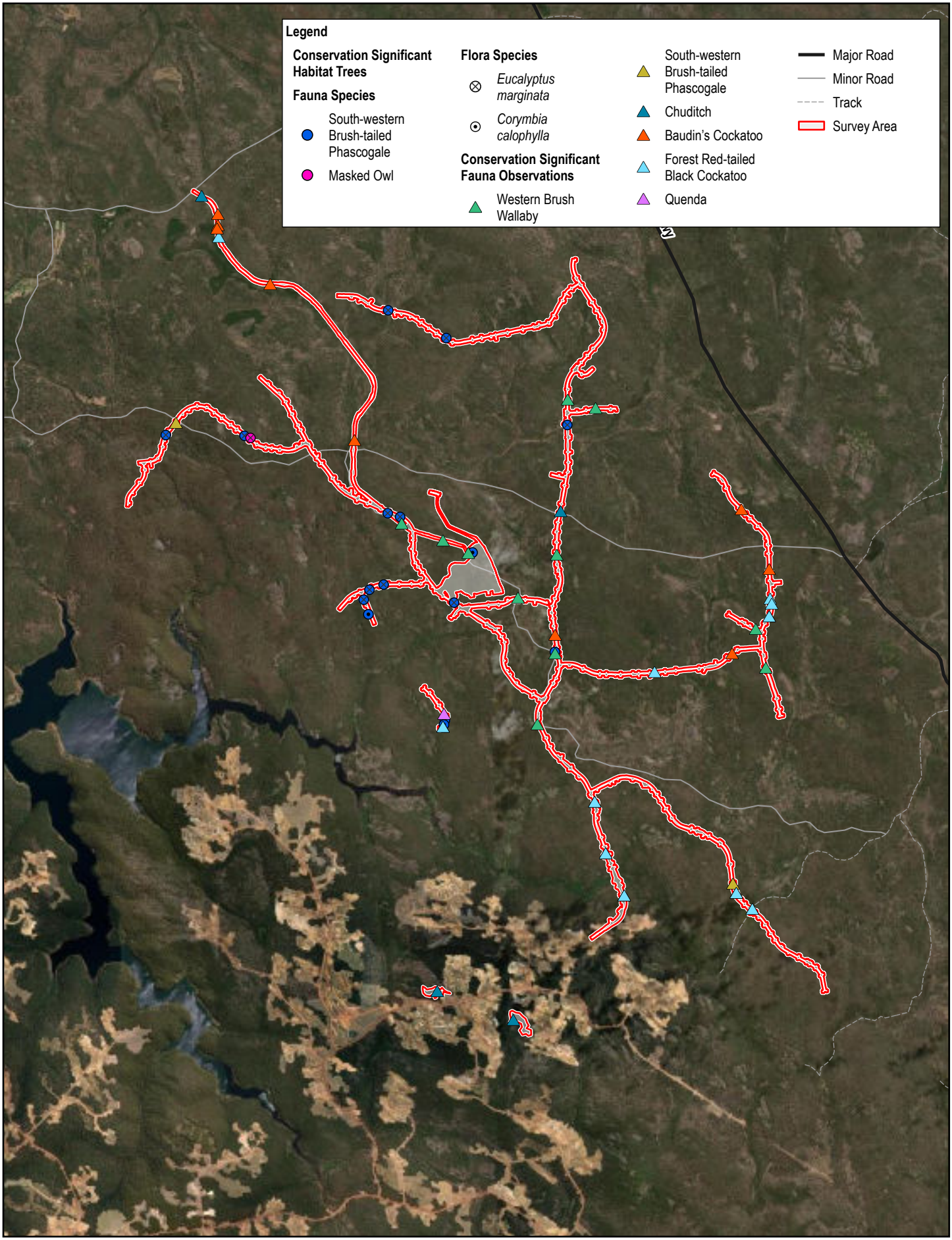
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Revision No. **0**
Date **4/10/2023**

Survey Effort

FIGURE 2

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Paper Size ISO A4

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Kilometers

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GHD

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Myara North 2022/23 Pre Clearance Surveys

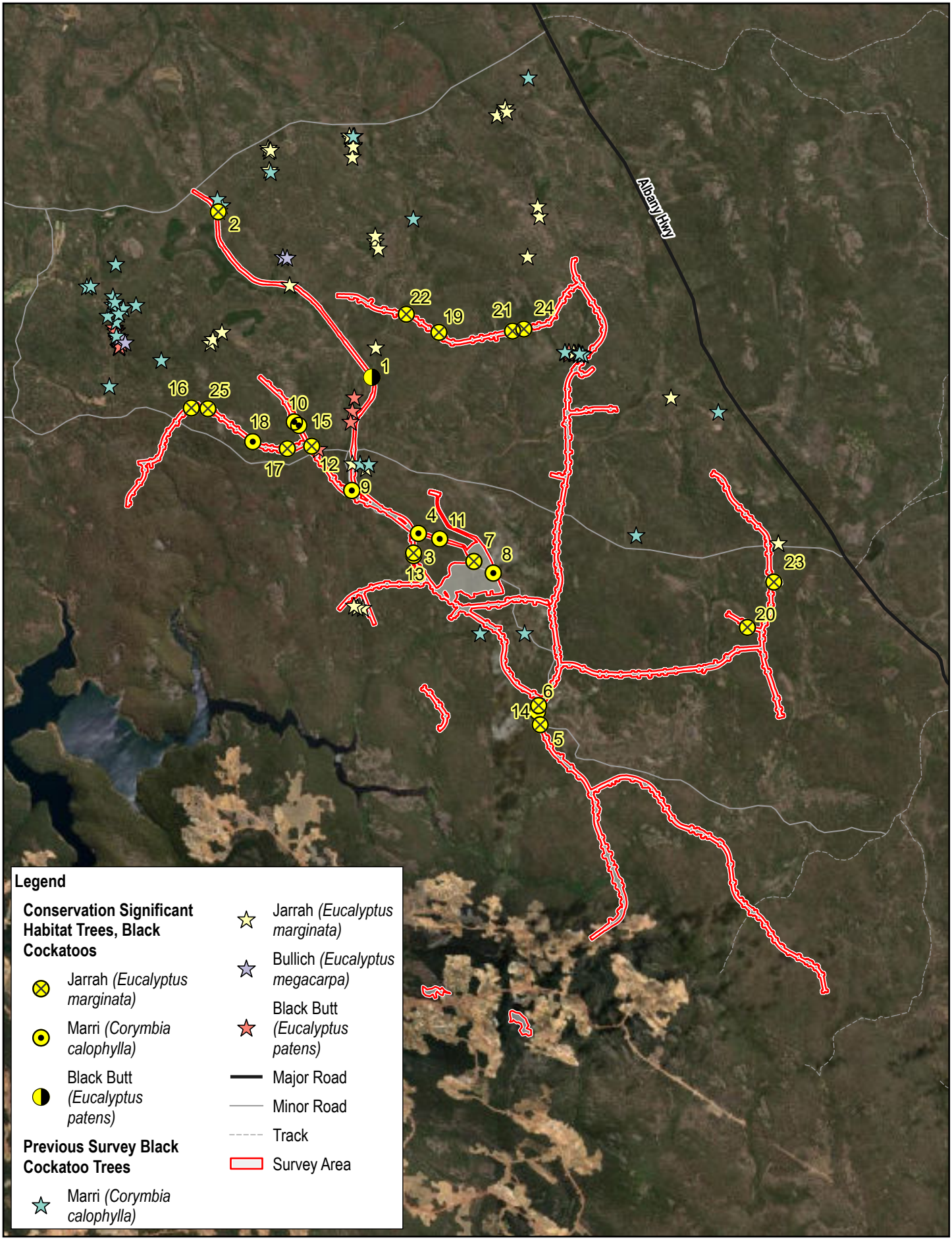
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Revision No. **0**
Date **4/10/2023**

Significant Fauna Locations

FIGURE 3

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Data source: World Imagery: Earthstar Geographics
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Paper Size ISO A4

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Kilometers

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GHD

Alcoa
Myara North 2022/23 Pre Clearance Surveys

Project No. **12592293**
Revision No. **0**
Date **4/10/2023**

Black Cockatoo Assessment

FIGURE 4

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Data source: World Imagery: Earthstar Geographics
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Appendix B

Relevant legislation, background information and conservation codes

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

– Nationally threatened flora and fauna species and ecological communities
– Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of Climate Change, Energy, the Environment and Water (DCCEEW).

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

1. Native vegetation should not be cleared if it comprises a high level of biodiversity.
2. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
3. Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
4. Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
5. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
6. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.
7. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.
8. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
9. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

10. Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

– Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
– If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
– The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
– The conservation of biodiversity and ecological integrity should be a fundamental consideration indecision-making
– Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976.* The main purposes of the BAM Act and its regulations are to:

– Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
– Manage the impact and spread of those pests already present in the state
– Safely manage the use of agricultural and veterinary chemicals
– Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Background information

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

Aspects of ESAs

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the EPBC Act.
An area that is included on the Register of the National Estate (RNE), because of its natural values, under the *Australian Heritage Commission Act 1975* of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community.
A Bush Forever Site listed in "Bush Forever" Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission.
The areas covered by the *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*.
The areas covered by the *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002.*
The areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) applies.
Protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*.

Reserves and conservation areas

Department of Biodiversity, Conservation and Attractions managed lands and waters

DBCA manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DBCA managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. Access to, or through, some areas of DBCA managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DBCA managed lands will generally be referred to DBCA throughout the assessment process.

Wetlands

Ramsar Wetlands (Wetlands of International Importance)

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are "sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity … because of their ecological, botanical, zoological, limnological or hydrological importance" (DAWE 2020b). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use.

Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DAWE 2020b).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DAWE 2020a):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance.

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia’s biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia’s Biological Diversity (ANZECC 2000).

The extent of remnant native vegetation in WA has been assessed by Shepherd et al. (2002) and the GoWA (2019), based on broadscale vegetation association mapping by Beard (various publications). The GoWA produces Statewide Vegetation Statistics Reports that are used for a number of purposes including conservation planning, land use planning and when assessing development applications. The reports are updated every 2-3 years.

Vegetation condition

The vegetation condition can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA 2016a). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating and scale for the South West and Interzone Botanical Provinces

Condition	South West and Interzone Botanical Provinces description
Pristine	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.

Condition	South West and Interzone Botanical Provinces description
Completely Degraded	The structure of vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as ‘parkland cleared’ with the flora comprising weed or crop species with isolated native trees or shrubs.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State BC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Ecological communities

Significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The BC Act provides for the Minister to list an ecological community as a TEC (section 27), or as a collapsed ecological community (section 31) statutory listing of State TECs by the Minister. The legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

Possible TECs that do not meet survey criteria are added to the DBCA Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation, however, may be listed as TECs under the EPBC Act.

Codes and definitions for TECs listed under the EPBC Act and/or BC Act

Categories	Definition
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	An ecological community if, at that time, is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000).
Endangered (EN)	An ecological community if, at that time: – is not critically endangered; and – is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000).
Vulnerable (VU)	An ecological community if, at that time: – is not critically endangered or endangered; and – is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000).
Western Australia Conservation Categories (BC Act)	
Threatened Ecological Communities	
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

Categories	Definition
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.
Collapsed ecological communities	
An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time – – there is no reasonable doubt that the last occurrence of the ecological community has collapsed); or – the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover – • its species composition or structure; or • its species composition and structure. Section 33 of the BC Act provides for a collapsed ecological community to be regarded as a threatened ecological community if it is discovered in a state that no longer makes it eligible for listing as a collapsed ecological community.	

Categories and definitions for PECs as listed by the DBCA

Category	
Priority 1	Poorly known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Poorly known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	Poorly known ecological communities. – Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: – communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; – communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. – Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.

Category	
	– Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. – Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	Conservation Dependent ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Other significant vegetation

Vegetation may be significant for a range of reasons other than a statutory listing. The EPA (2016a, b) states that significant vegetation may include vegetation that includes the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- A role as a refuge
- Providing an important function required to maintain ecological integrity of a significant ecosystem
- Local endemism in restricted habitats
- Novel combinations of taxa
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of a vegetation unit in 'pristine' condition in a highly cleared landscape, recently discovered range extensions, or isolated outliers of the main range.

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Flora and fauna

Significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the BC Act can warrant referral to the DCCEEW and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for flora and fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of flora and fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act flora and fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened or Extinct species under the BC Act cannot also be listed as Specially Protected species.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered significant.

Categories and definitions for EPBC Act and BC Act listed flora and fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
Endangered (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines.
Vulnerable (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.
Extinct species	
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Specially protected species	
Migratory (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Codes for DBCA listed Priority flora and fauna

Priority category	Definition
Priority 1	Poorly-known taxa Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy

Priority category	Definition
	of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	Poorly-known taxa Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	Poorly-known taxa Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring – Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. – Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. – Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

Other significant flora

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than a statutory listing. The EPA (2016a, b) states that significant flora may include taxa that have/are:

– A keystone role in a particular habitat for Threatened or Priority flora or fauna species, or large populations representing a considerable proportion of the local or regional total population of a species
– Relictual status, being representation of taxonomic or physiognomic groups that no longer occur widely in the broader landscape
– New species or anomalous features that indicate a potential new species
– Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
– Unusual species, including restricted subspecies, varieties, or naturally occurring hybrids
– Local endemism (a restricted distribution) or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems).

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007.*

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

– Invasiveness
– Impacts
– Potential for spread
– Socio-economic and environmental values.

Australian state and territory governments have identified thirty-two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

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Appendix C

Fauna Field Data

Conservation significant fauna recorded during the survey

Family	Taxa	Common Name	Status
Birds			
Cacatuidae	*Calyptorhynchus baudinii*	Baudin's black cockatoo	EN
Cacatuidae	*Calyptorhynchus banksia naso*	Red-tailed black cockatoo	VU
Mammals			
Peramelidae	*Isoodon obesulus fusciventer*	Southern brown bandicoot	P4
Macropodidae	*Notamacropus irma*	Western brush wallaby	P4
Dasyuridae	*Phascogale tapoatafa wambenger*	South-Western brush-tailed phascogale	CD
Dasyuridae	*Dasyurus geoffroii*	Chuditch	VU

Black cockatoo habitat trees supporting hollows identified within the survey area

No.	Species	DBH (mm)	No. of hollows	Hollow Entrance size (mm)	Hollow Height from ground (m)	Hollow suitability	Latitude (Lat)	Longitude (Long)	Eastings (AGD)	Northings (AGD)
1	*Eucalyptus patens*	2000	5	300	15	Potentially good.	-32.354191	116.170859	421844.4981	6419851.396
2	*Eucalyptus marginata*	900	1	300	15	Potentially quite good. Feeding evidence on Jarrah nuts.	-32.330043	116.144859	419376.5404	6422509.107
3	*Eucalyptus marginata*	900	1	450	25	Potential suitable breeding tree	-32.379702	116.177745	422514.0016	6417028.576
4	*Corymbia calophylla*	1300	1	200	20	possible very suitable, definite habitat tree. Marri nut feeding evidence.	-32.376874	116.178606	422592.5397	6417342.697
5	*Eucalyptus marginata*	1000	1	250	25	highly suitable. Chew marks on hollow. Possible breeding tree.	-32.404737	116.199166	424550.3764	6414268.437
6	*Eucalyptus marginata*	1200	1	250	20	potential suitable	-32.401955	116.198923	424525.3381	6414576.558
7	*Eucalyptus marginata*	1300	1	150	20	potential suitable	-32.38100	116.188038	423483.4956	6416892.131

No.	Species	DBH (mm)	No. of hollows	Hollow Entrance size (mm)	Hollow Height from ground (m)	Hollow suitability	Latitude (Lat)	Longitude (Long)	Eastings (AGD)	Northings (AGD)
8	*Corymbia calophylla*	1200	1	250	20	potential suitable	-32.382708	116.191349	423796.4542	6416705.158
9	*Corymbia calophylla*	1700	1	350	-	Highly suitable breeding habitat tree. Chew marks around hollow entrance.	-32.370591	116.167281	421521.9052	6418030.899
10	*Corymbia calophylla*	1400	1	250	25	Highly suitable breeding habitat tree	-32.360584	116.157548	420597.5375	6419132.985
11	*Corymbia calophylla*	1100	1	200	20	possible very suitable	-32.377693	116.182232	422934.3794	6417254.531
12	*Eucalyptus marginata*	1000	1	350	20	Highly suitable breeding habitat tree. Chew marks hollow entrance.	-32.364114	116.160495	420877.8852	6418743.862
13	*Corymbia calophylla*	1600	1	600	25	Potential suitable breeding tree	-32.380082	116.177764	422516.12	6416986.465
14	*Corymbia calophylla*	1000	1	250	15	potential suitable	-32.402844	116.198714	424506.3728	6414477.904
15	*Corymbia calophylla*	1400	1	350	25	Highly suitable breeding habitat tree. Chew marks hollow entrance.	-32.361094	116.158318	420670.4304	6419077.019
16	*Eucalyptus marginata*	1100	1	350	25	Highly suitable breeding habitat tree. Chew marks hollow entrance.	-32.358442	116.139983	418942.9504	6419357.306
17	*Eucalyptus marginata*	1000	1	250	20	Highly suitable breeding habitat tree. Chew marks hollow entrance.	-32.364454	116.156324	420485.7502	6418703.084
18	*Corymbia calophylla*	800	2	200	20	Highly likely a breeding tree, with lots of chew marks around hollow entrance	-32.36340	116.150436	419930.8495	6418815.538
19	*Eucalyptus marginata*	1000	1	250	15	possibly very suitable, definite habitat tree	-32.347769	116.182375	422922.5641	6420571.602
20	*Eucalyptus marginata*	700	1	200	15	possibly very suitable, definite habitat tree	-32.390861	116.234683	427879.1217	6415831.369
21	*Eucalyptus marginata*	1300	3	250	15	possibly very suitable, definite habitat tree	-32.347659	116.194943	424105.2971	6420592.801

No.	Species	DBH (mm)	No. of hollows	Hollow Entrance size (mm)	Hollow Height from ground (m)	Hollow suitability	Latitude (Lat)	Longitude (Long)	Eastings (AGD)	Northings (AGD)
22	*Eucalyptus marginata*	700	1	200	15	possibly very suitable, definite habitat tree	-32.345103	116.176820	422397.5438	6420863.142
23	*Eucalyptus marginata*	1100	1	200	15	possibly very suitable, definite habitat tree	-32.384309	116.239253	428303.7281	6416560.668
24	*Eucalyptus marginata*	1300	1	200	15	possibly very suitable, definite habitat tree	-32.347375	116.196876	424287.0025	6420625.659
25	*Eucalyptus marginata*	2000	2	350	25	Highly suitable breeding habitat tree. Chew marks around hollow entrance.	-32.358569	116.142814	419209.4372	6419345.361

Conservation significant fauna habitat trees supporting hollows identified within the survey area

No.	Species	Fauna species	DBH (mm)	No. of hollows	Latitude (Lat)	Longitude (Long)	Eastings (AGD)	Northings (AGD)
1	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	900	1	-32.384986	116.170172	421806.2706	6416437.302
2	*Corymbia calophylla*	South-Western Brush-Tailed Phascogale	1300	1	-32.379715	116.187828	423462.6119	6417034.422
3	*Corymbia calophylla*	South-Western Brush-Tailed Phascogale	900	1	-32.388544	116.169954	421788.8381	6416042.726
4	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	800	2	-32.384255	116.172595	422033.5382	6416520.105
5	*Corymbia calophylla*	South-Western Brush-Tailed Phascogale	1300	1	-32.394213	116.201764	424786.1414	6415436.764
6	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	600	1	-32.404028	116.182876	423017.6506	6414335.812
7	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	1800	3	-32.374465	116.175500	422298.2616	6417607.491
8	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	700	3	-32.386958	116.184605	423165.7137	6416229.207
9	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	1200	1	-32.373925	116.173390	422099.3351	6417665.815

No.	Species	Fauna species	DBH (mm)	No. of hollows	Latitude (Lat)	Longitude (Long)	Eastings (AGD)	Northings (AGD)
10	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	900	1	-32.386423	116.169182	421714.3997	6416277.28
11	*Corymbia calophylla*	South-Western Brush-Tailed Phascogale	600	1	-32.404616	116.182727	423004.1539	6414270.54
12	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	1700	1	-32.344518	116.17373	422106.2661	6420925.769
13	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	900	1	-32.361327	116.204176	424985.1535	6419084.182
14	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	1200	1	-32.348601	116.183616	423040.0508	6420480.259
15	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	900	3	-32.362538	116.149026	419797.4291	6418910.042
16	*Eucalyptus marginata*	South-Western Brush-Tailed Phascogale	800	1	-32.362337	116.135588	418532.9012	6418922.211
17	*Eucalyptus marginata*	Masked Owl	1100	1	-32.362847	116.150052	419894.2345	6418876.554

Remote camera data

Camera number	Set date	Collect date	Lat	Long	Eastings (AGD)	Northings (AGD)
CAM HF12	20/02/2023	20/03/2023	-32.37091936	116.1810785	422820.0946	6418004.548
CAM 6	20/02/2023	20/03/2023	-32.394005	116.23396	427813.6039	6415482.349
CAM 8	20/02/2023	20/03/2023	-32.38833854	116.2386881	428253.7746	6416113.626
CAM C43	20/02/2023	21/03/2023	-32.44324371	116.1812133	422894.3535	6409987.08
CAM HP4	20/02/2023	21/03/2023	-32.42005777	116.2250912	427000.3662	6412588.227
CAM 19	20/02/2023	20/03/2023	-32.34304648	116.1692912	421687.289	6421085.686
CAM NO NAME	20/02/2023	20/03/2023	-32.37382469	116.2029309	424878.3196	6417697.965
CAM B1	20/02/2023	21/03/2023	-32.40306204	116.1827424	423004.2437	6414442.776
CAM 52	20/02/2023	20/03/2023	-32.37860275	116.2384147	428220.4025	6417192.632
CAM 28	20/02/2023	20/03/2023	-32.38240987	116.1887441	423551.1627	6416736.357
CAM C(42)	20/02/2023	21/03/2023	-32.44748106	116.1941861	424117.4119	6409526.69
CAM HF10	20/02/2023	20/03/2023	-32.35344808	116.1704094	421801.5427	6419933.424
CAM 11	20/02/2023	20/03/2023	-32.32773919	116.1420485	419109.9848	6422762.371
CAM 2	20/02/2023	20/03/2023	-32.36058266	116.1373397	418696.1471	6419118.011
CAM 14	19/02/2023	20/03/2023	-32.34099404	116.2064796	425185.4319	6421339.847
CAM 5	20/02/2023	21/03/2023	-32.38592971	116.1669362	421502.736	6416330.318
CAM R41	20/02/2023	21/03/2023	-32.43165114	116.2348365	427925.8792	6411309.688

Significant fauna recorded on camera

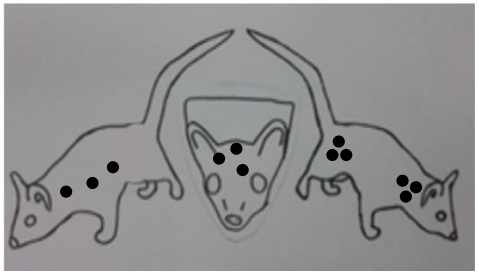
Camera No.		14	11	28	5	8	6	2	12	42	No Name	19	4	10	1	52	41	43
Common name	**Scientific Name**																	
Chuditch	*Dasyurus geoffroii*		4							1	1							2
Brushed Tailed Phascogale	*Phascogale tapoatafa wambenger*							1										
Southern Brown Bandicoot*	*Isoodon obesulus fusciventer*														1			

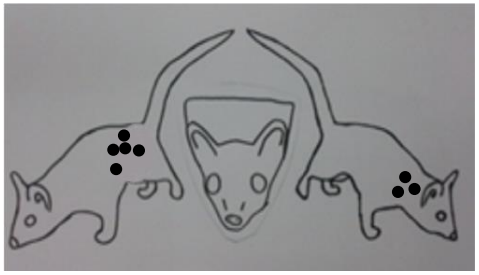
Chuditch Camera Capture (Dasyurus geoffroii) Physical Assessment data

Spot patterns of Chuditch were examined in detail and used to identify individuals from camera trap photographs. In order to use these patterns to identify individuals, accurate and proportionate sketches were made of the top of the head, back, left and right sides of individual Chuditch from the photographs taken by the remote cameras. Each sketch aimed to provide a useful summary that strongly aided subsequent recognition of individuals (Hohnen *et a*l 2015). The spot patterns were examined to determine whether the Chuditch in question was new or a previously viewed individual. Often two or more key spot patterns were visible in a photograph of a single side (e.g. one group on the shoulder and one on the haunch). When these key collections of spots could be matched and no area of the coat had con-complementary patterns, it was deemed to be the same individual. Therefore a clear view of a single side was sufficient to confirm the identify of the individual, if that individual had been previously identified. Only good quality images showing two or more clear spot patterns were used for identification and photographs with obscured or blurred patterns were not used (Hohnen *et al* 2015).

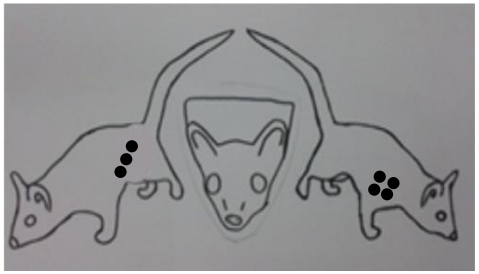
Chuditch ID	Camera ID	Date	ID marks	Spot pattern diagram	Remote camera Image
Chuditch 1	CAM 11	25/02/2023	Square pattern on the left rear. Right front limb shows a small spot towards foot.		Chuditch Left Side:  Chuditch Right Side: 

Chuditch ID	Camera ID	Date	ID marks	Spot pattern diagram	Remote camera Image
Chuditch 2	CAM 11	27/02/2023	Five defined spots in a straight line running from front left limb to rear left limb. Two spots creating a square among the spot line. Four dots on mid right rear with a tight triangle and an outlying defined spot.		Chuditch Left Side:  Chuditch Right Side: 
Chuditch 3	CAM 11	12/03/2023	Six defined spots on the mid right side creating two lines of three. Two defined spots on the rear left limb and two defined spots mid upper left.		Chuditch Left Side:  Chuditch Right Side:

Chuditch ID	Camera ID	Date	ID marks	Spot pattern diagram	Remote camera Image
					
Chuditch 4	CAM 11	13/03/2023	Three defined spots running in a straight line from the front left limb to the mid body. Three defined spots on the rear right limb and three less defined spots behind the right ear. Three less defined spots on the head. One above the left brow, one under the right ear and one centre between both ears.		Chuditch Left Side:  Chuditch Right Side:  Chuditch Head View:

Chuditch ID	Camera ID	Date	ID marks	Spot pattern diagram	Remote camera Image
					
Chuditch 5 *(Only two images captured, possibly Chuditch 1).*	CAM 11	18/03/2023	Three visible spots on head in a triangle pattern above the left eye. Four defined spots on the rear upper left limb creating a square. One less defined spot between the upper two defined spots of the square pattern.		Chuditch Head/Left View: 
Chuditch 6	CAM 42	11/03/2023	Three defined spots in a triangle on the rear left side with two smaller bludges within. Three defined spots in a tight triangle pattern behind the right ear.		Chuditch Left View:  Chuditch Right View:

Chuditch ID	Camera ID	Date	ID marks	Spot pattern diagram	Remote camera Image
					
Chuditch 7	CAM No Name	12/03/2023	Four defined spots in the pattern of two separate triangle on the rear right limb. Three defined spots in a line on the rear left limb and one defined spot of the line creating a triangle.		Chuditch Right View:  Chuditch Left View: 

Chuditch ID	Camera ID	Date	ID marks	Spot pattern diagram	Remote camera Image
Chuditch 8	CAM 43	22/02/2023	Three distinct spots located behind the right ear with one of the spots merging behind the ear with another. Three defined spots creating a line in the mid area and one defined spot moving to the spine.		Chuditch Right View:  Chuditch Left View: 
Chuditch 9	CAM 43	27/02/2023	Three distinct spots in a line located on the rear. Four distinct spots located on the front right limb in a square pattern.		Chuditch Left View: 

Chuditch ID	Camera ID	Date	ID marks	Spot pattern diagram	Remote camera Image
					Chuditch Right View: 

Reference

Hohnen, R, Ashby, J, Tuft, K, & McGregor, H 2012, *'Individual identification of northern quolls (Dasyurus hallacatus) using remote cameras'*, Australian Mammalogy, CSIRO Publishing. http://dx.doi.org/10.1071/AM12015.

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The Power of Commitment

Appendix 8 – Myara North Power/Water Alignments, Black Cockatoo Breeding Habitat Survey (Kirkby, 2022)

MYARA NORTH POWER/WATER/BOUNDARY ALIGNMENTS, BLACK COCKATOO BREEDING HABITAT SURVEY.

The purpose of the survey was to locate black cockatoo nests, possible nests and habitat trees at the Myara North Power/Water/Boundary alignments.

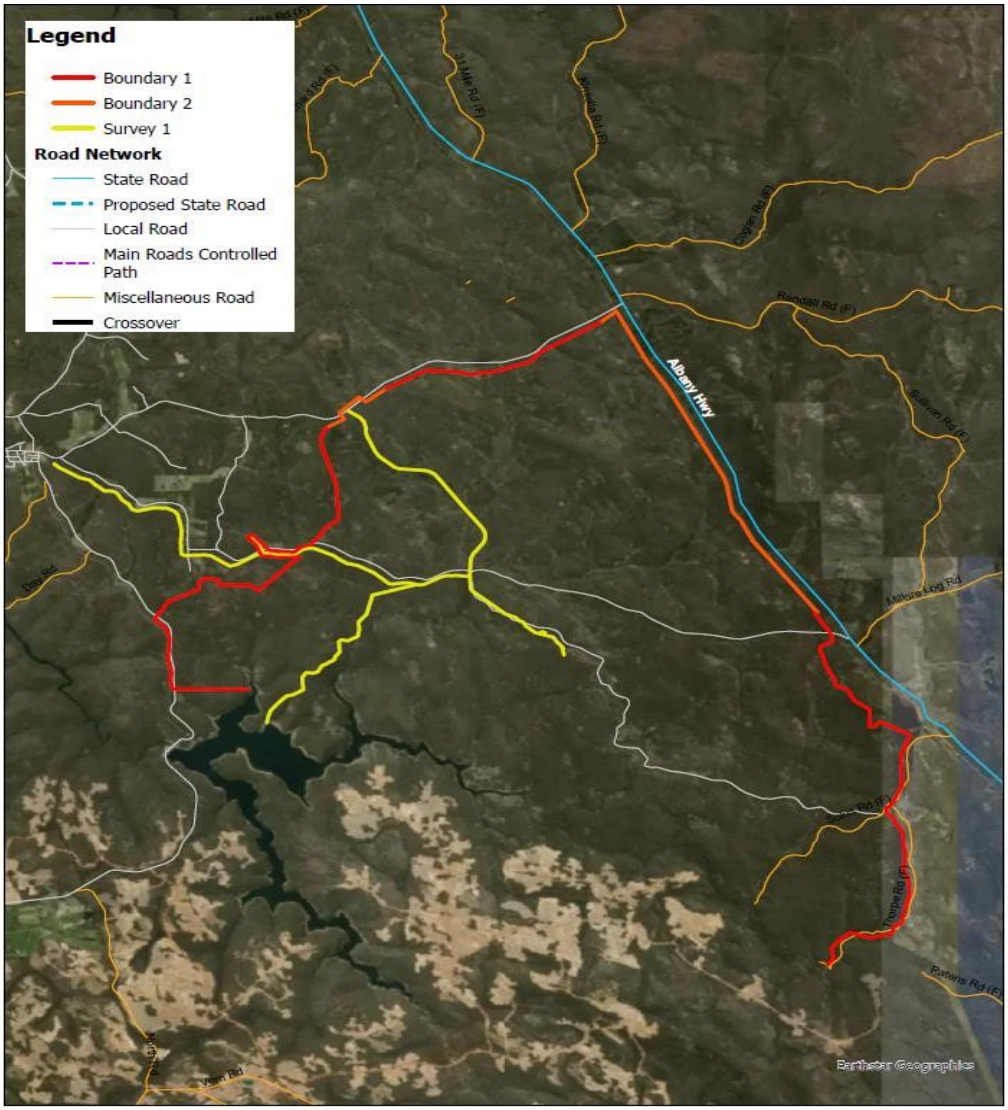


Figure 1: Myara North Black Cockatoo Survey 2023

Alcoa

Methods and timing

The areas were surveyed using Alcoa's 'Procedure for surveying haul road alignments and mine pits for black cockatoo habitat (MIN).

Trees are described as:

- Nest trees - that show signs of use by black cockatoos, including worn and chewed entrance of a suitable sized hollow (NB: it is possible some of these trees no longer provide suitable nest habitat but have either been used as nests in the past or been well prospected by cockatoos);
- Possible nest trees – that have a suitable size and shape hollow entrance but show no signs of use. During assessment of these trees, the position, entrance size and orientation of the hollow should be considered because these will influence the likelihood of a suitable depth of hollow for cockatoos;
- Habitat trees – mature marri trees (>500mm diameter) that have the potential to provide nest habitat in the future either based on:
    i) Already starting to develop a hollow; or
    ii) Tree form conducive to hollow formation/development such as elbows or major V branching of primary trunk (that may hollow out); tall, straight trunked trees, particularly showing signs of decay (that may form a top entrance hollow in the event of the top of the trunk being blown off); trees with major branches coming off the main trunk (that may hollow out if branch drops).
- Roost sites – groups of trees with evidence of roosting, e.g. bird faeces and feathers found beneath the roost trees.

Note. The above mentions Marri trees but the current surveys also include Blackbutt *Eucalyptus patens,* Bullich *E. megacarpa* and Flooded Gum *E. patens.* These species provide nest hollows but are restricted in distribution to wet areas and creeklines and are rarely encountered other than where a haul road crosses a stream zone.
Alcoa's current surveys also allow for significant stands of suitable trees (>500mm diameter) which may provide a future hollow but are not necessarily forming a hollow at present.

Jarrah and Blackbutt above 2000mm dia. and Marri above 1500mm dia. are considered 'Significant Trees' and were also noted during the survey.

Parts of the Power and Water alignments were surveyed in a previous survey (Myara North power and water alignments 22-23). This was originally a 40m corridor but was widened during the present survey to 100m. The 2022-2023 40m width was not resurveyed.

For the most part the boundary fence alignment was also surveyed to a width of 50m either side of the centreline. This was later reviewed and the fence line between Solus Rd (430934E – 6414701N) and Millars Log Rd (429291E – 6417055N) was surveyed to a 30m wide corridor.

All trees of interest were picked up using handheld GPS. AGD84.
Nest trees were marked 'H.' with white paint and tagged with a stainless-steel number tag.

The diameter of Nest Trees and Significant Trees was measured accurately while the diameter of possible nest trees was approximate.

The survey was undertaken between November 2023 to January 2024 by Tony Kirkby who has over 20 years of experience conducting black cockatoo surveys in the south-west of Western Australia.

Results

A total of 636 trees were picked up during the survey. *See spreadsheet for details*.

Tree species and number

- Marri – 441
- Bullich – 5
- Blackbutt – 179
- Jarrah – 1
- Flooded Gum - 10

Nest trees

- Marri – 20
- Blackbutt – 1
- Bullich - 2
-

Possible nest trees

- Marri – 27

Significant trees

- Marri – 2
- Blackbutt – 3
- Jarrah - 1

Roost sites

No roost sites were located during the survey.

Tony Kirkby

7th February 2024

Date	Mine	Nest_type	Tree_species	Tree_condition	Tree_diameter_dbh	Hollow_type	Hollow _u:	Bees	Camera	Nest_ID	Location	Comment	EastingAGD	NorthingAG	Protect_Status	Action	Record_no	GPS_source	Change_recorded	Ider	Status
13/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		419034	6422794			1324	Garmin		TK	
13/11/2023	Myara North	Habitat	Marri	Good	900						PW alignment		419199	6422705			1325	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419252	6422662			1327	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419247	6422666			1328	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419251	6422659			1329	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	900						PW alignment		419322	6422500			1330	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	700						PW alignment		419319	6422498			1331	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1200						PW alignment		420993	6420970			1332	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	800						PW alignment		421080	6420860			1333	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	1200						PW alignment		421065	6420861			1334	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	1200						PW alignment		421822	6419815			1335	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	1000						PW alignment		421533	6419123			1336	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	600						PW alignment		421535	6419114			1337	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	500						PW alignment		421530	6419102			1338	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	1000						PW alignment		421528	6419088			1339	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	1000						PW alignment		421528	6419077			1340	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	600						PW alignment		421518	6419065			1341	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	1300						PW alignment		421505	6419066			1342	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	700						PW alignment		421501	6419057			1343	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	1000						PW alignment		421505	6419040			1344	Garmin		TK	
14/11/2023	Myara North	Habitat	Blackbutt	Good	1000						PW alignment		421528	6418860			1345	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		419932	6421501			1350	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		419823	6421572			1352	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1100						PW alignment		419522	6421863			1353	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		419465	6422096			1354	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	800						PW alignment		419460	6422096			1355	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419450	6422102			1357	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	800						PW alignment		419367	6422238			1358	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419367	6422293			1360	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419393	6422374			1361	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419418	6422368			1362	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	500						PW alignment		419411	6422443			1363	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	500						PW alignment		419404	6422451			1364	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	700						PW alignment		419397	6422445			1365	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419377	6422446			1366	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419375	6422450			1367	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419370	6422422			1368	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	700						PW alignment		419306	6422630			1369	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419307	6422632			1370	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		419323	6422647			1371	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419327	6422657			1372	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419279	6422680			1373	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419275	6422689			1374	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419263	6422694			1375	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	800						PW alignment		419296	6422652			1377	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		419200	6422749			1378	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	500						PW alignment		419218	6422736			1379	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419229	6422747			1380	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		419215	6422769			1381	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		415213	6420336			1383	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	700						PW alignment		415375	6420191			1384	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		415368	6420195			1385	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		415397	6420167			1388	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	800						PW alignment		415450	6419987			1389	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1100						PW alignment		416251	6419053			1390	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	600						PW alignment		416416	6418923			1391	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		416421	6418928			1392	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1000						PW alignment		416731	6418978			1393	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	800						PW alignment		416769	6419028			1394	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	900						PW alignment		417023	6419168			1395	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	800						PW alignment		417022	6419154			1396	Garmin		TK	
14/11/2023	Myara North	Habitat	Marri	Good	1100						PW alignment		416807	6419076			1400	Garmin		TK	

14/11/2023	Myara North	Habitat	Marri	Good	1100	PW alignment	416222	6419132	1402	Garmin	TK
14/11/2023	Myara North	Habitat	Marri	Good	600	PW alignment	416166	6419170	1403	Garmin	TK
14/11/2023	Myara North	Habitat	Marri	Good	1100	PW alignment	416141	6419217	1404	Garmin	TK
14/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	416137	6419218	1405	Garmin	TK
14/11/2023	Myara North	Habitat	Marri	Good	1100	PW alignment	415757	6419203	1406	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	1200	PW alignment	418760	6417016	1407	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	418769	6416967	1408	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	418774	6416975	1409	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	418771	6416921	1411	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	700	PW alignment	418773	6416740	1412	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	700	PW alignment	418770	6416731	1413	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	417838	6415642	1415	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	418061	6416096	1418	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	418059	6416102	1419	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	418067	6416128	1420	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	418105	6416161	1422	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	418123	6416170	1423	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	418142	6416167	1424	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	418692	6416515	1426	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	418722	6416543	1427	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	418722	6416552	1428	Garmin	TK
15/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	418730	6416558	1429	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	1100	PW alignment	420257	6418452	1431	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	420255	6418453	1432	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	430324	6412789	1433	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430337	6412767	1434	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	430341	6412764	1435	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	430346	6412747	1436	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	430711	6411846	1437	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	430674	6411469	1438	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	1300	Boundary 1	430679	6410130	1439	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	430265	6409598	1440	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1200	Boundary 1	430268	6409573	1441	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	430256	6409559	1442	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1200	Boundary 1	430282	6409577	1443	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	800	Boundary 1	430310	6409587	1444	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	430331	6409593	1445	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1200	Boundary 1	430342	6409608	1446	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	430333	6409610	1447	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1400	Boundary 1	430320	6409617	1448	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430296	6409605	1449	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430300	6409605	1450	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	800	Boundary 1	430398	6409602	1452	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430400	6409637	1453	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	900	Boundary 1	430393	6409647	1454	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430481	6409638	1456	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430491	6409627	1457	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	430503	6409639	1458	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430508	6409635	1459	Garmin	TK
17/11/2023	Myara North	Habitat	Flooded Gum	Good	900	Boundary 1	430499	6409640	1460	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430488	6409654	1461	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430470	6409689	1462	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	430459	6409688	1463	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	430474	6409706	1464	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	700	Boundary 1	430502	6409744	1465	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	430509	6409787	1466	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	430515	6409811	1467	Garmin	TK
17/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430526	6409857	1468	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430654	6409912	1469	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1200	Boundary 1	430661	6409902	1470	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430672	6409893	1471	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1500	Boundary 1	430709	6409968	1472	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	430712	6410007	1473	Garmin	TK

17/11/2023	Myara North	Habitat	Blackbutt	Good	1200	Boundary 1	430711	6410011	1474	Garmin	TK	
17/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430668	6409955	1476	Garmin	TK	
17/11/2023	Myara North	Habitat	Blackbutt	Good	1200	Boundary 1	430643	6409929	1477	Garmin	TK	
17/11/2023	Myara North	Habitat	Blackbutt	Good	800	Boundary 1	430729	6410127	1478	Garmin	TK	
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430746	6410120	1479	Garmin	TK	
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430751	6410128	1480	Garmin	TK	
17/11/2023	Myara North	Habitat	Blackbutt	Good	700	Boundary 1	430747	6410186	1481	Garmin	TK	
17/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	430707	6410167	1482	Garmin	TK	
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430780	6410387	1483	Garmin	TK	
17/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	430822	6410615	1484	Garmin	TK	
17/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430807	6411133	1485	Garmin	TK	
17/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	430814	6411141	1486	Garmin	TK	
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	430724	6412260	1487	Garmin	TK	
17/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430503	6412534	1488	Garmin	TK	
17/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	430352	6412742	1490	Garmin	TK	
17/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	430360	6412757	1491	Garmin	TK	
17/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	430352	6412749	1492	Garmin	TK	
20/12/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	412837	6421426	1494	Garmin	TK	
20/12/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	412830	6421421	1495	Garmin	TK	
20/12/2023	Myara North	Habitat	Marri	Good	1100	PW alignment	413436	6421108	1497	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	413578	6421025	1498	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	413601	6420994	1499	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1500	PW alignment	413581	6420991	1500	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	PW alignment	413630	6420986	1501	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	413632	6420984	1502	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	700	PW alignment	413890	6420796	1503	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	PW alignment	413902	6420809	1504	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	PW alignment	413949	6420797	1505	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	414320	6420453	1506	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1500	PW alignment	414430	6420341	1507	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	414647	6420309	1509	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1200	PW alignment	414826	6420396	1513	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	414814	6420389	1514	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	PW alignment	414791	6420385	1515	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	900	PW alignment	414789	6420383	1516	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	PW alignment	414505	6420325	1517	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	414503	6420326	1518	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	414428	6420403	1519	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	414424	6420405	1520	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	414395	6420485	1521	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	414256	6420566	1522	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	414245	6420573	1523	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	414262	6420615	1524	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	PW alignment	414185	6420637	1525	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	PW alignment	412988	6421386	1526	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 2	427647	6419409	1527	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 2	427604	6419435	1528	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	427567	6419494	1529	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 2	427462	6419678	1530	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 2	427263	6420139	1531	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	427264	6420133	1532	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 2	426902	6421178	1533	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1500	Boundary 2	426919	6421211	1535	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	426824	6421389	1536	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 2	426819	6421382	1537	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1300	Boundary 2	426780	6421481	1538	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	426434	6422219	1539	Garmin	TK	
20/11/2023	Myara North	Habitat	Flooded Gum	Good	600	Boundary 2	425553	6423676	1542	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 2	425498	6423825	1546	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 2	425476	6423847	1547	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 2	425470	6423859	1548	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 2	425425	6423902	1549	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	425274	6424057	1550	Garmin	TK	

20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	425304	6424095	1551	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 2	425198	6424167	1552	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	425089	6424490	1553	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	425084	6424501	1554	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 2	425073	6424513	1555	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 2	424585	6425289	1556	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	424130	6424923	1557	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	424036	6424838	1558	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	423557	6424556	1559	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	423469	6424576	1560	Garmin	TK	
20/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	423459	6424565	1561	Garmin	TK	
21/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	423354	6424474	1562	Garmin	TK	
21/11/2023	Myara North	Habitat	Blackbutt	Good	1200	Boundary 1	423322	6424511	1563	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	423470	6424632	1564	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	423463	6424650	1565	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	423565	6424636	1566	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	423567	6424650	1567	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	423584	6424676	1568	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	423618	6424676	1569	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	424072	6424963	1570	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	424112	6424977	1571	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 2	424463	6425209	1572	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430570	6413286	1573	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430440	6412884	1574	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430442	6412866	1575	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430533	6413002	1576	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	430608	6413228	1580	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	430639	6413223	1581	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	430648	6413332	1582	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	430687	6413384	1583	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	430679	6413452	1584	Garmin	TK	
21/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	430715	6414194	1585	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	422957	6424232	51	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	422946	6424210	52	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	422944	6424198	53	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	422903	6424136	55	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	422910	6424163	108	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	422718	6424052	110	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	422732	6424021	111	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	422680	6424069	112	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	422644	6424026	113	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	422635	6424013	114	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	422598	6424012	115	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	422575	6424024	116	Garmin	TK	
26/11/2023	Myara North	Habitat	Marri	Good	1300	Boundary 1	422503	6423995	117	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	422428	6423894	120	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	422576	6423928	121	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	422556	6423933	122	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	421873	6423769	123	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	421862	6423776	124	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	421862	6423779	125	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	420554	6423884	126	Garmin	TK	
27/11/2023	Myara North	Significant tree	Jarrah	Good	6350	Boundary 1	420817	6423833	127	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	420833	6423828	128	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	421448	6423738	129	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	419193	6423150	131	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 2	419196	6423148	132	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 2	419198	6423125	133	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 2	419169	6423101	134	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 2	419226	6423168	136	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1300	Boundary 2	419213	6423180	137	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 2	419757	6423341	138	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 2	419404	6423037	140	Garmin	TK	

27/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 2	419385	6423069	141	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1300	Boundary 2	419357	6423030	142	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 2	419344	6423011	143	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 2	419323	6423013	144	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	419299	6423053	146	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 2	419302	6423072	147	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 2	419299	6423069	148	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 2	419288	6423069	149	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 2	419268	6423082	150	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 2	419327	6423091	152	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 2	419608	6423332	153	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	419608	6423338	154	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 2	419687	6423381	155	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	419695	6423401	169	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	419863	6423430	170	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	419922	6423500	171	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	420114	6423609	172	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	420120	6423620	173	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	420125	6423617	174	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	420186	6423644	175	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	420225	6423640	176	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	420224	6423601	177	Garmin	TK	
27/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	420270	6423630	178	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	418581	6422407	180	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	418580	6422416	181	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 2	418593	6422416	182	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1300	Boundary 2	418835	6422667	184	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 2	418831	6422661	185	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 2	418848	6422649	186	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 2	418800	6422607	187	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418480	6422417	190	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418453	6422272	191	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	418417	6422262	192	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	418462	6422174	193	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1400	Boundary 1	418459	6422248	194	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	418439	6422213	195	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418384	6422124	196	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418397	6421909	197	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418421	6421870	198	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418467	6421791	199	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	418444	6421730	200	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418457	6421737	201	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1400	Boundary 1	418676	6421268	202	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	418659	6421215	203	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	418656	6421222	204	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1300	Boundary 1	417764	6419273	207	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	418043	6419387	208	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418069	6419426	209	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418391	6419635	210	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	418400	6419663	212	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	418417	6419653	213	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	418427	6419660	214	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	418431	6419658	215	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	418472	6419729	216	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	418468	6419730	217	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418468	6419736	218	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418482	6419775	219	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	418486	6419778	220	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418506	6419783	221	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	418505	6419831	222	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1400	Boundary 1	418696	6419992	223	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	418718	6420016	224	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	418837	6420121	225	Garmin	TK	

28/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	418830	6420124	226	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	418754	6420563	228	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418797	6420752	229	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	418707	6420791	230	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	418719	6420782	231	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	418725	6420677	232	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	418743	6420411	233	Garmin	TK	
28/11/2023	Myara North	Habitat	Blackbutt	Good	1500	Boundary 1	418781	6420151	236	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	418785	6420151	237	Garmin	TK	
28/11/2023	Myara North	Habitat	Blackbutt	Good	800	Boundary 1	418779	6420145	238	Garmin	TK	
28/11/2023	Myara North	Habitat	Blackbutt	Good	600	Boundary 1	418767	6420140	239	Garmin	TK	
28/11/2023	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	418760	6420137	241	Garmin	TK	
28/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	418760	6420127	242	Garmin	TK	
28/11/2023	Myara North	Habitat	Blackbutt	Good	800	Boundary 1	418676	6420094	243	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	418413	6419777	245	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	418410	6419771	246	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	418403	6419762	247	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	418327	6419698	248	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	418282	6419632	249	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	418156	6419499	251	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	418039	6419445	252	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417977	6419421	253	Garmin	TK	
28/11/2023	Myara North	Habitat	Blackbutt	Good	1500	Boundary 1	417936	6419392	254	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417910	6419346	255	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417836	6419280	256	Garmin	TK	
28/11/2023	Myara North	Habitat	Bullich	Good	500	Boundary 1	417064	6419656	260	Garmin	TK	
28/11/2023	Myara North	Habitat	Bullich	Good	1000	Boundary 1	416926	6419731	261	Garmin	TK	
28/11/2023	Myara North	Habitat	Bullich	Good	900	Boundary 1	416929	6419716	262	Garmin	TK	
28/11/2023	Myara North	Habitat	Blackbutt	Good	1800	Boundary 1	416906	6419738	263	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	416841	6419627	267	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	416889	6419584	268	Garmin	TK	
28/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417043	6419346	269	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	417410	6419186	270	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	417399	6419195	271	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417365	6419158	272	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	417270	6419207	273	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417170	6419188	276	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417226	6419138	277	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	417297	6419122	278	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	417734	6419126	280	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	417794	6419109	281	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	417183	6418404	282	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	417178	6418406	283	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	417171	6418407	284	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417162	6418402	285	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	417205	6418415	286	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417190	6418417	287	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	417186	6418415	288	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	417593	6418755	290	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417705	6418861	293	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	417719	6418892	295	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	417557	6418809	299	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417509	6418715	300	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417502	6418711	301	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417259	6418503	302	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	417107	6418347	303	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	416714	6418470	304	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	416638	6418500	305	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	416538	6418534	306	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	416649	6418409	312	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	416673	6418406	313	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	415908	6418520	314	Garmin	TK	
29/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	415894	6418534	315	Garmin	TK	

29/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	416379	6418404	316	Garmin	TK	
29/11/2023	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	416390	6418425	317	Garmin	TK	
29/11/2023	Myara North	Habitat	Blackbutt	Good	1500	Boundary 1	416408	6418431	319	Garmin	TK	
29/11/2023	Myara North	Habitat	Blackbutt	Good	1700	Boundary 1	416391	6418448	320	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	416284	6418540	321	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	416285	6418542	325	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	416288	6418543	326	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	416225	6418605	327	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	415978	6418635	328	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	415971	6418620	329	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	1300	Boundary 1	415869	6418573	332	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	415836	6418534	334	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	900	Boundary 1	415838	6418523	335	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	700	Boundary 1	415806	6418453	336	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	800	Boundary 1	415806	6418413	337	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	415819	6418347	338	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	1100	Boundary 1	415185	6417024	339	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	415186	6417227	340	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	1200	Boundary 1	415107	6417341	341	Garmin	TK	
30/11/2023	Myara North	Habitat	Marri	Good	1400	Boundary 1	415272	6416962	342	Garmin	TK	
7/12/2023	Myara North	Habitat	Marri	Good	1000	Boundary 1	416348	6415799	654	Garmin	TK	
7/12/2023	Myara North	Habitat	Marri	Good	600	Boundary 1	416093	6415798	655	Garmin	TK	
7/12/2023	Myara North	Habitat	Marri	Good	500	Boundary 1	416082	6415800	656	Garmin	TK	
11/12/2023	Myara North	Habitat	Blackbutt	Good	800	PW alignment	421585	6418714	660	Garmin	TK	
11/12/2023	Myara North	Habitat	Blackbutt	Good	800	PW alignment	421593	6418786	662	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	500	PW alignment	421592	6418792	663	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	800	PW alignment	421654	6419317	667	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	500	PW alignment	421651	6419307	668	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	700	PW alignment	421652	6419276	669	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	700	PW alignment	423106	6417260	671	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1300	PW alignment	423099	6417248	672	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1300	PW alignment	423037	6417305	675	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	422945	6417275	676	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1200	PW alignment	422845	6417366	677	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	800	PW alignment	422843	6417377	678	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	422695	6417511	679	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	600	PW alignment	422693	6417528	680	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	422677	6417552	681	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	600	PW alignment	422664	6417553	683	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	500	PW alignment	422634	6417547	684	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1000	PW alignment	422613	6417575	686	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	600	PW alignment	422635	6417514	687	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	900	PW alignment	422633	6417520	688	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1200	PW alignment	422837	6417285	689	Garmin	TK	
11/12/2023	Myara North	Habitat	Marri	Good	1200	PW alignment	422847	6417299	690	Garmin	TK	
10/01/2024	Myara North	Habitat	Blackbutt	Good	1400	Boundary 1	429910	6409554	1280	Garmin	TK	
10/01/2024	Myara North	Habitat	Blackbutt	Good	600	Boundary 1	429860	6409587	1281	Garmin	TK	
10/01/2024	Myara North	Habitat	Blackbutt	Good	900	Boundary 1	429860	6409560	1282	Garmin	TK	
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	429814	6409568	1283	Garmin	TK	
10/01/2024	Myara North	Habitat	Blackbutt	Good	1100	Boundary 1	429798	6409570	1284	Garmin	TK	
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	429740	6409568	1285	Garmin	TK	
10/01/2024	Myara North	Habitat	Blackbutt	Good	1500	Boundary 1	429748	6409595	1286	Garmin	TK	
9/01/2024	Myara North	Habitat	Flooded Gum	Good	600	Boundary 1	429107	6408877	1586	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	600	Boundary 1	429111	6408884	1587	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	700	Boundary 1	429115	6408894	1588	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	429136	6408892	1589	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000. 900	Boundary 1	429172	6408928	1590	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	429191	6408942	1591	Garmin	TK	
9/01/2024	Myara North	Habitat	Marri	Good	1100	Boundary 1	429205	6408956	1592	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	900	Boundary 1	429209	6408965	1593	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	429191	6408981	1594	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	800	Boundary 1	429196	6408987	1595	Garmin	TK	
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000	Boundary 1	429197	6408995	1596	Garmin	TK	

9/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429200	6409007	1597	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	?		Boundary 1	429250	6409081	1598	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good		700	Boundary 1	429215	6409073	1599	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good		1500	Boundary 1	429229	6409085	1600	Garmin	TK
9/01/2024	Myara North	Habitat	Marri	Good		800	Boundary 1	429239	6409086	1601	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good		800	Boundary 1	429245	6409060	1602	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429232	6409102	1603	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good		900	Boundary 1	429223	6409101	1604	Garmin	TK
9/01/2024	Myara North	Habitat	Marri	Good		1000	Boundary 1	429240	6409119	1605	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		800	Boundary 1	429241	6409118	1606	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		900	Boundary 1	429243	6409128	1607	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1100	Boundary 1	429204	6409159	1608	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		900	Boundary 1	429207	6409179	1609	Garmin	TK
10/01/2024	Myara North	Habitat	Flooded Gum	Good		1000	Boundary 1	429204	6409228	1610	Garmin	TK
10/01/2024	Myara North	Habitat	Flooded Gum	Good		600	Boundary 1	429185	6409194	1611	Garmin	TK
10/01/2024	Myara North	Habitat	Flooded Gum	Good		600	Boundary 1	429192	6409205	1612	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429168	6409249	1613	Garmin	TK
10/01/2024	Myara North	Habitat	Flooded Gum	Good		800	Boundary 1	429170	6409268	1614	Garmin	TK
10/01/2024	Myara North	Habitat	Flooded Gum	Good		700	Boundary 1	429169	6409267	1615	Garmin	TK
10/01/2024	Myara North	Habitat	Flooded Gum	Good		700	Boundary 1	429180	6409266	1616	Garmin	TK
10/01/2024	Myara North	Habitat	Flooded Gum	Good		700	Boundary 1	429179	6409290	1617	Garmin	TK
10/01/2024	Myara North	Habitat	Marri	Good		1000	Boundary 1	429208	6409343	1618	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		800	Boundary 1	429218	6409351	1619	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1300	Boundary 1	429238	6409355	1620	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429221	6409351	1621	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429221	6409352	1622	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429248	6409367	1623	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1300	Boundary 1	429284	6409359	1624	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1100	Boundary 1	429272	6409389	1625	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		900	Boundary 1	429303	6409397	1626	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429284	6409408	1627	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1400	Boundary 1	429272	6409388	1628	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429317	6409437	1629	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1000	Boundary 1	429356	6409521	1630	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		800	Boundary 1	429409	6409488	1631	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		700	Boundary 1	429422	6409483	1632	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1300	Boundary 1	429448	6409495	1633	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		900	Boundary 1	429448	6409505	1634	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1200	Boundary 1	429457	6409551	1635	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		900	Boundary 1	429472	6409508	1636	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1200	Boundary 1	429485	6409531	1637	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		700	Boundary 1	429526	6409529	1638	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1400	Boundary 1	429525	6409526	1639	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1100	Boundary 1	429528	6409554	1640	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		900	Boundary 1	430005	6409595	1641	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		600	Boundary 1	430004	6409590	1642	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1500	Boundary 1	429972	6409558	1643	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1400	Boundary 1	429969	6409588	1644	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		600	Boundary 1	429958	6409578	1645	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1500	Boundary 1	429929	6409567	1646	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1400	Boundary 1	429915	6409568	1647	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		600	Boundary 1	429739	6409610	1648	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		600	Boundary 1	429722	6409605	1649	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		800	Boundary 1	429703	6409621	1650	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		800	Boundary 1	429707	6409636	1651	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		600	Boundary 1	429707	6409605	1652	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1200	Boundary 1	429756	6409622	1653	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1800	Boundary 1	429772	6409611	1654	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1100	Boundary 1	429796	6409620	1656	Garmin	TK
10/01/2024	Myara North	Habitat	Marri	Good		1000	Boundary 1	429794	6409626	1657	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1300	Boundary 1	429811	6409609	1658	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1100	Boundary 1	429819	6409598	1659	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good		1800	Boundary 1	429838	6409589	1660	Garmin	TK

10/01/2024	Myara North	Habitat	Blackbutt	Good	1000. 900		Boundary 1	429842	6409613	1661	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429823	6409613	1662	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429829	6409637	1663	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1200		Boundary 1	429848	6409624	1664	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429880	6409631	1665	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	800		Boundary 1	429882	6409642	1666	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429903	6409615	1667	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	600		Boundary 1	429905	6409621	1668	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	700		Boundary 1	429918	6409625	1669	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1500		Boundary 1	429932	6409614	1670	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429964	6409630	1671	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	900		Boundary 1	429963	6409629	1672	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1800		Boundary 1	429994	6409534	1673	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1500		Boundary 1	430005	6409515	1674	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1100		Boundary 1	430044	6409509	1675	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	430048	6409498	1676	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	430071	6409510	1677	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1100		Boundary 1	430109	6409521	1678	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	800		Boundary 1	430093	6409529	1679	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1100		Boundary 1	430132	6409530	1680	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	430123	6409550	1681	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	600		Boundary 1	430463	6409597	1682	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	600		Boundary 1	430502	6409709	1683	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	900		Boundary 1	430502	6409734	1684	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1200		Boundary 1	430588	6409863	1685	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	800		Boundary 1	430590	6409856	1686	Garmin	TK
10/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	430628	6409856	1687	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1200		Boundary 1	429526	6409681	1248	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	700		Boundary 1	429529	6409657	1249	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	600		Boundary 1	429532	6409650	1250	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	600		Boundary 1	429529	6409615	1251	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1200		Boundary 1	429531	6409613	1252	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429540	6409627	1253	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429545	6409635	1259	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1200		Boundary 1	429554	6409657	1260	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429562	6409687	1261	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1200		Boundary 1	429583	6409691	1263	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1100		Boundary 1	429592	6409691	1264	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	700		Boundary 1	429609	6409676	1265	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1100		Boundary 1	429614	6409669	1266	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	800		Boundary 1	429645	6409665	1267	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	800		Boundary 1	429647	6409667	1268	Garmin	TK
9/01/2024	Myara North	Habitat	Blackbutt	Good	1000		Boundary 1	429660	6409663	1269	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	800		Boundary 1	430077	6414872	1173	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	600		Boundary 2	430078	6414860	1174	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	1400		Boundary 2	430028	6415054	1175	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	900		Boundary 2	430023	6415170	1176	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	600		Boundary 2	430031	6415193	1177	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	600		Boundary 2	430025	6415195	1178	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	1100		Boundary 2	430031	6415219	1179	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	1000		Boundary 2	430031	6415217	1180	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	900		Boundary 2	430029	6415243	1181	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	500		Boundary 2	430024	6415245	1182	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	700		Boundary 2	430024	6415259	1183	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	800		Boundary 2	430007	6415294	1184	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	600		Boundary 2	429991	6415328	1185	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	600		Boundary 2	429964	6415359	1186	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	600		Boundary 2	429967	6415362	1187	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	1100		Boundary 2	429951	6415362	1188	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	1000		Boundary 2	429762	6415483	1189	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	800		Boundary 2	429739	6415487	1190	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	500		Boundary 2	429260	6416007	1191	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	600		Boundary 2	429264	6416020	1192	Garmin	TK

8/01/2024	Myara North	Habitat	Marri	Good	700				Boundary 2		429279	6416019		1193	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	500				Boundary 2		429286	6416024		1194	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	1000				Boundary 2		429276	6416040		1195	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	900				Boundary 2		429253	6416069		1197	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	500				Boundary 2		429252	6416065		1198	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	600				Boundary 2		429185	6416224		1200	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	900				Boundary 2		429177	6416246		1201	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	800				Boundary 2		428522	6418236		1205	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	1000				Boundary 1		428511	6418234		1206	Garmin	TK
8/01/2024	Myara North	Habitat	Marri	Good	1100				Boundary 1		428708	6417975		1207	Garmin	TK
17/11/2023	Myara North	Habitat	Blackbutt	Good	1000		No signs	Yes	Boundary 1		430392	6409628		1451	Garmin	TK
27/11/2023	Myara North	Habitat	Marri	Good	1000		No signs	Yes	Boundary 1		421564	6423725		130	Garmin	TK
26/11/2023	Myara North	Habitat	Marri	Good	1300		No signs	Yes	Boundary 1		422758	6424091		109	Garmin	TK
28/11/2023	Myara North	Habitat	Marri	Good	1000		No signs	Yes	Boundary 1		417722	6419306		206	Garmin	TK
14/11/2023	Myara North	Possible nest	Marri	Good	900	Side entry	No signs		PW alignment		419943	6421489		1351	Garmin	TK
14/11/2023	Myara North	Possible nest	Marri	Good	1000	Side entry	No signs		PW alignment		415391	6420188		1387	Garmin	TK
14/11/2023	Myara North	Possible nest	Marri	Good	1000	Side entry	No signs		PW alignment		417026	6419181		1397	Garmin	TK
21/11/2023	Myara North	Possible nest	Marri	Good	1000	Side entry	No signs		Boundary 1		430534	6413039		1578	Garmin	TK
21/11/2023	Myara North	Possible nest	Marri	Good	800	Side entry	No signs		Boundary 1		430510	6413035		1579	Garmin	TK
26/11/2023	Myara North	Nest	Marri	Good. Sen 4	1028	Top entry	Chewing at entrance		2024 Boundary 1		422899	6424130		107	Garmin	TK
26/11/2023	Myara North	Possible nest	Marri	Good	1200	Side entry	No signs		Boundary 1		422241	6423881		118	Garmin	TK
27/11/2023	Myara North	Possible nest	Marri	Good	1000	Side entry	No signs		Boundary 2		419775	6423350		139	Garmin	TK
28/11/2023	Myara North	Possible nest	Marri	Dead	700	Top entry	No signs		Boundary 2		418530	6422329		179	Garmin	TK
28/11/2023	Myara North	Possible nest	Marri	Good	1000	Top entry	No signs		Boundary 1		418940	6422644		183	Garmin	TK
28/11/2023	Myara North	Nest	Marri	Good. Sen 3	1206	Side entry	Chewing at entrance		2022 Boundary 1		418618	6422472		189	Garmin	TK
28/11/2023	Myara North	Nest	Marri	Good	1311	Side entry	Chewing at entrance		2047 Boundary 1		418776	6421250		205	Garmin	TK
28/11/2023	Myara North	Nest	Marri	Good. Sen 4	920	Top entry	Chewing at entrance		2066 Boundary 1		418799	6420446		227	Garmin	TK
28/11/2023	Myara North	Possible nest	Marri	Good	1000	Side entry	No signs		Boundary 1		418183	6419533		250	Garmin	TK
28/11/2023	Myara North	Nest	Bullich	Good	735	Side entry	Chewing at entrance		2018 Boundary 1		417001	6419671		258	Garmin	TK
28/11/2023	Myara North	Nest	Bullich	Good	767	Side entry	Chewing at entrance		2074 Boundary 1		417004	6419670		259	Garmin	TK
29/11/2023	Myara North	Possible nest	Marri	Good	1500	Top entry	No signs		Boundary 1		417194	6418456		289	Garmin	TK
29/11/2023	Myara North	Possible nest	Marri	Good	1100	Top entry	No signs		Boundary 1		417599	6418755		291	Garmin	TK
29/11/2023	Myara North	Possible nest	Marri	Good	1200	Top entry	No signs		Boundary 1		417707	6418826		292	Garmin	TK
29/11/2023	Myara North	Possible nest	Marri	Good	1000	Top entry	No signs		Boundary 1		417711	6418886		294	Garmin	TK
29/11/2023	Myara North	Nest	Marri	Good. Sen 4	983	Side entry	Chewing at entrance		2046 Boundary 1		417863	6418982		296	Garmin	TK
29/11/2023	Myara North	Nest	Marri	Good. Sen 4	1213	Top entry	Chewing at entrance		2048 Boundary 1		417857	6419024		297	Garmin	TK
29/11/2023	Myara North	Possible nest	Marri	Good	1200	Side entry	No signs		Boundary 1		417681	6418954		298	Garmin	TK
29/11/2023	Myara North	Nest	Marri	Good. Sen 3	1279	Side entry	Chewing at entrance		2010 Boundary 1		416392	6418485		308	Garmin	TK
29/11/2023	Myara North	Possible nest	Marri	Good	1300	Side entry	No signs		Boundary 1		416499	6418461		310	Garmin	TK
30/11/2023	Myara North	Nest	Marri	Good. Sen 4	970	Side entry	Chewing at entrance		2017 Boundary 1		415877	6418611		331	Garmin	TK
11/12/2023	Myara North	Possible nest	Marri	Good	900	Top entry	No signs		PW alignment		421859	6419499		665	Garmin	TK
11/12/2023	Myara North	Nest	Marri	Good. Sen 4	948	Top entry	Chewing at entrance		2013 PW alignment		422671	6417553		682	Garmin	TK
8/01/2024	Myara North	Possible nest	Marri	Good	1000	Top entry	No signs		Boundary 1		429274	6416041		1196	Garmin	TK
8/01/2024	Myara North	Nest	Marri	Good. Sen 7	751	Top entry	Chewing at entrance		2110 Boundary 1		429248	6416125		1199	Garmin	TK
8/01/2024	Myara North	Possible nest	Marri	Good	1100	Top entry	No signs		Boundary 1		429104	6416389		1202	Garmin	TK
8/01/2024	Myara North	Possible nest	Marri	Good	600	Top entry	No signs		Boundary 1		429081	6416930		1204	Garmin	TK
13/11/2023	Myara North	Nest	Marri	Good. Sen 2	716	Top entry	Chewing at entrance		2026 Boundry 2		419217	6422722		1326	Garmin	TK
14/11/2023	Myara North	Nest	Marri	Good	1069	Top entry	Chewing at entrance		2208 PW alignment		421743	6419390		1346	Garmin	TK
14/11/2023	Myara North	Nest	Marri	Good. Sen 4	831	Top entry	Chewing at entrance		2021 PW alignment		419454	6422099		1356	Garmin	TK
14/11/2023	Myara North	Nest	Marri	Good. Sen 4	570	Top entry	Chewing at entrance		2060 PW alignment		419377	6422267		1359	Garmin	TK
14/11/2023	Myara North	Nest	Marri	Good. Sen 7	538	Top entry	Chewing at entrance		2062 PW alignment		415392	6420188		1386	Garmin	TK
15/11/2023	Myara North	Possible nest	Marri	Good	700	Side entry	No signs		PW alignment		418761	6416943		1410	Garmin	TK
15/11/2023	Myara North	Possible nest	Marri	Good	700	Side entry	No signs		PW alignment		417838	6415643		1414	Garmin	TK
15/11/2023	Myara North	Possible nest	Marri	Dead	1000	Top entry	No signs		PW alignment		417890	6415649		1416	Garmin	TK
15/11/2023	Myara North	Possible nest	Marri	Good	900	Side entry	No signs		PW alignment		418628	6416455		1425	Garmin	TK
17/11/2023	Myara North	Possible nest	Marri	Good	1000	Side entry	No signs		Boundary 1		430452	6412646		1489	Garmin	TK
20/12/2023	Myara North	Nest	Marri	Poor. Sen 8	1069	Side entry	Chewing at entrance		2042 PW alignment	Pair of Car	412783	6421438		1496	Garmin	TK
20/11/2023	Myara North	Possible nest	Marri	Good	1400	Side entry	No signs		PW alignment		414561	6420291		1508	Garmin	TK
20/11/2023	Myara North	Possible nest	Marri	Good	1200	Side entry	No signs		PW alignment		414728	6420341		1510	Garmin	TK
20/11/2023	Myara North	Nest	Marri	Good. Sen 5	1725	Side entry	Chewing at entrance		2041 PW alignment		414780	6420353		1512	Garmin	TK
20/11/2023	Myara North	Nest	Marri	Good. Sen 4	862	Side entry	Chewing at entrance		2045 Boundary 2		426861	6421183		1534	Garmin	TK
21/11/2023	Myara North	Nest	Marri	Good. Sen 2	862	Side entry	Chewing at entrance		2040 Boundary 1		430531	6413001		1577	Garmin	TK
10/01/2024	Myara North	Nest	Blackbutt	Good. Sen 2	1069	Top and side	Chewing at entrance		2112 Boundary 1		429157	6417077		1688	Garmin	TK

14/11/2023	Myara North	Significant tree	Blackbutt	Good	2050			PW alignment	421846	6419852	1348	Garmin		TK
28/11/2023	Myara North	Significant tree	Blackbutt	Good	2050			Boundary 1	418618	6420028	244	Garmin		TK
29/11/2023	Myara North	Significant tree	Blackbutt	Good	2050			Boundary 1	417274	6419204	274	Garmin		TK
29/11/2023	Myara North	Significant tree	Marri	Good	1925			Boundary 1	416462	6418451	309	Garmin		TK
20/11/2023	Myara North	Significant tree	Marri	Good	1600			Boundary 2	425528	6423779	1544	Garmin		TK
20/11/2023	Myara North	Habitat	Marri	Good	1200			Boundary 2	425502	6423812	1545	Garmin		TK
28/11/2023	Myara North	Nest	Marri	Good. Sen 5	808	Top entry	Old chewing at entrance	2028	PW alignment	418701	6422537	188	Garmin	TK

Appendix 9 – Myara North Power/Water/Boundary Alignments, Black Cockatoo Breeding Habitat Survey (Kirkby, 2024)

MYARA NORTH POWER/WATER ALIGNMENTS, BLACK COCKATOO BREEDING HABITAT SURVEY.

The purpose of the survey was to locate black cockatoo nests, possible nests and habitat trees at the Myara North Power/Water Alignments. A polygon of approximately 11 hectares located at the western end of the power alignment.



Methods and timing

The areas were surveyed using Alcoas 'Procedure for surveying haul road alignments and mine pits for black cockatoo habitat (MIN).

Trees are described as:

- Nest trees - that show signs of use by black cockatoos, including worn and chewed entrance of a suitable sized hollow (NB: it is possible some of these trees no longer provide suitable nest habitat but have either been used as nests in the past or been well prospected by cockatoos);
- Possible nest trees – that have a suitable size and shape hollow entrance but show no signs of use. During assessment of these trees, the position, entrance size and orientation of the hollow should be considered because these will influence the likelihood of a suitable depth of hollow for cockatoos; These will indicate a suitable entrance type but not the depth?
- Habitat trees – mature marri trees (>500mm diameter) that have the potential to provide nest habitat in the future either based on:
  i) Already starting to develop a hollow; or

ii) Tree form conducive to hollow formation/development such as elbows or major V branching of primary trunk (that may hollow out); tall, straight trunked trees, particularly showing signs of decay (that may form a top entrance hollow in the event of the top of the trunk being blown off); trees with major branches coming off the main trunk (that may hollow out if branch drops); photos or drawings?

- Roost sites – groups of trees with evidence of roosting, e.g. bird faeces and feathers found beneath the roost trees.

Note. The above mentions Marri trees but the current surveys also include Blackbutt *Eucalyptus patens* and Bullich *E. megacarpa.* These species provide nest hollows but are restricted in distribution to wet areas and creeklines and are rarely encountered other than where a haul road crosses a stream zone.
Alcoas current surveys also allow for significant stands of suitable trees (>500mm diameter) which may provide a future hollow but are not necessarily forming a hollow at present.,

Haul road alignments are normally surveyed to a width of 50m either side of the centre alignment, but the water and power alignment footprints are narrower and were surveyed to a total of 20m either side of the alignment.

All trees of interest were picked up using handheld GPS. AGD84.

The survey was undertaken between September and November 2022.

Results

A total of 155 trees (two from pre-mine surveys) and two black cockatoo roosting sites were picked up during the survey.

Trees

- Marri – 43
- Bullich – 20
- Blackbutt – 91
- Jarrah – 1

Of these 155 trees, three of the Marri – identification numbers 618,1475,1477 were considered nest trees and numbers 851 and 680 were considered possible nest trees. One each of the Blackbutt and Jarrah were significant trees being over 1500mm and 2000mm diameter respectively. All other trees were classed as 'habitat trees'.

Roost sites

Two black cockatoo roost sites were located. The first (number 597) was located in Bullich/Blackbutt in the 11 ha power polygon and the second (number 625) on the power alignment near the old POW camp at Balmoral Rd. Judging by the broken twigs, leaves and droppings they appeared to of significant size and may have been being used by up to 50 birds at he time of the survey.

Tony Kirkby

2nd November 2022

Point number	Tree species	Coordinates AGD84		App. Dia. Mm	Comments
589	Blackbutt	417257	6419388	1100	Dead
593	Blackbutt	417316	6419373	1200	Dead
542	Blackbutt	417138	6419429	2000	Forks early into two smaller trunks
540	Blackbutt	417147	6419378	800	Habitat tree
541	Blackbutt	417144	6419392	700	Habitat tree
549	Blackbutt	417083	6419509	700	Habitat tree
553	Blackbutt	417028	6419601	1000	Habitat tree
565	Blackbutt	417168	6419466	600	Habitat tree
568	Blackbutt	417189	6419442	1000	Habitat tree
570	Blackbutt	417191	6419419	1000	Habitat tree
571	Blackbutt	417178	6419411	900	Habitat tree
572	Blackbutt	417172	6419411	900	Habitat tree
574	Blackbutt	417166	6419399	600	Habitat tree
575	Blackbutt	417178	6419392	1000	Habitat tree
576	Blackbutt	417197	6419353	700	Habitat tree
577	Blackbutt	417202	6419343	700	Habitat tree
578	Blackbutt	417207	6419339	700	Habitat tree
579	Blackbutt	417207	6419333	800	Habitat tree
580	Blackbutt	417207	6419334	700	Habitat tree
581	Blackbutt	417212	6419323	1000	Habitat tree
582	Blackbutt	417227	6419302	1000	Habitat tree
583	Blackbutt	417233	6419300	600	Habitat tree
584	Blackbutt	417235	6419285	1200	Habitat tree
585	Blackbutt	417213	6419368	600	Habitat tree
586	Blackbutt	417223	6419381	600	Habitat tree
587	Blackbutt	417230	6419383	500	Habitat tree
588	Blackbutt	417248	6419387	600	Habitat tree
590	Blackbutt	417274	6419382	1000	Habitat tree
591	Blackbutt	417277	6419381	1000	Habitat tree
592	Blackbutt	417285	6419383	900	Habitat tree
595	Blackbutt	417314	6419391	500	Habitat tree
596	Blackbutt	417246	6419418	1000	Habitat tree
603	Blackbutt	417367	6419390	1300	Habitat tree
604	Blackbutt	417365	6419393	800	Habitat tree
606	Blackbutt	417269	6419268	1000	Habitat tree
608	Blackbutt	417287	6419334	600	Habitat tree
619	Blackbutt	421169	6418684	600	Habitat tree
620	Blackbutt	421171	6418685	600	Habitat tree
621	Blackbutt	421175	6418685	600	Habitat tree
622	Blackbutt	421176	6418685	600	Habitat tree
623	Blackbutt	421183	6418685	500	Habitat tree
624	Blackbutt	421204	6418689	900	Habitat tree
627	Blackbutt	421214	6418673	1000	Habitat tree
628	Blackbutt	421232	6418669	900	Habitat tree
629	Blackbutt	421260	6418664	600	Habitat tree
630	Blackbutt	421264	6418667	600	Habitat tree
631	Blackbutt	421280	6418677	1400	Habitat tree
632	Blackbutt	421270	6418694	800	Habitat tree
633	Blackbutt	421247	6418697	700	Habitat tree
634	Blackbutt	421234	6418703	1100	Habitat tree
635	Blackbutt	421213	6418697	500	Habitat tree
636	Blackbutt	421206	6418699	900	Habitat tree
637	Blackbutt	421192	6418690	500	Habitat tree
638	Blackbutt	421364	6418669	1100	Habitat tree
639	Blackbutt	421388	6418673	800	Habitat tree
640	Blackbutt	421390	6418674	500	Habitat tree
641	Blackbutt	421388	6418680	700	Habitat tree
642	Blackbutt	421388	6418683	1000	Habitat tree
643	Blackbutt	421399	6418679	800	Habitat tree
644	Blackbutt	421418	6418678	1000	Habitat tree
645	Blackbutt	421419	6418681	1100	Habitat tree
646	Blackbutt	421459	6418673	1000	Habitat tree
647	Blackbutt	421458	6418677	1200	Habitat tree
648	Blackbutt	421454	6418654	1000	Habitat tree
649	Blackbutt	421452	6418651	1000	Habitat tree
650	Blackbutt	421452	6418624	900	Habitat tree

651	Blackbutt	421431	6418611	1000	Habitat tree
652	Blackbutt	421422	6418610	1000	Habitat tree
653	Blackbutt	421427	6418605	900	Habitat tree
654	Blackbutt	421407	6418532	800	Habitat tree
655	Blackbutt	421411	6418493	1000	Habitat tree
656	Blackbutt	421411	6418488	500	Habitat tree
657	Blackbutt	421406	6418469	1100	Habitat tree
658	Blackbutt	421406	6418467	1000	Habitat tree
659	Blackbutt	421411	6418449	700	Habitat tree
660	Blackbutt	421420	6418412	1000	Habitat tree
661	Blackbutt	421440	6418404	1000	Habitat tree
662	Blackbutt	421439	6418403	1200	Habitat tree
663	Blackbutt	421450	6418379	600	Habitat tree
664	Blackbutt	421438	6418383	1000	Habitat tree
665	Blackbutt	421439	6418382	1000	Habitat tree
666	Blackbutt	421473	6418318	600	Habitat tree
667	Blackbutt	421474	6418310	600	Habitat tree
668	Blackbutt	421475	6418294	600	Habitat tree
669	Blackbutt	421460	6418280	1200	Habitat tree
670	Blackbutt	421464	6418247	800	Habitat tree
671	Blackbutt	421459	6418247	1000	Habitat tree
673	Blackbutt	421473	6418195	1200	Habitat tree
674	Blackbutt	421475	6418182	1000	Habitat tree
678	Blackbutt	421494	6418104	900	Habitat tree
607	Blackbutt	417290	6419324	1500	Significant tree/habitat tree
536	Bullich	417169	6419356	800	Habitat tree
537	Bullich	417172	6419353	800	Habitat tree
538	Bullich	417169	6419356	500	Habitat tree
543	Bullich	417106	6419463	1000	Habitat tree
548	Bullich	417102	6419495	1000	Habitat tree
550	Bullich	417081	6419526	800	Habitat tree
551	Bullich	417068	6419536	800	Habitat tree
552	Bullich	417064	6419544	1000	Habitat tree
554	Bullich	417034	6419597	800	Habitat tree
555	Bullich	417039	6419598	700	Habitat tree
556	Bullich	417045	6419586	600	Habitat tree
557	Bullich	417049	6419581	800	Habitat tree
558	Bullich	417061	6419581	1000	Habitat tree
559	Bullich	417063	6419580	1000	Habitat tree
560	Bullich	417068	6419570	1000	Habitat tree
561	Bullich	417079	6419563	1000	Habitat tree
562	Bullich	417127	6419520	800	Habitat tree
563	Bullich	417130	6419506	800	Habitat tree
564	Bullich	417155	6419485	1200	Habitat tree
567	Bullich	417187	6419445	1000	Habitat tree
850	Jarrah	419259	6417197	2000	Significant tree. 2 m dia
545	Marri	417113	6419436	1000	Forks early into two smaller trunks
838	Marri	418715	6416512	700	Forming hollows. Habitat tree
839	Marri	418718	6416492	1000	Forming hollows. Habitat tree
840	Marri	418748	6416493	1000	Forming hollows. Habitat tree
845	Marri	419008	6416733	900	Forming hollows. Habitat tree
842	Marri	418934	6416660	1100	Habitat tree
843	Marri	418977	6416697	800	Habitat tree
844	Marri	418972	6416702	600	Habitat tree
846	Marri	419016	6416744	600	Habitat tree
847	Marri	419018	6416743	500	Habitat tree
848	Marri	419061	6416744	600	Habitat tree
849	Marri	419150	6416825	800	Habitat tree
539	Marri	417145	6419367	600	Habitat tree
546	Marri	417107	6419431	1000	Habitat tree
547	Marri	417136	6419387	1100	Habitat tree
573	Marri	417171	6419404	700	Habitat tree
594	Marri	417319	6419385	500	Habitat tree
599	Marri	417586	6419304	1000	Habitat tree
600	Marri	417614	6419306	1100	Habitat tree
601	Marri	417761	6419260	1200	Habitat tree
602	Marri	417723	6419307	1100	Habitat tree

605	Marri	417265	6419265	800	Habitat tree
609	Marri	417297	6419298	700	Habitat tree
610	Marri	417296	6419295	600	Habitat tree
611	Marri	417300	6419295	1000	Habitat tree
612	Marri	417316	6419271	1000	Habitat tree
613	Marri	417326	6419256	700	Habitat tree
614	Marri	417298	6419260	1100	Habitat tree
615	Marri	417276	6419240	1100	Habitat tree
616	Marri	417496	6419204	1100	Habitat tree
617	Marri	417523	6419217	800	Habitat tree
672	Marri	421469	6418224	1000	Habitat tree
675	Marri	421492	6418154	1000	Habitat tree
676	Marri	421487	6418163	600	Habitat tree
677	Marri	421492	6418108	800	Habitat tree
679	Marri	421487	6418099	700	Habitat tree
685	Marri	421487	6418304	1000	Habitat tree
686	Marri	421473	6418333	700	Habitat tree
618	Marri	419113	6418957	2202	Nest tree and significant tree. Tagged 1887. Cockatoo egg on ground
1475	Marri	417398	6419195		Nest tree located in Alcoa premine surveys
1477	Marri	417346	6419278	1100	Nest tree located in Alcoa premine surveys
851	Marri	419250	6417604	1200	Possible nest hollow
680	Marri	421526	6418013	1200	Possible nest tree
597	Roost site	417122	6419518		
625	Roost site	421202	6418681		

Hydrology and Water Quality Assessment for Huntly Mine

Pinjarra Alumina Refinery Revised Proposal

Alcoa of Australia Limited

14 January 2022

→ The Power of Commitment

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Executive summary

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery (Refinery) by 5 per cent from 5.0 million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel region of Western Australia (WA), approximately 100 km south-east of Perth.

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

The Myara North mine region lies adjacent and north of the existing Myara mining operations. The Holyoake mine region lies north-east of Dwellingup, approximately 20 km south of Myara North.

This Hydrology and Water Quality Assessment has been prepared to support the EPA assessment and addresses the Myara North and Holyoake Development Envelopes (DE) of the Proposal.

The aim of this Hydrology and Water Quality Assessment technical report is to present an understanding of the setting and impacts to the receptors, as a consequence of bauxite mining and related activities.

The proposed Myara North DE and Holyoake DE (Mine DE) are located in State Forest, which is managed for multiple uses including drinking water production, timber harvesting, pine plantation and recreation.

The scope of works to support this Hydrology and Water Quality Assessment technical report comprised the following:

– Complete a comprehensive desktop assessment comprising review of databases, existing studies and geospatial information for the Huntly Mine, and proposed Mine DE to inform the baseline monitoring program and development of conceptual and numerical models
– Undertake a baseline monitoring program, including development of a surface water and groundwater Sampling and Analysis Quality Plan, installation of surface water monitoring equipment and groundwater monitoring bores, and completion of baseline surface and groundwater monitoring
– Complete catchment scale groundwater and surface water modelling, using updated Mine DE conceptualisation from field investigations including the outcomes from the baseline monitoring program
– Carry out a public drinking water risk assessment for the Serpentine, Pipehead and South Dandalup reservoirs and upper Wungong Brook catchment, considering potential contaminants arising from mining and non-mining activities, and including a detailed assessment of potential impacts to human health.
– Provide technical reports for the various supporting studies including:
    - Baseline Surface and Ground Water Monitoring Report – Myara North and Holyoake
    - Sampling Analysis and Quality Plan
    - Surface and Groundwater Monitoring Installation Report
    - 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.

This report is subject to, and must be read in conjunction with the limitations, assumptions and qualifications contained throughout the report.

A literature review of previously analogous cleared and mined areas indicates increased stream flows of 7% to 30% of rainfall. In addition, an assessment of a former mining area adjacent to the Myara North DE indicates increased groundwater levels of on average 5.5 metres (but as much as 14 metres) as a response to mining and land clearing. This supports that a local rise in groundwater levels (mounding), which will progressively dissipate towards the groundwater discharge boundaries, will accompany mining.

The potential rise in groundwater levels and associated increase in groundwater discharge may temporarily alter the water regime that supports identified environmental values in the Mine DE, which include riparian and swamp vegetation, aquatic ecosystems, reservoir/drinking water and recreational beneficial uses, associated with the drainage lines and streams.

Within the Myara North DE the Serpentine reservoir is fed by the Serpentine River, with other major tributaries including Big Brook and 39 Mile Brook. The South Dandalup reservoir in the Holyoake DE is fed primarily by the South Dandalup River. In the western part of the Darling Plateau, in the area identified as the high rainfall zone (HRZ), these rivers are characterised by sharply incised drainage lines.

The drying climate across the south-west of Western Australia has resulted in a decline in groundwater storage and consequently in groundwater levels, reducing groundwater connectivity with stream beds, reducing streamflow, and leading to a shift from perennial to ephemeral streamflow conditions.

A review of long-term trends in groundwater levels and streamflow for the Mine DE support these general trends in diminished groundwater streamflow connectivity, and reduced streamflow.

Long-term groundwater level data in the Myara North DE exhibits a decline of between 1 to 10 m since the 1990s, with an average decline of close to 4.5 m. While historic groundwater level data in the Holyoake DE is sparse the long-term trends from six bores with timeseries information suggests a similar average groundwater level decline of close to 9 m since the 1990s.

The change in groundwater levels is reflected in annual and seasonal streamflow data. Within the Myara North, flow gauging stations with long-term records observe a step change reduction in annual average streamflow in the period after 2000. A marked decline in streamflow is observed with a minor reduction in rainfall. Review of historical streamflow data also identifies a delay in flow commencement and typically earlier cease to flow for streamflows records post 2000 when compared to the preceding period.

As with groundwater level data, long-term surface water flow data in the Holyoake DE is even more sparse. For surface water gauging stations with long-term records (data pre and post 2000), there is an observed step change reduction in annual average streamflow as observed for Myara North DE gauging station locations. Flow seasonality in Holyoake DE also has a similar trend to Myara North DE with delay in flow commencement and earlier cease to flow.

The Serpentine, Pipehead, Wungong and South Dandalup reservoirs are key reservoirs that form part of the Water Corporation Integrated Water Supply System (IWSS) supplying drinking water to the Perth metropolitan region. The dams are protected by a Reservoir Protection Zone (RPZ), which forms a 2 km buffer area around the top water level of the reservoir, including the reservoir itself, but not extending outside the catchment area.

Changes in groundwater recharge and quickflow dynamics due to vegetation removal and subsequent bauxite mining have the potential to increase the groundwater level by several metres, with variations reflecting local hydrogeological conditions and properties. Historical data from an area south of Myara North indicates that in some cases groundwater levels can rise by up to 14 m in locations next to cleared and mined areas.

Mining also has the potential to temporarily increase stream flows during mining followed by their return to their natural status reflective of climatic conditions. Catchment-scale numerical modelling was completed to estimate groundwater level changes due to the Proposal for indicative mining periods comprising clearing/mining and rehabilitation periods.

The numerical modelling results suggest that proposed mining within Myara North results in an average increase in stream flows to the Serpentine Reservoir from the modelled catchments of 1.3 GL/year over the active clearing, mining, and rehabilitation period from about 2023 to 2033 (indicative clearing/mining to rehabilitation timeframe).

These effects slowly recede over the post-mining rehabilitation period, with:

– Groundwater level mounding, typically of 1 to 5 m scale by the end of the model simulation in 2060 during drier periods, and 1 to 10 m during wetter (recharge event) periods. The latter observation arises from enhanced recharge in previously mined areas. This estimate is consistent with the history-matching to observed groundwater level responses to rehabilitation, noting that there is only a limited historical period and limited areas where rehabilitation has been historically conducted within the model domain. In the simulated drying climate case (simulated as decrease in recharge and quickflow), relative groundwater level changes

between the cases with and without Myara North mining are of a similar order but are generally smaller in magnitude and in area.

– The extent of mounding is predicted to be generally localised to cleared and mined areas, with the magnitude of mounding decreasing towards low-lying areas and groundwater receptors (potential Groundwater Dependent Ecosystems, GDEs).
– An average decrease of 0.3 GL/year in surface water inflows to the Serpentine Reservoir from the modelled catchments over the simulated post-mining period in the base climate case, relative to the unmined case at Myara North. For the simulated drying climate case, the modelling estimates an average decrease of 0.2 GL/year inflow.

Within the proposed Holyoake mine region, similar to Myara North the modelling indicates increase in groundwater levels and streamflows. The modelling estimates average increases in streamflows to the South Dandalup Reservoir from the modelled catchments of 0.1 GL/year during the modelled active clearing and mining period from 2029 to 2033 and 0.2 to 0.3 GL/year in the post-mining period. These effects recede over the post-mining period, with:

– Groundwater level mounding, typically 1 to 10 m, in some case more than 10 m directly beneath previously cleared and mined areas. The latter observation arises from enhanced recharge in previously mined areas (in Myara), even after rehabilitation. This estimate is based on the history-matching to observed groundwater level responses to rehabilitation, noting that there is only a limited historical period and limited areas where rehabilitation has been historically conducted within the (Myara) model domain which in this case is used as proxy to the Holyoake model. Mounding near and away from previously cleared areas will be progressively smaller.
– In the simulated drying climate case, relative groundwater level changes between the cases with and without Holyoake mining are of a similar order but are generally slightly smaller in magnitude and in area.
– An average increase of 0.2 GL/year in surface water inflows to the South Dandalup Reservoir from the modelled catchments over the post-mining period in the base climate case, relative to the unmined case at Holyoake. For the simulated drying climate case, the modelling estimates an average increase of 0.1 GL/year inflow. During the modelled active clearing and mining phase, the modelling forecasts similarly increased inflows to the reservoir (0.1 GL/year in both climate cases). Uncertainty in these estimates of inflow reduction to the South Dandalup Reservoir are narrow, ranging from increases of 0.2 to 0.3 GL/year in the post-mining period.

These predictions are of similar magnitude to historical observations of groundwater level effects from clearing and mining, and to the outcomes of similar studies in the Darling Range (e.g., Dixon et al., 2019).

Model scenarios under “current” climatic conditions (last 20 years), and a drying climate under climate change (30% step reduction in recharge, runoff, and near surface flow from the last 20 years’ conditions) indicate the following for the Myara North mine region:

– Variable years of salinity increases and decreases during the land clearing and mining period, with an average reduction in TDS of between 1 mg/L and 10 mg/L for the current climate case and between 1 mg/L and 7 mg/L under the climate change case.
– In the modelled post-mining period the modelling estimates an increase in average TDS of between 3 mg/L and 20 mg/L for the current climate case, and between 3 mg/L and 24 mg/L for the drying climate case. This indicates relatively small differences in relative impact from Myara North mining activities between the climate scenarios modelled.

In the Holyoake mining region:

– Variable salinity increases during the land clearing and mining period on an inter-annual basis, with elevated TDS during low streamflow years as groundwater comprises a larger than usual proportion of streamflow. Averages over this period for the current climate case are 5 mg/L to 11 mg/L. Corresponding average increases under the drying climate case are 3 mg/L and 6 mg/L.
– In the post-mining period, the modelling estimates less inter-annual variability. The increase in average annual TDS due to mining is between 11 mg/L and 24 mg/L for the current climate case, and between 6 mg/L and 13 mg/L for the drying climate case. Differences in relative impact from Holyoake mining activities between the climate scenarios modelled are considered minor.

A Drinking Water Risk Assessment and Source Vulnerability Assessment was undertaken in accordance with the Australian Drinking Water Quality Guidelines and relevant contemporary guidance. Qualitative and quantitative methods were used to estimate the risk of microbial pathogens, turbidity, hydrocarbons and other hazardous agents. The major conclusions reached from the risk assessment included the following:

– The highest risk event, of direct faecal deposition in the Pipehead Dam catchment, was elevated above the threshold of acceptable risk for pathogen exposure. As an elevated risk, this hazard requires attention during detailed design, to define how to reduce the risk to an acceptable level.
– Extreme combinations of turbidity input variables have minimal impact to the Serpentine Pipehead and South Dandalup offtake turbidity levels, but will exceed the guideline value for significantly longer than the baseline pre-mining condition in the Serpentine reservoir. After assessing the range of results for likelihood and consequence, the overall turbidity risk is considered moderate.
– Concentrations of hazardous hydrocarbons associated with a diesel spill did not exceed guideline values.

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Terminology

Terminology	Definition
Alcoa of Australia Limited (Alcoa)	The proponent of the Proposal.
GHD Pty Ltd (GHD)	Consultant engaged by Alcoa to prepare environmental approvals documentation and supporting technical studies for the Proposal.
Myara North Development Envelope	Myara North mine region and associated infrastructure corridor within the Huntly mine region. 22,703 ha total
Myara North Infrastructure Corridor	Corridor adjacent to Myara North mine region in which a conveyor, haul road and other infrastructure may be developed. May also be referred to as a transport study area or conveyor/haul road corridor. 5,254 ha
Holyoake Development Envelope	Holyoake mine region and associated infrastructure corridor within the Huntly mine region. 18,700 ha total
Holyoake Infrastructure Corridor	Corridor adjacent to Holyoake mine region in which a conveyor, haul road, access road and other infrastructure may be developed. May also be referred to as a transport study area or conveyor/haul road corridor. 9,542 ha
Mine Development Envelope	Total Mine Development Envelope for the Proposal, this being Myara North and Holyoake mine regions and associated infrastructure corridors. 41,403 ha
Mining region	Sub-regions that comprise the Huntly Mine, including current (Myara), past (O'Neil, McCoy) and future (Myara North, Holyoake), etc.
Haul Road	Truck and mine infrastructure access road linking into existing corridors.
Huntly Mine	Huntly Bauxite Mine within ML1SA. This includes the previous and current mine regions of Del Park, Huntly, White Road, McCoy, O'Neil, and Myara, and the transition to the future mine regions of Myara North and Holyoake.

Abbreviations

Abbreviations	Definition
ANZG	Australia New Zealand Guidelines
BoM	Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAR	Comprehensive Adequate Representative
CRD	Cumulative Rainfall Departure
DE	Development Envelope
DWER	Department of Water and Environmental Regulation
EC	Electrical Conductivity
EPA	Environmental Protection Authority Western Australia
EP Act	Environmental Protection Act 1986
EPBC Act	Environmental Protection and Biodiversity Conservation Act
ERD	Environmental Review Document
ESD	Environmental Scoping Document
GDE	Groundwater Dependent Ecosystem
ha	Hectares
HRZ	High Rainfall Zone
IRZ	Intermediate Rainfall Zone
km	Kilometres
MBAS	Methylene Blue Active Substances
mBGL	Metres Below Ground Level
µS/cm	Microsiemens Per Centimetre
mg/L	Milligrams Per Litre
ML	Megalitre
NTU	Nephelometric Turbidity Units
PAH	Polycyclic Aromatic Hydrocarbons
PER	Public Environmental Review
PDWSA	Public drinking water source area
PFAS	Per- and Polyfluoroalkyl Substances
RPZ	Reservoir Protection Zone
SWL	Standing Water Level
TDS	Total Dissolved Solids
TMP	Trial Mining Project
TRH	Total Recoverable Hydrocarbons

1. Introduction

1.1 Project background

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery (Refinery) by 5 per cent from 5.0 million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel region of Western Australia (WA), approximately 100 km south-east of Perth.

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

This Hydrology and Water Quality Assessment has been prepared to support the EPA assessment and addresses the Myara North and Holyoake mine regions of the Proposal. The Hydrology and Water Quality Assessment is supported by several technical documents including the Baseline Hydrology Monitoring Report, Groundwater-Surface Water Conceptual Model report, Groundwater Modelling Reports, Drinking Water Risk Assessment, and Reservoir Modelling Report and associated environmental technical studies.

1.2 Purpose of this report

This Hydrology and Water Quality Assessment has been prepared to support the EPA assessment of the Proposal with respect to surface water and groundwater systems (Inland Waters) in the Myara North and Holyoake mine regions of the Proposal. The Hydrology and Water Quality Assessment will guide mine and infrastructure planning, and environmental mitigation for the Proposal.

The assessment has been prepared in accordance with the Environmental Scoping Document (ESD) prepared for the Proposal under Part IV of the EP Act. The Surface and Groundwater Assessment report has been undertaken in accordance with EPA (2018) *Environmental Factor Guideline – Inland Waters*.

The purpose of this report is to assess the hydrological and water quality impacts of the proposal on the existing environment as part of the assessment of Inland Waters for the Proposal. Table 1-1 outlines the EPA scoping requirements as outlined in the ESD.

Table 1-1 EPA scoping requirements

EPA scoping requirements	Where addressed in this assessment
47. Characterise the surface water and groundwater systems in a local and regional context and describe recharge and discharge mechanisms, aquifer connectivity, surface water/groundwater interaction and water chemistry. This should include identifying and mapping groundwater and surface water dependent ecosystems, including the catchment interactions with the Peel-Yalgorup System Ramsar Site.	Sections 4, 5, and 6
48. Undertake surveys to establish baseline water quality and the environmental values identified.	Sections 5 and 6
49. Characterise the hydrology of the Serpentine and South Dandalup Rivers and upper Wungong Brook, and the beneficial use of the Serpentine, Pipehead and South Dandalup reservoirs, including reservoir protection zone. Characterise the current water quality and hydrodynamics of the Serpentine, Pipehead and South Dandalup reservoirs. Describe the impacts from this Proposal on the water yield and water and sediment quality of the Serpentine, Pipehead and South Dandalup reservoirs, upstream rivers, tributaries, upper Wungong Brook, and Peel-Yalgorup System Ramsar Site. This is to include a detailed description of the development of river crossings for access/haul roads and conveyors.	Section 7 Section 8
50. Undertake a public drinking water risk assessment for the Serpentine, Pipehead and South Dandalup reservoirs and upper Wungong Brook catchment, including source vulnerability assessment, in accordance with the Australian Drinking Water Quality	Section 8.5

EPA scoping requirements	Where addressed in this assessment
Standards and relevant contemporary guidance. The risk assessment should consider potential contaminants arising from mining activities and infrastructure, as well as mobilisation of existing contaminants from past catchment activities. For identified high risks to public drinking water beneficial uses, undertake a detailed assessment of potential impacts to human health in accordance with contemporary guidance.	
51. Analyse, describe and assess surface water and groundwater impacts, including direct and indirect impacts, from the Proposal. This should include, but not limited to: a. changes to groundwater levels and surface water flows associated with the Proposal; b. changes to water quality; c. the nature, extent and duration of impacts; and d. impacts on environmental values of ground and surface water dependent ecosystems; e. impacts to aquatic fauna species or communities; f. impacts to Peel-Yalgorup System – Ramsar Site; g. cumulative impacts with existing operations, and other development and activities in the region including mining, timber harvesting, rehabilitation activities, fire, and interactions under projected climate change.	Section 8

1.3 Scope of works

The scope of works is to:

- Complete a comprehensive desktop assessment comprising review of databases, existing studies and geospatial information for the Huntly Mine, and Mine DE to inform the baseline monitoring program and development of conceptual and numerical models
- Develop and install a baseline monitoring program, including development of a surface water and groundwater Sampling and Analysis Quality Plan, installation of surface water monitoring equipment and groundwater monitoring bores, and completion of baseline surface and groundwater monitoring
- Carry out catchment scale modelling groundwater surface water interaction, using updated Mine DE conceptualisation from field investigations including the baseline monitoring program
- Undertake public drinking water risk assessment for the Serpentine, Pipehead, Wungong and South Dandalup reservoirs, considering potential contaminants arising from mining and non-mining activities, and including a detailed assessment of potential impacts to human health.
- Complete technical reports for the various supporting studies including the Baseline Surface and Ground Water Monitoring Report and the associated Sampling Analysis and Quality Plan and Surface and Groundwater Monitoring Installation Report (Appendix B), Hydrological setting and Understanding – Myara North and Holyoake (Appendix C), Groundwater Modelling Report for Huntly Mine – Myara North (Appendix D), Groundwater Modelling Report for Huntly Mine – Holyoake (Appendix E), and Drinking Water Risk Assessment (Appendix F)with associated Reservoir Modelling Report.).
- Provide a Hydrology and Water Quality Assessment technical report that consolidates the results and findings of the various supporting studies (this report).

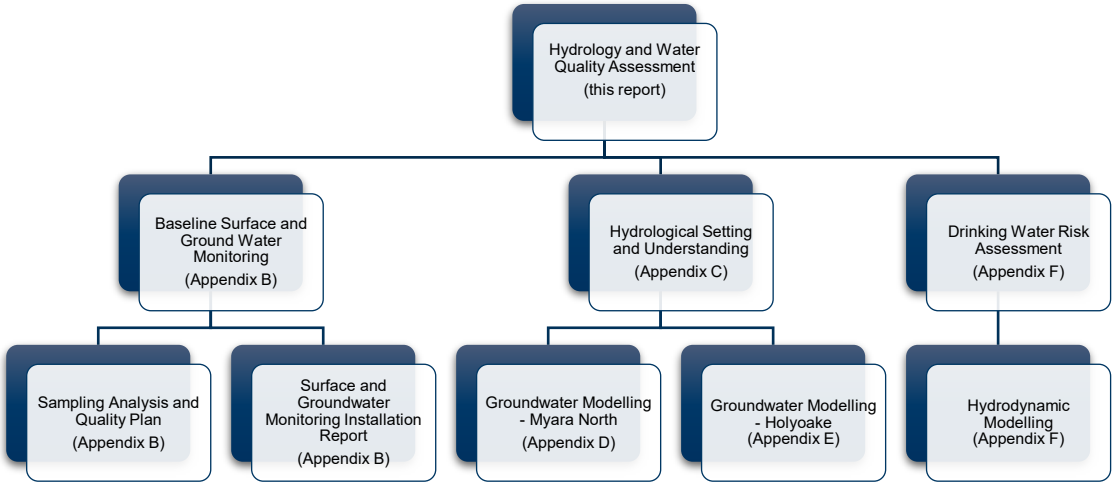


Figure 1-1 Reporting structure

1.4 Limitations and assumptions

This report has been prepared by GHD for Alcoa of Australia Limited and may only be used and relied on by Alcoa of Australia Limited for the purpose agreed between GHD and Alcoa of Australia Limited as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Alcoa of Australia Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Alcoa of Australia Limited and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions. Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Assessment methodology

2.1 Desktop assessment

A hydrological desktop assessment was completed to inform the various technical studies that were completed as part of the Hydrology and Water Quality Assessment.

The hydrological desktop assessment comprised a review of various literature and data sources related to the surface water and groundwater hydrology and water quality of the proposed Myara North Development Envelope (DE) and Holyoake DE.. The hydrological desktop assessment also incorporated a review of the existing Huntly Mine operations and management relevant to hydrology and water quality, including mine water use and water supply.

2.1.1 Data sources and previous studies

Alcoa has supported studies to assess the potential impacts of its mining activities on the environment since the 1970s, previously in association with the former Water and Rivers Commission as part of the *Joint Intermediate Rainfall Zone Research Program*. This research was overseen by the Bauxite Hydrology Committee, formerly a subcommittee of the MMPLG, which was suspended in 2014.

The following generalised information sources were reviewed, the reference and details of which are presented in section 9:

– Alcoa Environmental Research Bulletins No 16 and No 22, relating to salinity research within mining exploration boreholes across the Darling Range
– Reports prepared by and for the Bauxite Hydrology Committee, a subcommittee of the Mine Management Program Liaison Group (Section 3.4)
– Published technical journal and research papers
– Geotechnical and hydrogeological reports and data including for soils and groundwater
– Flora and fauna surveys of the Proposal area, conducted as part of this study or previously conducted.

Groundwater and surface water related reports for historical, current, and future mining operations were also reviewed, including:

– Triennial Environmental Review 2015-2017; Alcoa WA Mining Operations, September 2018 (Alcoa of Australia Limited 2018)
– Annual Environmental Review 2018; Alcoa WA Mining Operations, July 2019 (Alcoa of Australia Limited 2019)
– Alcoa/DEC Working Arrangements; Bauxite Mining Operations, 2011-2015 (2011)
– Water Working Arrangements, Version 5 Effective Years of Operation 2018-2023(2019)
– Alcoa Mining and Management Program, 2019-2023 Inclusive, Huntly and Willowdale Mines, Western Australia Mining Operations, January 2019 (Alcoa of Australia Limited 2019)
– Draft Alcoa Mining and Management Program 2020-2024 Inclusive, Huntly and Willowdale Mines, Western Australia Mining Operations, December 2019 (2019)
– Huntly Mine Operations 10 Year Mine Plan 2019-2028 (1st edition May 2019)
– The following data have also been reviewed within the Mine DE and wider region:
– Data relating to sensitive environmental receptors, such as wetlands, threatened flora and fauna from published reports and Government of Western Australia databases
– Water monitoring data, including quality, levels, flows, and abstraction rates from Alcoa database and DWER Water Information Reporting and Water Register databases.
– Spatial and temporal data, including topography, drainage, vegetation, land use from Government of Western Australia databases.

A summary of the findings of key studies is chronicled in section 3.5, along with their gaps and limitations with respect to the proposed mining areas.

2.2 Baseline surface and groundwater monitoring program

A baseline monitoring program commenced in August 2020 to characterise current baseline surface water and groundwater conditions of the Myara North and Holyoake mine regions. The monitoring program was built on previous Alcoa and DWER monitoring data and designed to be commensurate with the key risks associated with existing and proposed activity.

The Alcoa Huntly Mine – Myara North and Holyoake Regions Baseline Hydrology Monitoring Program and Sampling Analysis and Quality Plan (SAQP) (GHD 2020a) documents the development of the baseline monitoring program, the sampling program and analytical work for the collection and validation of field data.

The scope of the baseline surface water and groundwater monitoring program included:

– Monitoring short-term, baseline surface water and groundwater conditions from August 2020 to February 2021
  - Surface water levels and quality
  - Groundwater levels and quality
– Installation of surface water monitoring instruments at six (6) locations within the Myara North DE and three (3) locations within the Holyoake DE.
– Installation of 18 groundwater monitoring wells at Myara North and 17 at Holyoake.

The monitoring locations were selected to establish baseline conditions, regarding historical and existing monitoring locations, and with selected reference locations using existing groundwater monitoring bores.

A summary of the 2020 baseline monitoring results (August 2020 to February 2021) is presented in section 5 for Myara North and section 6 for Holyoake.

Detail of the baseline monitoring program is provided in the following supporting technical reports:

– GHD (2020b) Pinjarra Alumina Refinery Revised Proposal –Surface Water and Groundwater Monitoring: Installation Report (Appendix B)
– GHD (2021a) Pinjarra Alumina Refinery Revised Proposal – Baseline Surface Water and Groundwater Monitoring Report (Appendix B)

2.3 Model development

Numerical modelling was completed to:

– Estimate changes to the watertable due to mining and rehabilitation, to inform the potential Groundwater Dependent Ecosystem (GDE) impact assessment.
– Estimate changes in surface flows due to mining and rehabilitation.
– Evaluate those changes in a model uncertainty framework for risk analysis.

Conceptual model development informed model build, simulation, and calibration, and is detailed in Appendix C.

The catchment-scale hydrological system responds to natural variability in climate, with spatial differences in response controlled by the topography, recharge and discharge mechanisms, and the variability in the subsurface material properties. The hydrological response in the study area is to be further affected by the effects of progressive clearing, mining, and rehabilitation. The combined effects of these spatially and temporally varying stressors result in hydrological responses that can be complex and highly variable.

While replicating such complex behaviour with a high degree of accuracy is often not feasible, the modelling provides an important mechanism for closely examining the cause-effect relationship observed in the field data. For example, the incremental effects of mining can be easily discerned from the natural variability simulated by the model. Where this is supported by data, the numerical modelling can provide a sensible basis for projecting

potential impacts of future mining activities. The goal of numerical modelling is to simulate the overall system behaviour and incremental effects of mining, using the data collected over a period of several decades and knowledge gained from relevant prior studies.

The broad approach to the modelling is centred around assimilation of as much data of relevance to the required predictions of interest as is possible. This is implemented in a framework that recognises model input and process representation uncertainties, in such a way that they are carried through to their effects on model predictions.

Detail of the numerical modelling is provided in the following supporting technical reports:

– GHD (2021b) Pinjarra Alumina Refinery Revised Proposal; Hydrological Setting and Understanding Report – Myara North and Holyoake (Appendix C)
– GHD (2021c) Pinjarra Alumina Refinery Revised Proposal; Groundwater Modelling Report for Huntly Mine Myara North (Appendix D)
– GHD (2021d) Pinjarra Alumina Refinery Revised Proposal; Groundwater Modelling Report for Huntly Mine Myara North – Holyoake (Appendix E)

2.4 Drinking water risk assessment

A Drinking Water Risk Assessment (DWRA) has been prepared in accordance with the Australian Drinking Water Guidelines (ADWG), the Health Based Targets Manual (WSAA, 2020), and other contemporary guidance. The DWRA:

– Identifies biological, chemical, and physical agents that have the potential to cause harm;
– Identifies hazardous events that can lead to the presence of a hazard;
– Estimates the likelihood and consequence of the hazardous event occurring and causing harm; and
– Estimates the level of risk after consideration of typical preventive measures.

The risk assessment identified the following unmitigated risks:

– Very High
  - Nil.
– High
  - Staff member with asymptomatic cryptosporidiosis in Pipehead Dam catchment area defecates in gully or riparian zone, followed by heavy rainfall.
  - Staff member with asymptomatic cryptosporidiosis in Serpentine or South Dandalup Dam catchment area defecates in gully or riparian zone, followed by heavy rainfall.
  - Mining-related inputs in reservoir results in 5 NTU or greater turbidity of source waters

With barriers and preventative measures, all residual risks are classified as Medium risk or lower. Details of the drinking water risk assessment is provided in the following supporting technical report:

– GHD (2021e) Drinking Water Risk Assessment; Serpentine, Serpentine Pipehead, South Dandalup and Wungong Brook Catchments (Appendix F).

2.5 Associated technical studies

This report draws upon a number of associated technical studies completed to establish the baseline environmental values of the Myara North and Holyoake mine regions. These technical studies are listed below and referred to where relevant within the current report:

– GHD (2021f) Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine – Myara North.
– GHD (2021g) Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine – Holyoake.
– Mattiske (2021a) Detailed Flora and Vegetation Survey for Huntly Mine – Myara North.
– Mattiske (2021b) Detailed Flora and Vegetation Survey for Huntly Mine – Holyoake.
– WRM (2021) Aquatic Fauna Desktop Assessment – Myara North and Holyoake Regions.

3. Project site setting

3.1 Project locations and overview

This surface water and groundwater study relates to the transition of mining and associated infrastructure to Alcoa's proposed Myara North DE and Holyoake DE, within the overall Huntly mining region. (Appendix A, Figure A 1). The location of the Myara North DE and Holyoake DE are presented in Appendix A, Figure A 2 and Figure A 3.

The proposed Myara North DE comprises approximately 17,449 ha and lies north of the existing Myara mine region. The Myara North DE is bounded by Serpentine National Park to the west, Serpentine Dam to the south, Monadnocks Conservation Park to the east, and the former Jarrahdale Mine to the north.

The Myara North DE is predominantly zoned as State Forest, which is managed for multiple uses including drinking water production, timber harvesting, pine plantation and recreation. The Myara North DE also features a small number of private properties used for residential and small-scale agriculture. Alcoa mined in this vicinity, near Jarrahdale, from 1963 to 1998.

The Holyoake DE comprises approximately 9,158 ha and lies south of the former McCoy mine region, which retains operating mine facilities. The Holyoake DE is bound by Lake Banksiadale (South Dandalup Dam) to the north-west and Pinjarra-Williams Road immediately to the south (Appendix A, Figure A 3).

The Holyoake DE is predominantly zoned as State Forest, which is managed for multiple uses including drinking water production, timber harvesting and recreation. Construction in Myara North DE is scheduled to occur from approximately 2023, with operations taking place from 2025 to 2030. The transition to Holyoake DE is scheduled to commence around 2030, post construction activities.

Conveyors and/or haul roads will be extended from existing infrastructure into each Mine DE to new mine facilities.

3.2 Overview of the bauxite mining process

Alcoa's bauxite mining process involves:

- Pre-mining environmental and heritage surveys.
- Exploration drilling (120 m or 60 m grid, subsequently refined to 30 m and 15 m grids) to identify ore bodies suitable for mining.
- Salvage of timber by the Forest Products Commission.
- Vegetation clearing.
- Topsoil and overburden are removed and stockpiled separately for re-use later or immediate re-use on an area undergoing rehabilitation.
- Caprock is broken by drilling and blasting, and in some areas by bulldozers.
- Drainage protection shots are established at the toe of each pit to capture runoff and sediment from the mine pit, where required.
- Mining of bauxite, haul road transport and associated crushing and conveying to the refineries.
- Rehabilitation to jarrah forest by regrading and contouring of pits to be compatible with the surrounding terrain, and ripping is undertaken up to 1.5 m depth to remove compaction.
- After replacing the topsoil and overburden in sequence, the area is ripped again up to 0.8 m to prepare for seeding and to facilitate infiltration and reduce erosion.
- Seeding and planting of nursery raised seedlings and fertilising

Bauxite is found in the form of tabular ore bodies averaging 4 to 5 m thick and in aerial extent varying from approximately 0.5 to 150 hectares (ha). Mining of bauxite is characterised by a mosaic of shallow and widespread mine voids linked to a centrally-located crusher by a network of haul roads.

The top soil and overburden vary in depth from 0 to 1.5 m, with the underlying bauxite ore consisting of 1 to 4 m of friable material and, in some cases, a cemented layer or duricrust.

Mine clearing is integrated with forest harvesting through Alcoa's working arrangements with the Forest Products Commission (FPC), along with other third parties, to maximise wood residue re-use practices. Alcoa completes removal of forest residue through burning, scraping and excavation.

After mining, the area is rehabilitated with the intention of restoring a functioning jarrah forest ecosystem that can support pre-mining land uses. Approximately up to 10 years are considered for the process of vegetation re-establishment and return to pre-mining hydrological trends. Around 40 to 50 different plant species are planted as seeds sourced from the surrounding forest within defined provenance zones or from nursery-raised recalcitrant plants.

3.3 Potential effects of bauxite mining on hydrological systems

Bauxite mining activities have the potential to cause increased rainfall recharge to groundwater given the reduced or removed evapotranspiration (vegetation removal) and increased soil disturbance (relative increase in soil surface area and possible increase in permeability).

During this process, bauxite mining typically causes a rise in groundwater levels and changes surface water quantity and potentially quality. This may affect environmental receptors including potential GDEs comprising swamps, wetlands, springs and rivers and creeks, the ecology of which may be sensitive to changes in groundwater levels, changes in water flows volumes / flow regime and salinity.

The groundwater level rise may also mobilise salts present in the unsaturated zone into the groundwater flow systems which could discharge into creeks or other surface water features in the area.

Given reduced evapotranspiration and increased infiltration, bauxite mining has been recognised as potentially causing a site based or off-site based rise in groundwater levels that may have the following effects:

– Waterlogging of surface soils causing salt build-up in soils through increased evaporation
– Waterlogging or saturation of dispersive soils – causing increase erosion and sediment load to rivers and creeks
– Waterlogging or saturation of dieback risk areas and vegetation/root systems – causing an increased risk of dieback transmission and stress to vegetation
– Mobilisations of salts, where stored within the soil profile
– Changes in volumes of groundwater discharge into rivers and creeks – causing alteration to flow regime
– Changes in streamflow salinity due to changing proportion of groundwater discharge
– Changes in quality of groundwater – change in groundwater salinity may cause stress to groundwater dependent vegetation

These above changes to the groundwater flow regime and quality have potential to impact the following receptors where confirmed as present within the areas potentially effected by mining,

– Riparian vegetation
– Potential GDEs
– Streams to which groundwater is discharging
– Aquatic fauna and flora
– Drinking water quality and irrigation/stock water use.

Following successful rehabilitation and establishment of pre-mining conditions, rainfall recharge and groundwater levels previously raised during mining should reduce and return to pre-mining conditions, which is anticipated to occur over decadal timeframes.

3.4 Mining Management Program Liaison Group

All Alcoa mining operations are currently conducted under the supervision of the Mining Management Planning Liaison Group (MMPLG), which oversees aspects of mining and rehabilitation that occur within ML1SA. The MMPLG was established in 1979.

Prior to the MMPLG, the Steering Committee on Research into the Effects of Bauxite Mining on the Water Resources of the Darling Range was established in 1973 to research effects on water resources and provide advice to a Bauxite Policy Committee (Croton et al. 2011).

The MMPLG comprises representatives from appropriate State Government departments and agencies whose areas of responsibility are associated with Alcoa's operations, including the Department of Jobs, Tourism, Science and Innovation (JTSI), Department of Biodiversity, Conservation and Attractions (DBCA), Department of Mines, Industry Regulation and Safety (DMIRS), Department of Water and Environmental Regulation (DWER) and the Water Corporation.

The MMPLG has two subcommittees:

– Mining Operations Group (MOG), which oversees and reports to the MMPLG regarding environmental and community issues of its operations; and
– CAR Informal Reserves Evaluation Committee (CARIREC), which evaluates planned incursions into Comprehensive, Adequate, and Representative (CAR) Informal Reserves.

The MMPLG receives rolling 5 Year Mining and Management Plans (MMPs) from Alcoa on an annual basis for review.

3.5 Previous studies

Alcoa has undertaken and supported research to assess the potential impacts of its mining activities on water resources and the environment since the 1970s. A number of studies were completed in association with the former Water and Rivers Commission as part of the Joint Intermediate Rainfall Zone Research Program, and overseen by the Bauxite Hydrology Committee, a former subcommittee of the MMPLG.

A summary of the findings of this research and other key studies is chronicled in Table 3-1 along with gaps and limitations with respect to the proposed mining areas.

The research has had a significant focus in understanding the relationship between rainfall, runoff, groundwater levels, and salinity in the region with respect to mining and other land uses.

Table 3-1 Technical documents reviewed

Title	Key features	Findings	Gaps/limitations/comments
Hydrology			
(Ruprecht & Stoneman, 1993 (Bari & Ruprecht, Water yield response to land use change in south-west Western Australia, 2003 (Croton & Reed, 2007	Mining in public drinking water catchments	Mining initially caused increases in stream flow, followed by a return to pre-mining levels or below after rehabilitation.	
Hydrological Response of the O'Neil to McCoy Mining Area (Water & Environmental Consultants, 2013	Six year GW/SW/salinity monitoring Mining in public drinking water catchment and control catchment Some mining areas within IRZ	Mining-related stream-salinity response observed, albeit much less than had previously been modelled.	Given mining-related stream-salinity response observed, there may be cumulative impacts from other areas in Myara yet to be mined or rehabilitated within Serpentine catchment.
Review of the Trial Mining Project (Water & Environmental Consultants, 2011 (Water & Environmental Consultants, 2013	10 year GW/SW/salinity monitoring in IRZ Mined catchments compared to control catchments	Experimental catchments in IRZ dominated by below-average rainfall conditions since 1974, with groundwater recharge processes essentially at zero or reducing. Streamflow and stream-salinity records not attributed to mining. Little to no potential for significant streamflow or stream-salinity response in experimental catchments to mining as long as below-average rainfalls continue.	
Hydrological response to bauxite mining and rehabilitation in the jarrah forest in south west Australia (Grigg, Hydrological response to bauxite mining and rehabilitation in the, 2017	36-year monitoring period Mined, thinned, control catchments compared	Mining caused peak streamflow response of 225 mm or 18% rainfall, returned to pre-disturbance levels 11 years after mining commenced. Changes in groundwater level related to rainfall and LAI, indistinguishable between rehabilitated and unmined areas. Mining could not be distinguished from thinning, clearing or clear-felling. No shallow-subsurface flow processes beyond valley floor and immediately adjacent slopes. Catchment disconnection observed such that paired catchment approach may be ineffective for future forecasts.	Localised impacts of short-term events (significant storm events) immediately after clearing.
A standardised Landsat time series (1973–2016) of forest leaf area index using pseudoinvariant features and	Remotely sensed imagery from Landsat dating back to 1972	Standardised time series of LAI was developed that could inform future hydrological modelling in the area, as previous modelling has typically	Potential for application of LAI time series in new models in the area.

Title	Key features	Findings	Gaps/limitations/comments
spectral vegetation index isolines and a catchment hydrology application (McFarlane, Grigg, & Daws, 2017		been based on rainfall only. For long-term annual average rainfall of 1,200 mm their model predicts zero streamflow when catchment average LAI reaches 2.	
On the contribution of groundwater to streamflow in laterite catchments of the Darling Range, south-western Australia (Grigg and Kinal 2020)	Estimation of baseflow proportion to streamflows. Groundwater contributions to streamflows	Groundwater contributions to streamflows have a large variability. Contributions from quickflow components vary primarily linearly with annual rainfall.	Applied to catchments outside of MDEs, however the approach is applicable to MN and HO MDEs.
Nonstationarity driven by multidecadal change in catchment groundwater storage: A test of modifications to a common rainfall–run-off model (Grigg & Hughes, Nonstationarity driven by multidecadal change in catchment groundwater storage: A test of modifications to a common rainfall-run-off model, 2018	GR8J Model 21,000 individual groundwater records 40 year dataset Model incorporates “catchment memory”	Improved rainfall-runoff model	Not applied to proposed mining areas
Salinity			
Environmental Research Bulletin No. 16. Salt Storage in the Bauxitic Laterite Region of the Darling Range, Western Australia (Slessar, Murray, & Passchier, 1983	327 bores drilled in Darling Range	Darling Range exhibits low soil salt storage west of 1,100 mm isohyet (0.16±0.15 kg/m^3) Near-exponential increase in soil salt content with distance inland (0.79 ± 0.84 kg/m^3)	Limited resolution within proposed mining areas, and in close proximity east of 1,100 mm isohyet
Environmental Research Bulletin No. 22. Estimation of Soil Salinities East of the Huntly Mine, Darling Range, WA (Tsykin, 1989	70 bores drilled east of Huntly mine (south-east of Myara North), predominantly in IRZ Soil salt content estimated in grid-cells based on rainfall, terrain type, vegetation “greenness” and position in landscape.	High rainfall areas had low soil salt contents (<0.4 kg/m^3), lower rainfall areas had high salt contents.	Limited resolution within proposed mining areas
Hydrology and Bauxite Mining on the Darling Plateau (Croton & Reed, 2007	Literature review	Under current rainfall regimes, it is unlikely that there will be a significant salinity response due to Alcoa’s mining, but it is inadvisable to discount the salinity issue in the lower rainfall zone, and research will need to consider the possibility of further climate change.	Water quality issues only discuss salinity. Myara North has specific setting in a drinking water catchment and would require assessment beyond salinity.

Title	Key features	Findings	Gaps/limitations/comments
Salinity Risk Assessment for the O'Neil to McCoy Mining Area (Water & Environmental Consultants, 2010	Mining in public drinking water catchment Application of a simple (unknown) groundwater flow model (data from 1970 to 2007) Application of salinity risk methodology	Stream salinities below average for the period of low rainfall post 1999, likely driven by falling groundwater levels. Modelling concluded that there will be streamflow, stream salt-load and stream salinity increases due to the mining of O'Neil to McCoy.	Unspecified groundwater model. Limited information on the model and its spatial domain.
Modelling long-term flow and salinity response to bauxite mining in the upper Serpentine catchment (DWER, 2019	Mining/rehab in dam catchment LUCICAT SW/salinity modelling	Regardless of mining case or future climate, change in inflows due to mining was <~2 GL/year, or five per cent of flow on an annual average basis. Effects on reservoir salinity of mining within Upper Serpentine were within acceptable limits (within 3% of no-mining case).	Dynamics of simulated groundwater levels in context of strong drought years not well understood in model (flows in these instances are overestimated). Model is suited to large catchment areas, however, the proposal area includes one large catchment (Upper Serpentine), and two smaller separate catchment areas (Lower Serpentine, and Wungong Brook). Model data is 10 years old. Landsat LAI data from 1963 to 1972 is linearly extrapolated. Short term impacts are either not captured by the model, or not described in the report.

4. Regional setting

This section provides a summary of the desktop assessment of the regional and groundwater and surface water systems of the Mine DE. It includes a summary of the Aquatic Fauna Desktop Assessment completed for the Mine DE.

4.1 Climate

Western Australia's south west region has a 'Mediterranean' type climate characterised by typically high winter rainfalls and an intense summer drought. A summary of the nearest Bureau of Meteorology (BoM) to the Mine DE is provided in Table 4-1.

Table 4-1 Summary of nearest BoM climate stations

BoM Station	Station number	Distance from Mine DE	Data range
Serpentine Main Dam Station	009115	Within Myara North DE	1963 to 2016 Rainfall
Karnet Station	009111	4 km south of Myara North DE, 47 km north of Holyoake DE	1963 to 2021 Rainfall, evaporation and solar radiation data
Dwellingup Station	009538	7 km from Holyoake DE	1935 to 2021 Rainfall, evaporation and solar radiation data

Given the proximity of the three stations, this review presents data from Karnet Station as representative of both the Myara North DE and Holyoake DE. Monthly statistics for the site since its inception are shown in Figure 4-1, and SILO[1] point data was extracted annual rainfall plotted in Figure 4-2. Dwellingup rainfall data has been used for site-specific comparison for Holyoake DE surface water and groundwater datasets.

The mean monthly maximum temperature ranges from 15.8°C in July to 30.9°C in January. Average annual evaporation (1,520 mm) typically exceeds average annual rainfall (1153 mm), albeit rainfall exceeds evaporation during winter and shouldering months.

Western Australia's south west region has undergone a 15 to 20% reduction in rainfall since the 1970s, as illustrated in Figure 4-2. This trend has been forecast to continue with a further 2% to 14% reduction predicted by 2030. Temperature increase and potential evapotranspiration are also forecast to increase by 0.7°C and 2 to 3%, respectively (CSIRO, 2009; DoW, 2015.

Rainfall is also known to decline with distance inland. Historical rainfall isohyets including the 1,100 mm annual rainfall isohyet (referred to as the High Rainfall Zone or HRZ) and the historical 900 to 1,100 mm annual rainfall isohyet (referred to as the Intermediate Rainfall Zone or IRZ) have been identified in research as defining features for differing hydrological effects across the Huntly Mine.

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

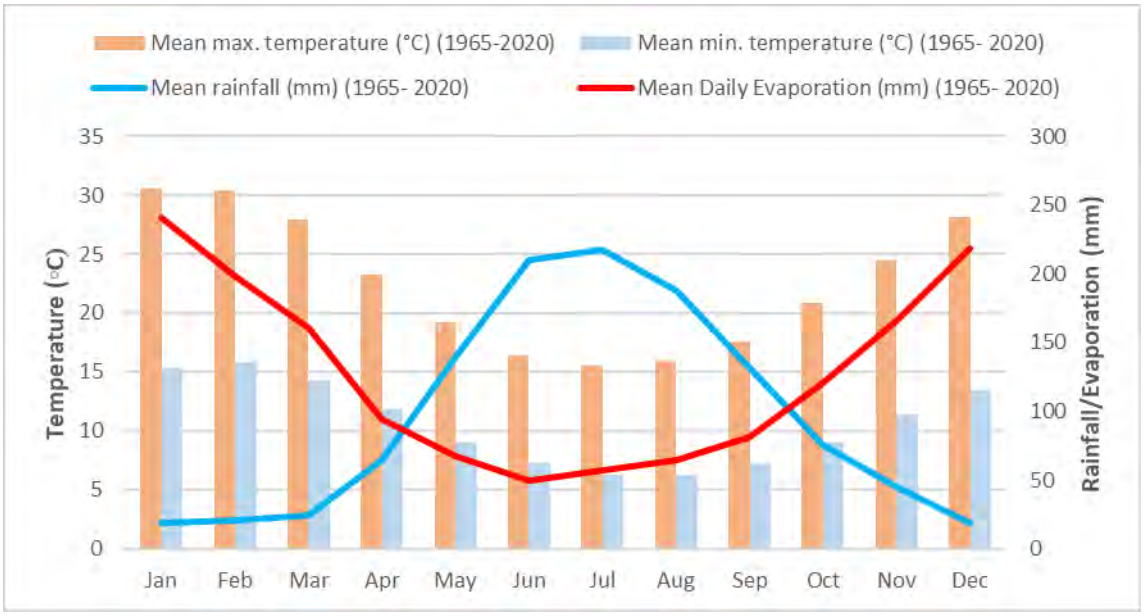


Figure 4-1 Monthly climate statistics at Karnet Station (1965 to 2020)

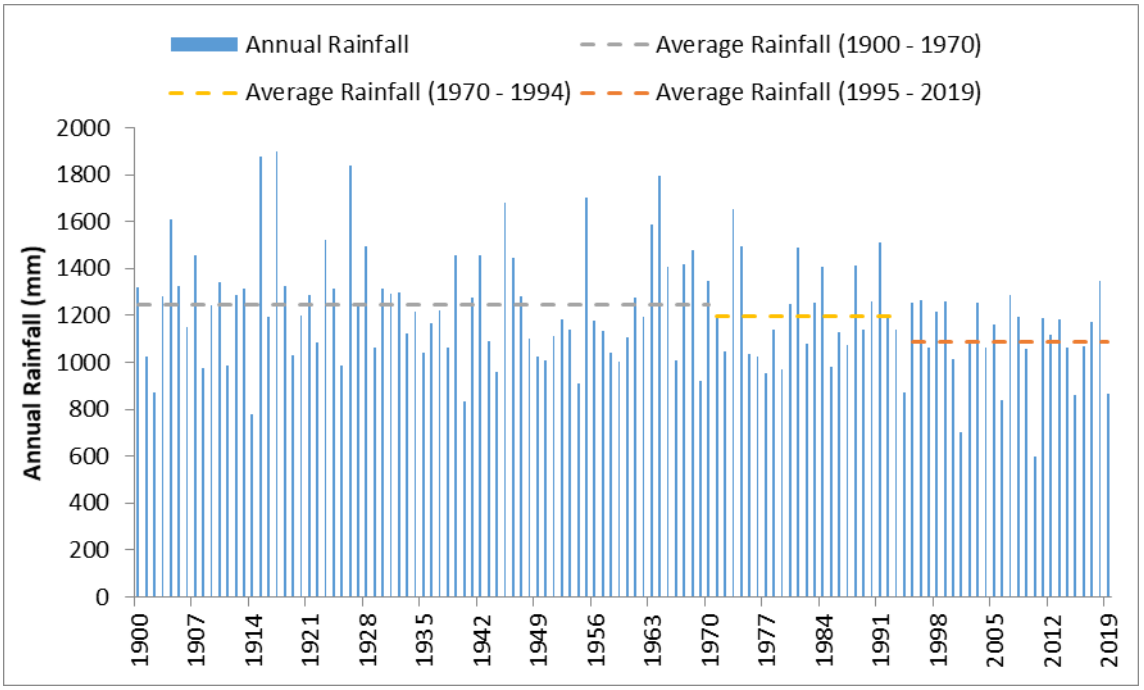


Figure 4-2 Annual rainfall at Karnet Station

4.2 Landforms and topography

The Huntly Mine is situated within the Darling Plateau, at 240 m AHD to 370 m AHD. The area is characterised by lateritic profiles (>30 m depth), formed from the in-situ weathering of basement rock. The laterite surface is undulating, dissected by streams and extending through a zone of variable thickness to weathered bedrock.

Landforms have been described by Churchward and McArthur (1980) and mapped as part of vegetation complexes of the South West forest region (Mattiske and Havel 1998). Table 4-2 presents the landform descriptions and mapped extent over the Myara North and Holyoake DEs.

Table 4-2 Soil landscape mapping in the Mine Development Envelope

Landform name	Landform Description	Myara North DE (ha)	Holyoake DE (ha)	Proportion of current extent in Mine DE (%)
Cooke	Hills rising above general plateau level; mainly mantled by laterite but with some rock outcrop	435	69	1.9
Dwellingup	Gently undulating landscape with duricrust on ridges; sands and gravels in shallow depressions	7,711	5,449	49.5
Goonaping	Shallow upland valleys with grey sands and some swamps	212	0	0.8
Murray	Deeply incised valleys with red and yellow earths on slopes; narrow alluvial terraces.	1,732	28	6.6
Pindalup	Valleys of the central part of the plateau; gravelly duplex soils on slopes; some rock outcrop; grey sands, duplex yellow soils and orange earths in broad floors.	33	0	0.1
Swamp	Depressions and swamps on uplands		68	0.3
Yarragil	Valleys of the western part of the plateau; sandy gravels on the slopes; orange earths in swampy floors.	7,322	3,544	40.8
Total		**17,446**	**9,157**	

As presented in Table 4-2, the landforms over the Myara North DE are predominantly Dwellingup lateritic uplands interspersed by Yarragil minor valleys with swampy floors. Murray landform major valleys occur along the Serpentine River on the southern boundary of the region. Goonaping sandy upland valley occurs in a shallow depression in the headwaters of Honour Brook north of Jack Rocks. Cooke upland hills and rock outcrops occur as pockets along the eastern portion of the region.

The landforms over the Holyoake DE are less diverse than in the Myara North DE and comprise almost totally (99%) Dwellingup lateritic upland and Yarragil minor valley landforms. A small area of Cooke upland hills occurs at Inglehope and a small area of Murray major valley in the headwaters of the Murray River on the southern boundary.

4.3 Regional geology

The Myara North and Holyoake DEs are located in the Yilgarn Craton, a predominantly granitic geological terrain. The regional geology of the area has been mapped by the Geological Survey of Western Australia (GSWA) and is presented in Appendix A, Figure A 4.

The bedrock outcrops over less than 10% of the region, as there is an extensive layer of Cainozoic laterite developed. A typical lateritic profile in the Darling Range is distinctly zoned. The laterite has been derived from the weathering of parent rock and consists of a ferruginous or aluminous hard cap layer which overlies a pallid, and often mottled kaolinitic zone of varied thickness (saprolite). The transition zone between the fresh rock and saprolite is referred to as saprock.

The laterite layer includes the bauxite resources which are proposed to be mined. Bauxitisation has been especially pronounced along the flanks and tops of ridges. The lateritic (bauxite) horizon is on average 2 to 3 m thick for granite-derived bauxite.

The younger-age tholeiitic quartz dolerite dykes intrude the Precambrian basement. The dykes are generally 10 m thick although the width can vary widely. These dykes generally follow east-west to northwest to southeast directions.

Observations of outcrops along the railway cutting near Jarrahdale suggest significant differences between the profile developed over metagranites and dolerites. These are related to the dominance or preservation of quartz in the profile developed over the metagranite whereas it is almost totally absent from the profile developed over the dolerite.

4.4 Hydrogeology

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

The understanding of the generalised hydrogeology of the Myara North DE and Holyoake DE comprises the following main aquifer units:

– Shallow weathered zone aquifer: comprising lateritic caprock and shallow gravely to sandy sediments with represents a seasonal aquifer with significant storage, infiltration and flow capability
– Deep weathered zone aquifer (lower saprolite), an aquifer of some storage potential, but limited bulk permeability (comprising clays). The clayey nature of this zone can be interspersed by macropore features developed along deep root systems which were subsequently filled with more clastic material
– Transition zone between the fresh basement and saprolite, referred to as saprock, which typically has enhanced permeability
– Fractured bedrock aquifer, permeability and yields are dependent on facture development and connectivity of the fractures.

Groundwater has been an active part of lateritisation process, particularly in development of cemented ferruginous hardcap (duricrust) often seen on the surface. Formation of duricrust has been driven by groundwater flow and capillary action which lead to precipitation of iron minerals leached from the weathered bedrock. Duricrust can also form in valley floors due to accumulation of iron brought by groundwater flow and its precipitation due to evapotranspiration or exposure to the surface.

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

Broadly, groundwater levels within all aquifers appear to follow the topography, such that groundwater level is highest in areas of highest topography and lowest in areas of lowest topography. Where groundwater levels intersect the base of the creek groundwater discharges provide baseflow following the winter rains (topped up aquifer storage and groundwater levels).

Given that topographical slopes reflect the groundwater gradient, the groundwater of the Myara North DE and the Holyoake DE is inferred as discharging into low lying creek lines when groundwater is in connection to the stream zone. These creek lines feed into, and discharge into the Serpentine Dam in the Myara North DE. The Myara North DE also includes several smaller catchments in the far north where the discharge is to the north towards the Wungong Dam, Gooralong Brook and some minor tributaries that drain towards the Pipehead Dam.

In the Holyoake DE, groundwater predominantly discharges towards the South Dandalup Dam. In the far south of the Holyoake DE, the catchments drain to the south of the South Dandalup Dam and towards the Murray River.

Previous work from the Darling Range catchments suggested that groundwater was a minor contributor to streamflows (e.g., Bari and Ruprecht, 2003, and others). This has been recently disputed (e.g., Grigg and Kinal, 2020). It was shown that groundwater contribution, as baseflow component of streamflows, varies within a wide range, and it includes years in which groundwater is the dominant proportion of streamflows (shown in tested Lemon, Wights and Yarragil 4X catchments).

4.5 Soils

The Huntly Mine (including proposed Myara North and Holyoake DEs) lies within the Darling Plateau, an undulating lateritic plateau. Soils have developed over the granitic terrain in a typical laterite profile with sand and gravelly topsoils which transition into a saprolite zone of weathering.

Soils typically comprise gravels, sands and loams including a discontinuous cemented layer or duricrust mostly in mid- to upper-slopes, merging with underlying mottled and pallid clays of the saprolite zone. Coarse gravels can be found on the upper slopes, trending to finer gravels downslope and sands near the valley floor, dominated by loams and clay loams (Churchwood and Dimmock, 1989), (Figure 4-3).

Of hydrological significance, root channels penetrating vertically via fissures and discontinuities in the cemented layer and deep into the clay zones are a consistent feature in the lateritic profiles. These channels form preferential flow paths and are understood to form significant vertical fluxes into groundwater systems (Grigg, 2017; McFarlane and Williamson, 2002; Turner et el. 1987).

The ‘dry flats’ and ‘wet flats’ are broadly consistent with alluvial deposits, developed along major drainage lines and creeks which may contain finer fraction especially in their downstream sections. The ‘dry flat’ term includes both the edge of the valley floor and permanently dry’ slightly elevated part of the flat. The ‘wet flat’ is the part of the valley floor which is waterlogged during winter. The soil profile is sometimes missing along the deeply incised drainage lines or at elevated highs which are often the granite outcrops.

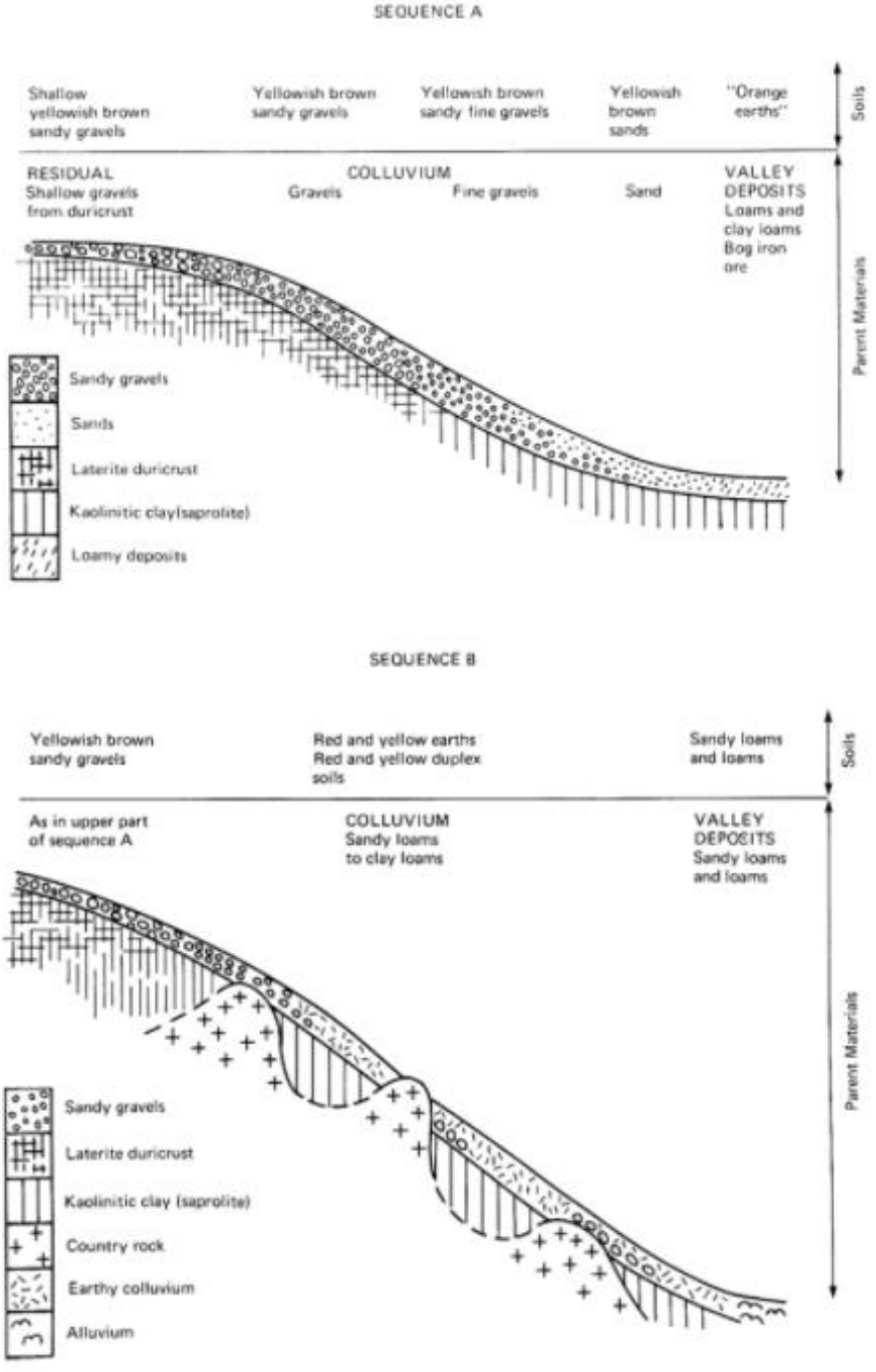


Fig. 2. **Schematic presentation of common soil/slope sequences for the northern jarrah forest ecosystem, south-western Australia. Sequence A associated with the shallow valleys of the plateau; sequence B associated with deep valleys.**

Figure 4-3 Typical textural changes in soils along the slopes (after Churchward and Dimmock, 1989)

4.6 Surface water hydrology

The Darling Plateau is characterised by sharply incised drainage lines forming dense drainage networks in the western, higher rainfall zone (HRZ), with these transitioning to open, flat-floored valleys in the eastern, intermediate rainfall zone (IRZ).

Some of the larger streams in the HRZ have previously exhibited perennial baseflows (Reed et al. 2012). However, the drying climate discussed in section 4.1 has caused a significant reduction in streamflow, leading to a shift from perennial to ephemeral streams and a decline in the runoff coefficient in recent decades. These declines have been observed as a step-change response to below-average rainfall years (Petrone, Hughes, Van Niel, & Silberstein, 2010; Hughes, Petrone, & Silberstein, 2012. For the Upper Serpentine catchment, a further decline in streamflow of 24% has been forecast by 2030, compared to the historical (1997-2007) average streamflow (Silberstein, et al., .

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

4.6.1 Myara North mine region surface watercourses

The Myara North DE lies predominantly within the Serpentine River catchment and lies adjacent to the Serpentine River and Serpentine Dam and Pipehead Dam Reservoirs (Appendix A, Figure A 5). The Serpentine River, originates to the east of the Myara North mine region, flowing north-west along the southern boundary towards the Serpentine Dam. Drainage floors occur in areas of alluvial deposits along the Serpentine River and tributaries and form ephemeral waterlogged damplands during the winter and spring.

The Myara North mine region comprises three dominant catchment areas:

– The majority of the Myara North mine region (129 km^2 or 74%) lies within the Serpentine Dam catchment area, including the main tributaries 39 Mile Brook, Banksia Gully and Goldmine Gully. The Serpentine River runs adjacent the southern boundary of the Myara North mine region. Linear hydrographic mapping of the Myara North mine region identifies a further eight tributaries that are second order streams and above, and a further twelve first order tributaries that discharge directly into the Serpentine River and Serpentine Dam.
– The north western portion of the Myara North mine region (25 km^2, 14%) is drained by Gooralong Brook flows west through Jarrahdale townsite then south-west through Serpentine National Park and discharges into the Serpentine River approximately 5.5 km downstream of the Serpentine Pipehead Dam.
– The northern portion of the Myara North mine region (21 km^2, 12%) includes the Chandler Road sub-catchment and Cobiac sub-catchments which flows in a north and north-westerly direction, converging as the Wungong Brook. Wungong Brook flows north-west through State Forest, including the former Jarrahdale Mine (operating 1963 to 1998), and discharges into the Wungong Reservoir.

4.6.2 Holyoake mine region surface watercourses

The Holyoake mine region lies predominantly within the South Dandalup River catchment (Appendix A, Figure A 6). The South Dandalup River has multiple tributaries that contribute flows that originate from within and outside the Holyoake mine region.

The Holyoake mine region comprises two dominant catchment areas:

– The majority of the Holyoake mine region (67 km^2 or 66%) lies within the South Dandalup Dam catchment. This part of the Holyoake mine region drains either into the main tributary of South Dandalup River or one of four of its tributaries. The South Dandalup Dam catchment extends well beyond the Holyoake boundary.
– The south-western portion of the Holyoake mine region (34 km^2, or 34%) drains south to the Murray River catchment, in one of two tributaries, Davis Brook and Swamp Oak Brook.

4.7 Public drinking water supply reservoirs

The Myara North and Holyoake mine regions intersect the catchment areas of public drinking water supply reservoirs, including:

– Serpentine Dam and Serpentine Pipehead Dam (Myara North mine region);
– Wungong Brook Dam (Myara North mine region); and
– South Dandalup Dam (Holyoake mine region).

The south-west extent of the Myara North mine region lies within the Reservoir Protection Zone of the Serpentine Dam and Pipehead Dam reservoirs. Holyoake mine region intersects a smaller portion of the South Dandalup Reservoir Protection Zone in proximity to its central western boundary.

The reservoirs form part of the Water Corporation's Integrated Water Supply System (IWSS) supplying drinking water to the Perth metropolitan region. The reservoirs are managed in accordance with their respective Drinking Water Source Protection Plan.

Figure 4-4 summarises the extent of current approved mine clearing and Proposal mine clearing within major river and reservoir catchment areas. The figure identifies that the current approved mine clearing (Myara) occurs within the Serpentine Dam (Big Brook, Reservoir Tributary and Serpentine River) and Pipehead Dam (Reservoir Tributary) catchment areas.

Within the Myara North mine region, proposed mine clearing will occur within less than 10% of the Gooralong Brook and Wungong Brook catchment areas. Within the Serpentine Dam catchment, proposed mine clearing areas will occur within less than 10% of the Serpentine River and Reservoir Tributaries, and comprise under 20% of the 39 Mile Brook catchment area.

No current mining occurs within the South Dandalup Reservoir catchments (Figure 4-4). Proposal mine clearing areas will comprise less than 10% of the South Dandalup River catchment.

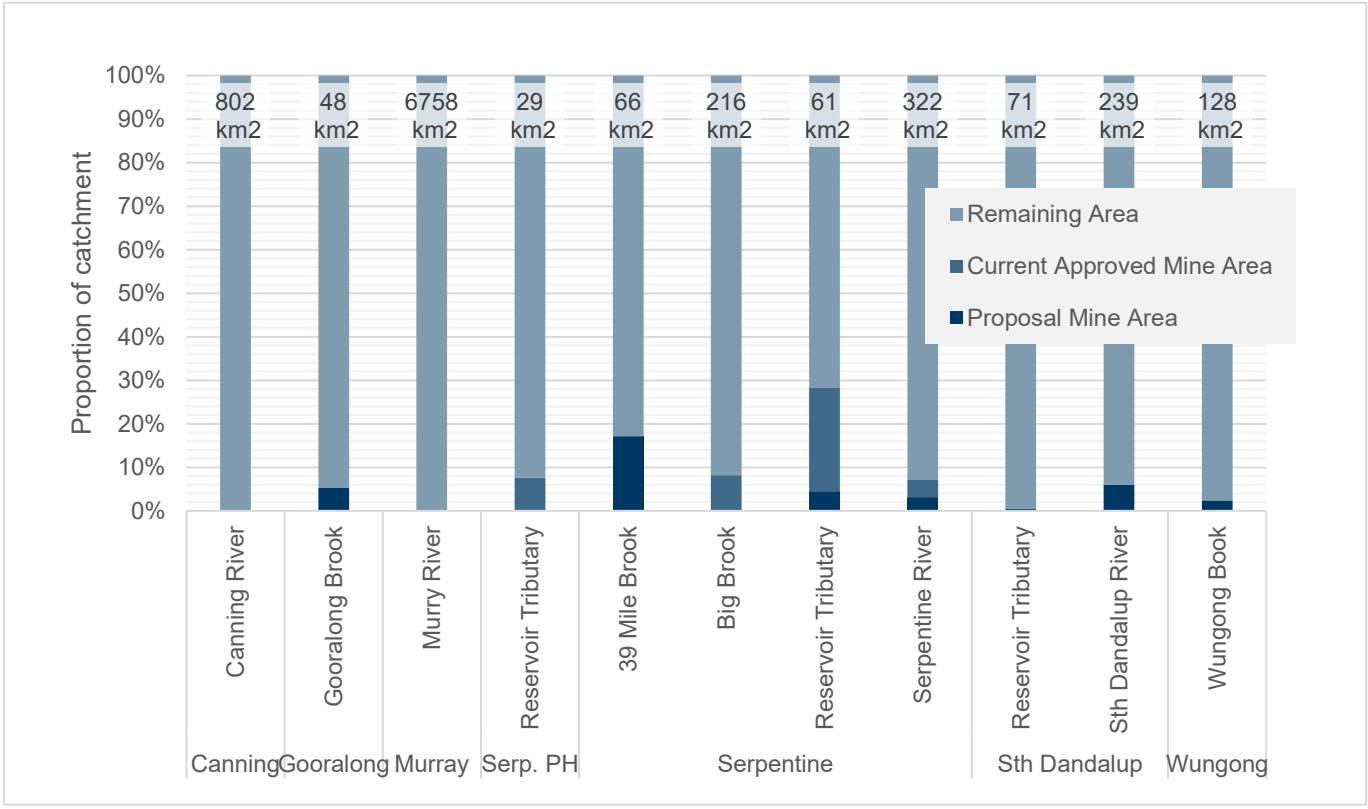


Figure 4-4 Extent of Myara North and Holyoake DE clearing areas within major river and reservoir catchment areas

4.8 Surface water bodies

The Landgate Medium Scale Topo Water Polygon dataset identifies several water bodies within and in proximity to the Myara North mine region (Appendix A, Figure A 5). The largest of these are the Serpentine Dam and Serpentine Pipehead Dam, both perennial reservoirs, which form part of the Water Corporations Integrated Water Supply System (IWSS) supplying drinking water to the Perth metropolitan region.

Non-perennial marshes are mapped as occurring within the mid and upper 39 Mile Brook valley floors, in the mid catchment valley floor of Goldmine Gully and in the unnamed eastern tributaries. A non-perennial swamp is also mapped in the unnamed eastern tributaries.

Within the Holyoake mine region, the largest mapped water body is the South Dandalup Dam (Appendix A, Figure A 6), a perennial reservoir, and part of the Water Corporations IWSS. Other water bodies distributed primarily through the central part of the Holyoake DE are described as non-perennial swamps.

4.9 Mapped wetlands

The Holyoake mine region is located approximately 30 km to the east of the Peel-Yalgorup System which is the closest Ramsar Wetland of International Importance and is also mapped under the Directory of Nationally Important Wetlands.

The Myara North mine region is located approximately 35 km north-east of the Peel Yalgorup System.

The Myara North mine region is located at the eastern extent of the Department of Biodiversity Conservations and Attractions *Geomorphic Wetlands Swan Coastal plain dataset*. The mapping classifies wetlands present within valley floors as palusplain or floodplain flats, and headwater swamps as sump or dampland basins. The geomorphic wetland mapping classifies wetlands as conservation category where they are relatively intact, and resource enhancement where they partially cleared for development.

The north-western portion of the Myara North mine region includes some mapped geomorphic wetlands which are summarised in Table 4-3 and presented in Appendix A, Figure A 5. The wetlands mapped as conservation category reflect the absence of clearing and relatively intact nature.

Unmapped valley floors and swamps that occur within the Myara North mien region and the Holyoake mine region are similarly expected to be of similar environmental values as those classified as conservation category, reflecting the absence of clearing of the wetlands except for occasional roads or access tracks.

Table 4-3 Myara North geomorphic wetland mapping

Management category	Wetland type	UFI number	Myara North DE sub-catchment
Conservation	Palusplain	12,396	Gooralong Brook
Multiple use	Dampland	12,398	Gooralong Brook
Resource enhancement	Palusplain	13,483	Gooralong Brook
Resource enhancement	Palusplain	12,525	Gooralong Brook
Multiple use	Dampland	12,300	Gooralong Brook
Multiple use	Palusplain	12,315	Gooralong Brook
Conservation	Dampland	12,330	Serpentine Pipehead Dam
Conservation	Dampland	12,325	Serpentine Pipehead Dam
Conservation	Dampland	12,312	Serpentine Pipehead Dam
Conservation	Dampland	12,316	Serpentine River
Resource enhancement	Sumpland	12,314	Serpentine River

4.10 Comprehensive Adequate Representative (CAR) Reserves

The Comprehensive Adequate Representative (CAR) Reserves system were a series of reserves delineated as part of the Regional Forest Agreement in 1999. The CAR reserves include a series of formal and informal reserves, the majority of which are identified along streamzones within the Myara North and Holyoake mine regions.

Ephemeral damplands occur within the valley floors of some tributaries (section 4.8), which contain vegetation communities that are distinct from the upland Jarrah forest and providing important habitats for terrestrial fauna. The CAR reserves are also considered to support vegetation communities important to terrestrial fauna.

4.11 Water use and environmental values

The water use and environmental values in the vicinity of the Myara North mine region and the Holyoake mine region were identified through review of existing mapping and published information, site survey of vegetation types and desktop assessment of aquatic fauna ecological values.

The surface water resources in the vicinity of the Myara North mine region and the Holyoake mine region support a wide range of social and environmental values including:

– Drinking water supply – Both existing and proposed Huntly Mine Operations occur within the catchment areas of public drinking water supply reservoirs (section 4.7, Figure 4-4).
– GDE which include terrestrial ecosystems that rely on the subsurface presence of groundwater – This is considered to include riparian and phreatophytic terrestrial vegetation (where depth to groundwater less than 10 m), where vegetation has a seasonal or occasional dependence on groundwater.
– Aquatic ecosystems that rely on surface expression of groundwater which include the surface watercourses that receive groundwater flow, groundwater fed springs and swamps within the study area and their respective biological and environmental values.
– Recreational use including aesthetic values.
– Cultural heritage values – Within the Myara North mine region the Serpentine River is a registered mythological/ethnographic Aboriginal heritage site.

This report includes a brief summary of the environmental values of the Myara North mine region and the Holyoake mine region, with detail of the ecology, drinking water and recreational values provided in the relevant Proposal Environmental Review Document chapter; chapter 5 (flora and vegetation), chapter 6 (terrestrial fauna), chapter 8 (inland waters) and chapter 11 (social surroundings).

5. Myara North hydrological setting

This section summarises the results of the historical surface and groundwater data review, baseline surface and groundwater monitoring program and supporting environmental technical investigations that were completed across the Myara North mine region.

5.1 Hydrogeological characterisation

Alcoa has collected groundwater level and groundwater quality data within the Myara North mine region since the 1970s, with available groundwater data typically concentrated within the eastern areas of the mine region. As part of the baseline monitoring program 18 new groundwater bores were installed at 16 locations within the Myara North mine region, to supplement 25 existing Alcoa groundwater bores (Appendix A, Figure A 7). Two sites included installation of a shallow and deep paired bores, providing data on groundwater for the upper 'perched' unit and the underlying more regional groundwater.

The baseline groundwater monitoring program comprised monthly water level dips and physico-chemical parameter measurements from October 2020, with groundwater samples collected for laboratory analysis of a broader suite of parameters in October 2020 and February 2021.

5.1.1 Aquifer units

Hydrogeological information on the aquifer system units was confirmed from installation and hydraulic testing of groundwater monitoring bores by GHD at Myara North. Data on bore depths and screen interval were reviewed to interpret the lithology profile (i.e. to infer depth to basement rock). A summary of the geological logs is provided below and monitoring bore locations are presented in Appendix A, Figure A 7. Detailed geological logs of GHD bores are presented in GHD (2020b) (Appendix B).

A review of the GHD geological logs indicates a broadly consistent lithology profile was identified across Myara North mine region with a typical weathering profile as follows:

- **Lateritic/ duricrust caprock:** 1 to 4.5 m thick, comprising of minor soils with pea-gravel and cemented duricrust or laterites. Caprock is hard to very hard and often strongly cemented with pisolitic nodules. In valley floors this can be overlain or replaced by relatively thin alluvial sediments.
- **Saprolite**: Highly variable depths from 1 to 29 m thickness, comprising clays derived from weathered basement. Clays are mottled or pallid towards the top becoming less pallid with depth reflecting the weathered bedrock lithology.
- **Weathered basement:** Weathered basement zone is characterised by decreasing clay content, an increasing rock texture/relict features which grades sharply into basement rocks, with a thickness of less than 2 to 4 m. Most active groundwater flow occurs in this zone and was often pressurised.
- **Fractured (fresh) basement**: Depth to fractured basement varies from 6 to 28.5 m below ground level (m BGL) and extended to end of bore hole. Basement rocks were dominantly granite interspersed with a few occurrences of dolerite.

The results of slug testing GHD (2021a) are summarised and presented in Figure 5-1. The monitoring bore slotted intervals were set along water strikes, which were generally identified within the transition zone from weathered bedrock to basement materials.

Figure 5-1 indicates an average hydraulic conductivity (K) of approximately to 0.6 m/day for the transition zone, and the range of hydraulic conductivity is relatively high (<0.05 to 1.2 m/day). The saprolite clays which overlie the transition zone are inferred to be less permeable at less than 0.001 m/day (saprolite clays were not hydraulically tested).

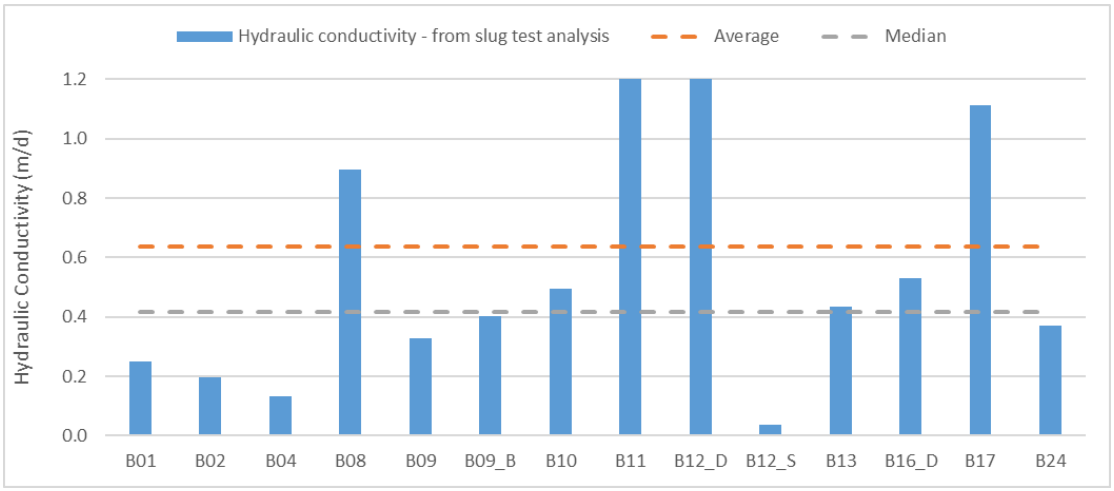


Figure 5-1 Myara North slug test results (hydraulic conductivity)

Alcoa's internal report (Raper and Croton, 1996) provides a regional summary of hydraulic conductivity data which provides information on various horizons of the weathering profile with wider range of K values (0.001 to 16 m/d) dependent on lithological textures and the geomorphological position. The average storativity was stated to be 0.013, with a range of values between 0.0037 to 0.1.

5.1.2 Groundwater levels and flow

Groundwater levels and flow

The groundwater level surface for the Myara North mine region is a subtle replica of the topography. There is an understandably strong correlation between the topographic elevation and measured water levels of all monitoring bores (see for comparison between maximum water levels and terrain elevation in Figure 5-2).

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

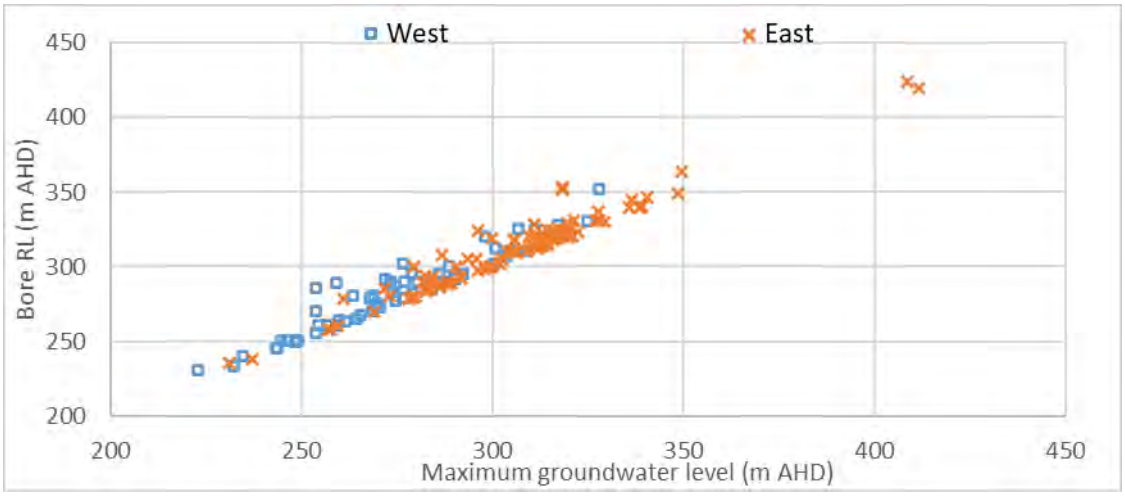


Figure 5-2 Comparison of measured maximum groundwater levels and ground elevation

Groundwater level trends and observations

A review to determine trends of the historical monitoring data collated for monitoring bores within the Myara North mine region was undertaken with results presented in the Hydrological Setting and Understanding Report (GHD 2021b) and summarised in Table 5-1. The table identifies the following key features and long-term trends in groundwater levels (groundwater salinity discussed in the section 5.1.3):

– A typical strong seasonal variation in groundwater levels, typically varying over an annual cycle by between 1 to 5 m.
– Most monitoring bores show declining groundwater levels since the 1990s which is considered to reflect the reducing rainfall pattern. This can be seen when groundwater levels are compared to cumulative rainfall departure (CRD) plots (GHD 2021b, Appendix C and Appendix F). These plots shown a declining trend in rainfall over the same period as the reduction in groundwater levels. Bore hydrographs are included in the Baseline Hydrology Monitoring Report (Appendix B).
– The summary data presented in Table 5-1 indicates that all but two monitoring bores show declining groundwater levels of between 1 to 10 m since the 1990s, with an average decline of close to 4.5 m (since the 1990s).

Installation of the new groundwater bores within the Myara North mine region provided further spatial representation and enabled refinement of groundwater level understanding across the proposed mine region. Key observations from the new groundwater bores include:

– Groundwater is generally shallow (<10 m BGL), with groundwater at depths of more than 10 m only observed in the far south (B02, B03 and B04), and B10 in the far east of the mine region.
– Average seasonal groundwater level decline over the winter to summer 2020-2021 season for all new bores is 1.9 m, with over 3.5 m range recorded in four bores (B12D, B13, B18 and B24). The least seasonal variation is seen in the bore with the greatest depth to groundwater (B02, B03 and B04).
– Seasonal reduction in groundwater levels resulted in the drying out of five of the monitoring bores. Of these, two (B12S and B16S) are shallow screened bores, with the paired deep bore also observing a decline in groundwater level though not drying out.
– Bores B01, B09, B18 also dry out during the summer monitoring, however these bores are installed just above the granite basement rock, indicating the absence of a saturated profile in these areas during summer periods.

Table 5-1 ***Myara North mine region - summary of groundwater level trends and salinity from selected Alcoa long term monitoring bores***

Monitoring well ID	Groundwater levels			Groundwater Salinity		
	1990 SWL[1] (mBGL)	2020 SWL[1] (mBGL)	Change SWL (m)	1990 TDS[1] (mg/l)	2020 TDS[1] (mg/L)	Change TDS (mg/L)
MJ38033A	3	4	-1	500	800	300
MJ38034A	6	10	-4	400	200	-200
MJ39222A	4	10	-6	200	400	200
MJ40121A	2	6	-4	2000	500	-1500
MJ41081A	7	5.5	1.5	NA	NA	NA
MK382511A	3	3	0	1500	500	-1000
MK39171A	1	2	-1	200	200	0
MK39181A	4	8	-4	400	400	0
MK39191A	2	10	-8	400	500	100
MK40102A	5	15	-10	NA	NA	NA
MK40111A	4	8	-4	300	300	0
MK40181A	2	10	-8	250	300	50
MK40182A	5	15	-10	100	250	150
MK40191A	2	8	-6	400	500	100
MK40251A	10	14	-4	NA	NA	NA
MK40252A	15	25	-10	NA	NA	NA
MK40261A	3	5	-2	150	100	-50

Monitoring well ID	Groundwater levels			Groundwater Salinity		
	1990 SWL[1] (mBGL)	2020 SWL[1] (mBGL)	Change SWL (m)	1990 TDS[1] (mg/l)	2020 TDS[1] (mg/L)	Change TDS (mg/L)
MK41041A	2	5	-3	200	200	0
MK41061A	10	15	-5	1550	1590	0
ML40092A	3	4	-1	400	300	-100
ML40093A	2	4	-2	300	300	0
ML40131A	4	6	-2	250	300	50
ML40271A	20	25	-5	NA	NA	NA
ML41011A	10	20	-10	NA	NA	NA
Notes	SWL - Standing Water Level					
	TDS – Total Dissolved Solids					
	1 - average values estimated from graphs observations (semi-quantitative)					
	NA - Not applicable, no data or unreliable data					

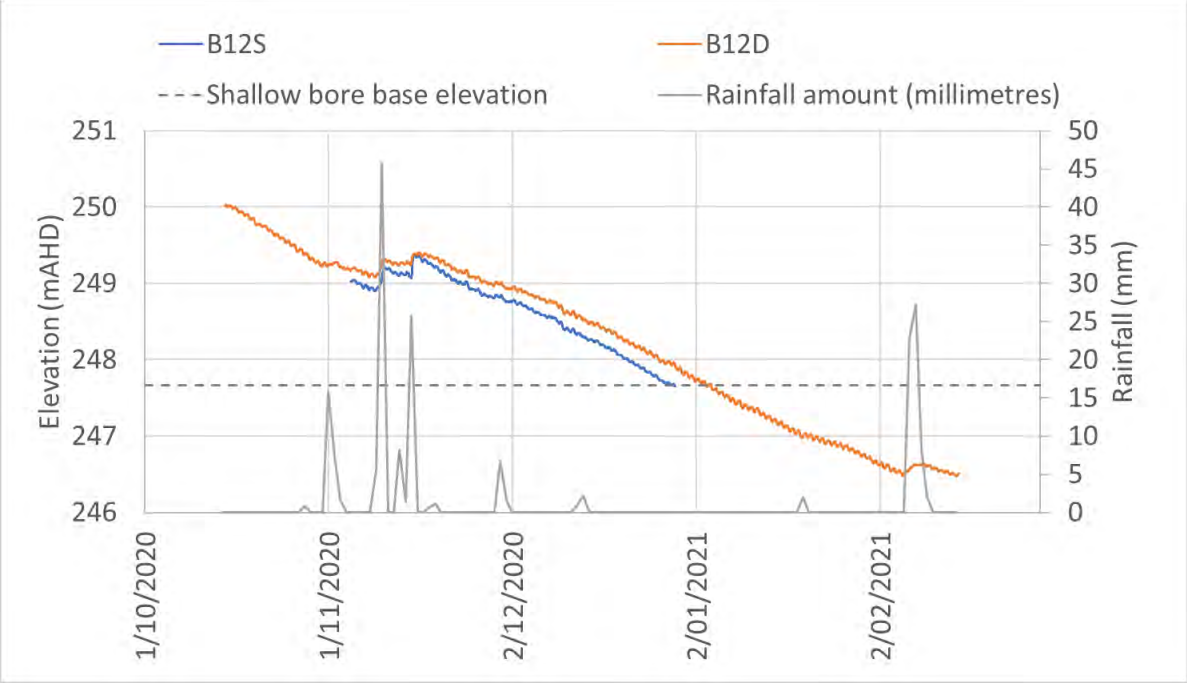


Figure 5-3 Groundwater levels (logger data) in B12 and rainfall during 2020/2021 summer period

5.1.3 Groundwater quality

Groundwater salinity

Groundwater quality within the Myara North mine region is typically fresh. The majority of the monitoring data for the study area, available for some sites since the 1970s, indicates generally fresh conditions with an average salinity of around 450 mg/L. However, as shown by the salinity trend data shown in Table 5-1 there is some variability within the salinity dataset with isolated bore locations having salinities around 2,000 mg/L. Unlike the long-term groundwater level data, the long-term salinity dataset does not show any site-wide trends in groundwater salinity (i.e., generally stable or variable up or down).

Within the limited spatial extent of the data, there does not appear to be a relationship between bore salinity and location with salinity ranges within each catchment being as variable as those between catchments. Whereas

there has been a definite reduction in-site wide groundwater levels, the groundwater quality data, albeit less comprehensive, does not show any widespread long-term trends. This may be partly explained by fewer salinity observations available for the last decade.

Other groundwater quality parameters

The groundwater quality sampling rounds for this study included the laboratory assessment for a wide range of water quality parameters. Sampling was carried out in later winter 2020 (October) and summer 2021 (February). The data indicated no discernible seasonal change in groundwater quality, however some effects of sampling soon after drilling of the bores was noted.

The results showed low nutrient levels, typical for the land-use, suggesting lack of applied nutrients. Dissolved metal concentrations were typical of 'natural' conditions and representative of the geological setting. Low concentrations of per- and polyfluoroalkyl substances (PFAS) were detected in four of the sampled bores, however all detections were significantly below the drinking water assessment criteria. Minor detection of total recoverable hydrocarbons (TRH) and polycyclic aromatic hydrocarbons (PAH) was noted, with concentrations reducing in the second sampling round, possibly indicating that the drilling was the source, or alternatively the low levels are associated with bush fire effects.

5.2 Surface water characterisation

5.2.1 Surface water flow

Myara North gauging stations

There are several stream gauging stations (GS) relevant to the Myara North mine region and study area (Appendix A, Figure A 5), details of which are summarised in Table 5-2. The River Road (Serpentine River) upstream of the Myara North mine region and Jack Rocks (39 Mile Brook) gauging stations provide a robust annual flow dataset from the early 1980s to 1998, and again from the mid to late 2000s through to late 2010s (Figure 5-4). Vardi Road (Wungong Brook) has a near continuous flow dataset from 1981 to present (Figure 5-5).

It is noted that there are large areas of the proposed mining catchment in which no stream gauging data exists.

Table 5-2 Gauging stations relevant to Myara North mine region

Site ID	Site name	Flow record	GS catchment area (km^2)	Annual average rainfall (mm) [2]	Annual average streamflow (ML) [3]	Runoff (mm)
Serpentine Catchment - regulated						
614035	River Road	1982 to 1998 2008 to 2019	243	840.7	5,572	22.9
614031	Jack Rocks	1981 to 1998 2006 to 2016	55	1,025.7	3,660	66.5
Serpentine Catchment - unregulated						
614073 [1]	Gooralong Brook - Mundlimup	1951 to 1998	51	*1,144.4*	10,594	207.7
Wungong Brook Catchment						
616041 [1]	Wungong Brook – Vardi Rd	1981 to current	81	*1,144.4*	7,368	90.9
616124	Wungong Brook – Chandler Rd	2005 to 2013	18	*1,144.4*	1,208	67.1
616058	Wungong Brook – Cobiac Rd	1992 to 2016	4	*1,144.4*	202	50.5

Note:
[1] Gauging stations 614073 and 616041 are located > 5km downstream of the DE boundary

Site ID	Site name	Flow record	GS catchment area (km^2)	Annual average rainfall (mm) [2]	Annual average streamflow (ML) [3]	Runoff (mm)
[2] Annual average rainfall for 614035 and 614031 derived from SILO 5 km daily grid data (1970-2020), remaining sites derived from SILO extraction for Karnet station (1970-2019) [3] Average of available streamflow record						

Long-term trends in annual flow

The step change in rainfall discussed in section 4.1 is reflected in observed step changes in streamflow, whereby annual average streamflows after year 2000 were considerably lower than the preceding period (Figure 5-4,Figure 5-5). Average annual streamflow in the Serpentine River has declined by more than 50% at River Road (614035), from 6,810 ML (1982-1998) to 3,232 ML (2008-2018), with an 80% decline in the streamflow record at Jack Rocks (614031), from 5,432 ML (1981-1998) to 1,093 ML (2006-2016)

A similar decline in average annual streamflow (70%) is observed in the upper Wungong River catchment with flows at Vardi Road (616041) reducing from 11,172 ML (1981-2000) to 3,416 ML (2000-2020).

The impact of decline in groundwater levels on streamflows (discussed in section 4.6) is also apparent at Jack Rocks with average annual streamflows from 2012 to 2016 approximately 75% lower than the six years prior to 2012, despite average rainfall decreasing by only 8% over the same period.

Long-term trends in flow seasonality

The long-term flow data for the River Road and Jacks Rocks gauging sites was used to generate box and whisker plots of monthly flow data (Figure 5-6 and Figure 5-7). The plots group the monthly flow data by the observed step changes in annual streamflow (pre-2000, post-2000), with the post 2000 flow data demonstrating a delay in flow commencement and typically earlier cease to flow, in comparison to the pre-2000 flow data.

Short-term trends in surface water levels and flow conditions

During the 2020 baseline monitoring period flow conditions at surface water sampling locations were recorded during monthly surface water sampling events (GHD 2021a, Appendix B). Surface water level loggers were installed late September at six Myara North surface water monitoring locations, five at the downstream extent of representative catchments prior to discharge to the Serpentine River or Serpentine Dam, and one in the Serpentine River downstream of the proposed conveyor crossing.

The observed periods of flow during the baseline monitoring program align with historical seasonality of flow observed across the Myara North mine region.

One site (SW05, Pipehead Dam catchment) sustained flows throughout the monitoring period, with upwelling water observed in the January 2021 monitoring round which may indicate a local groundwater source. Sustained flows were also observed at site SW06 (cease to flow in November 2020) within the upper Gooralong Brook catchment.

This site was located in the catchment of a prescribed burn completed in late September 2020. Talau (2015) report increased stream flow responses within areas subject to prescribed burns, however these are generally of a smaller magnitude compared to wildfire responses.

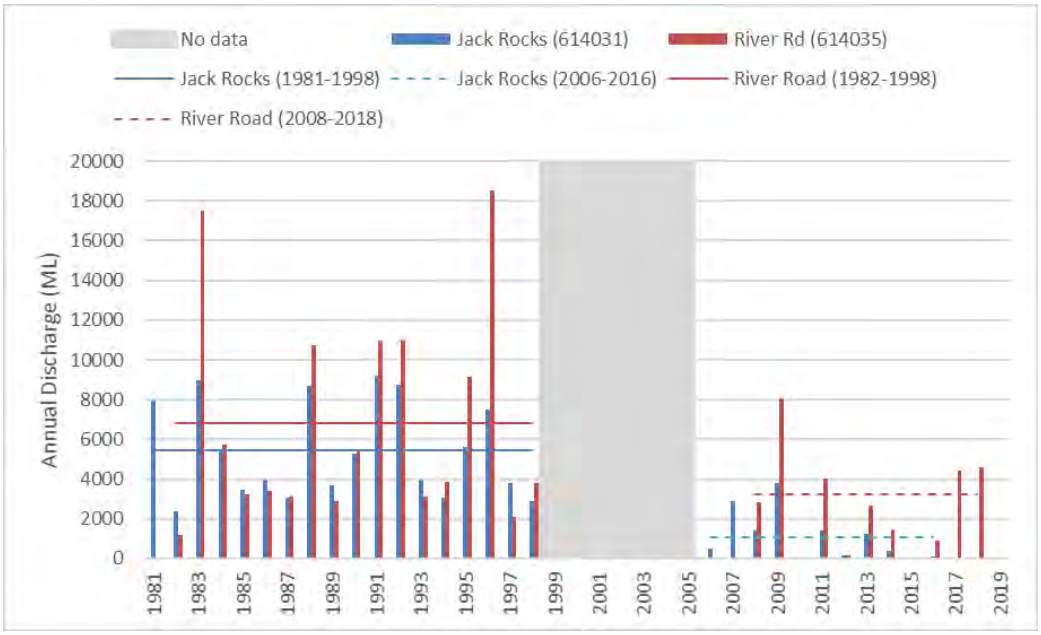


Figure 5-4 Annual flows at key Serpentine catchment gauging stations

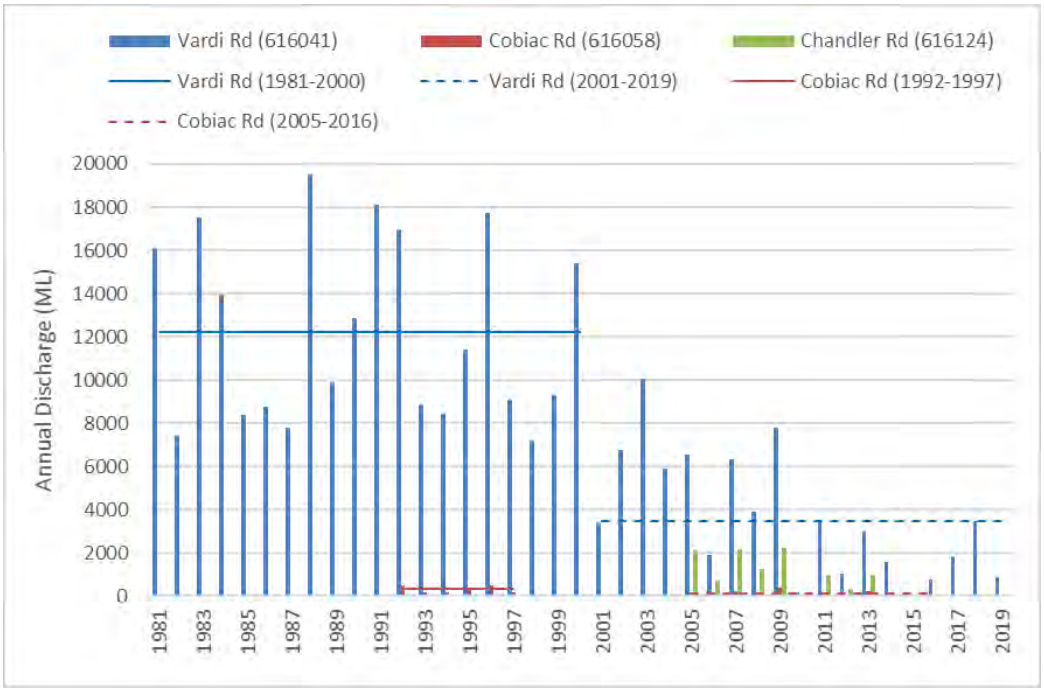


Figure 5-5 Annual flows at relevant Wungong catchment gauging stations

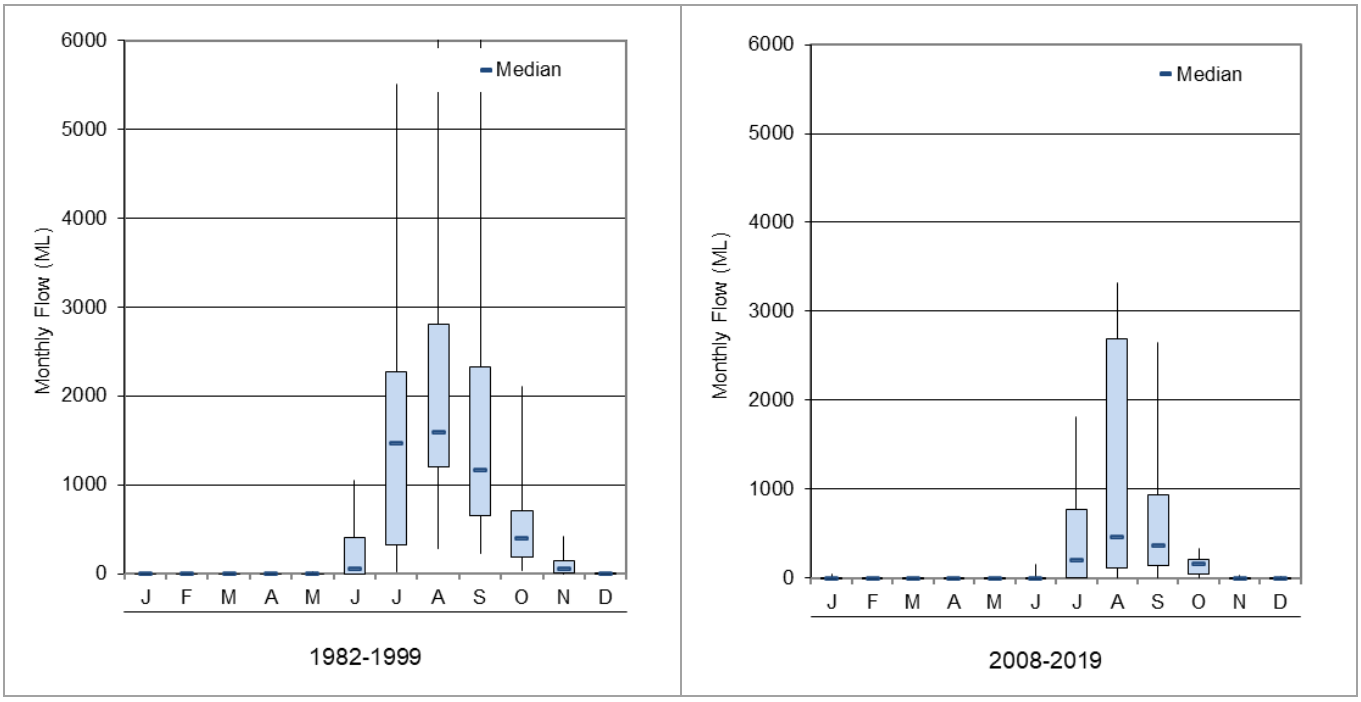


Figure 5-6 Flow seasonality – River Road (Serpentine River) for periods 1982-1999 and 2008-2019

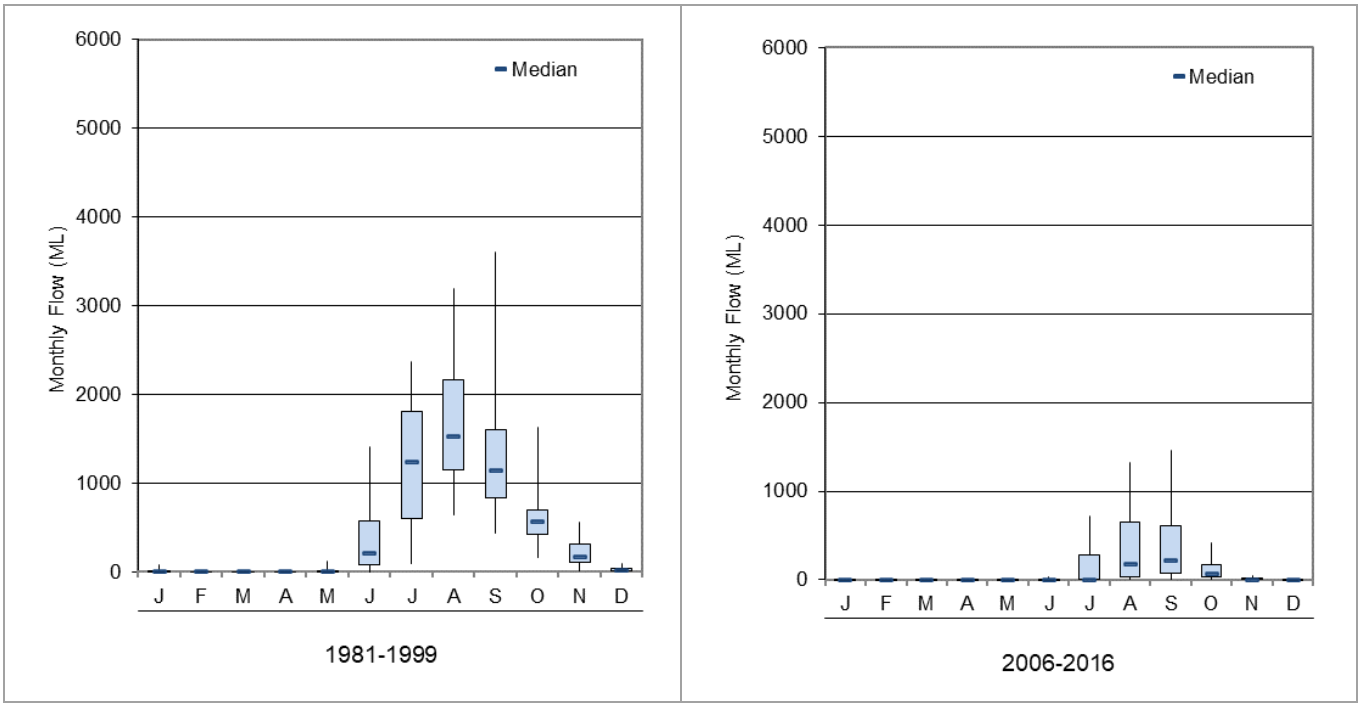


Figure 5-7 Flow seasonality – Jack Rocks (39 Mile Brook) for periods 1981-1999 and 2006-2016

Baseflow and interflow

Baseflow is the portion of streamflow that is sustained between precipitation events but also forms part of the flow during rainfall events. Interflow represents lateral movement of water in the unsaturated zone. It is usually considered a component of baseflow, depending on the response time – and in this case in position with respect to the stream.

For the Serpentine catchment, Bari et al. (2010) used a model to estimate that interflow is the largest contributor to streamflow followed by groundwater connected baseflow and surface runoff.

Data analysis by GHD using methods described by Barlow, et. al., (2014) for the gauging stations located in the Myara North DE and study area indicates that baseflow represents between 45% and 67% of streamflow, depending on location and baseflow separation methodology.

For the O'Neil Road station (Big Brook, located to south of Myara North mine region), representing the largest catchment of the Serpentine River and longest record, the baseflow proportion of runoff has a weak downward trend.

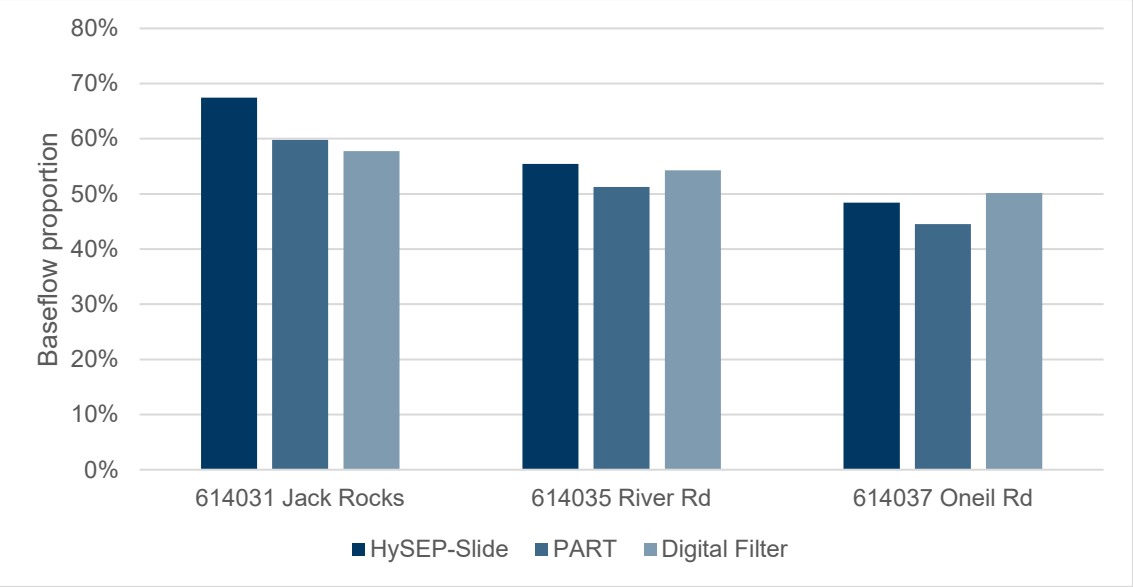


Figure 5-8 ***Baseflow contribution to runoff***

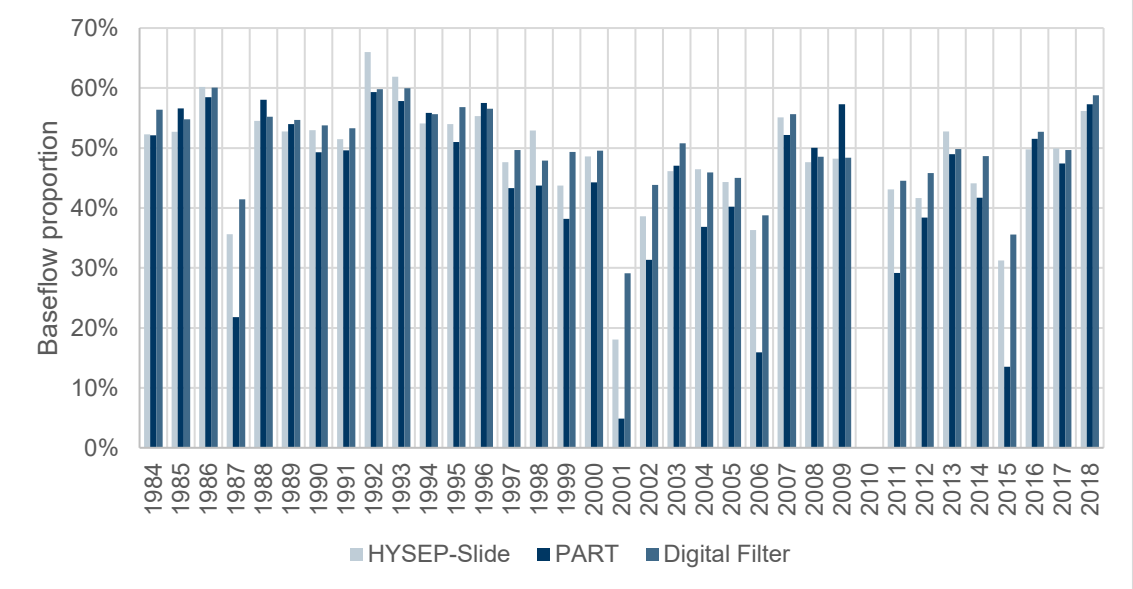


Figure 5-9 ***Baseflow trends***

5.2.2 Surface water quality

Historical water quality data

Surface water quality monitoring data across the Myara North region has historically been completed by Alcoa and DWER, and is limited to salinity, pH and some turbidity data.

The spatial distribution and frequency of Alcoa monitoring data varies widely across the Myara North mine region, with historical focus on research catchments and proposed mining catchments. Data for many sampling locations is not continuous. Data records range from short periods in the 1970s, with more extensive data from the mid 1970s through mid 1980s and mid 1990s.

The historical data identifies that surface water salinity is classified as fresh (0 to 500 mg/L TDS) in the surface water tributaries west of the 1,100 mm isohyet. Median salinity is comparable across all sampling locations, however maximum salinity values (as TDS and electrical conductivity (EC)) typically increase for tributaries east of the 1,100 mm isohyet.

Available pH data indicates that median pH of all tributaries is neutral, with some tributaries reporting minimum pH values in the acidic range.

Historical turbidity data for surface water tributaries in the Myara North study area identify median turbidity values below 1.5 nephelometric turbidity units (NTU). DWER monitoring of Serpentine River locations identifies marginally higher median turbidity values ranging from 1.6 to 2.6 NTU.

Baseline surface water laboratory results

Baseline surface water sampling events were completed monthly at selected Myara North monitoring locations between August 2020 and January 2021.

The results of the baseline monitoring program identify that surface water quality is generally similar across the Myara North mine region, reflecting the similar hydrological and hydrogeological conditions. As with groundwater quality the surface water quality is typically fresh, unimpacted by anthropogenic activities and consistent with the site setting within state forest.

The salinity, pH and turbidity data observed during the baseline monitoring period is consistent with the historical data record for the various subcatchments of the Myara North region.

Surface water is non-saline and moderately acidic, with marginally elevated surface water salinity observed in some samples during late season monitoring or when sampling occurred from pools. A short continuous EC logger record at two tributaries east of the 1,100 mm isohyet identified EC at the lower end of historically observed ranges. There is a trend observed between streamflow rates and salinity, the latter increases as the streamflow decreases (Figure 5-11).

Surface water samples typically had low turbidity and low total suspended solids. The low background turbidity was also observed in a short continuous turbidity logger record at four representative sites, with short pulses of elevated turbidity rapidly returning to background levels. The short duration of these pulses are indicative of passing debris rather than elevated turbidity. The salinity, pH and turbidity data observed during the baseline monitoring period is consistent with the historical data record for the various sub-catchments of the Myara North region.

An extended suite of surface water quality parameters were also sampled during the first three months of sampling in August, September and October 2020. As with groundwater within the Myara North mine region the surface water results had low nutrient levels, and metal concentrations representative of the geological setting. Microbiological parameters were detected at all sampling sites, with widespread detection consistent with the presence of fauna species within the national park setting.

Low concentrations of PFAS were detected at four sites, however all detections were significantly below the drinking water assessment criteria.

Detection of PAHs elevated above the drinking water guideline was recorded at site SW06 in October 2020, with PAH concentration dominated by naphthalene. Site SW06 is located in the catchment of a prescribed burn that occurred in late September 2020, and it is assumed that the elevated PAH concentration occurred due to natural introduction of PAHs from the prescribed burn. Dieldrin was detected in a single sample at a concentration significantly lower than the drinking water assessment criteria.

For other contaminants of potential concern, including methylene blue active substances (MBAS) surfactants, Benzene, Toluene, Ethylbenzene and Xylene (BTEX) compounds, TRH and explosives, all samples analysed returned results less than laboratory limits of reporting.

5.3 Conceptual understanding of surface water and groundwater connectivity

5.3.1 Introduction

Surface water and groundwater are hydraulically connected through drainage lines (and potentially springs), valley floors (wetlands, damplands) and the water reservoir (the Serpentine Dam). Surface water is at least intermittently connected to both the regional (or in some instances perched) watertable and the interflow vadose zone.

This is supported by observations from the surface water flow monitoring data. An example of recorded observations is shown for the Jack Rocks gauge and the nearby bore MJ40122A which documents the correlation between elevated groundwater levels and surface flows (Figure 5-10). Surface flows occur at the same time when groundwater levels are elevated by several metres in response to winter rainfall.

5.3.2 Surface and near surface flow

Stream gauges within and in proximity to the Myara North mine region (Appendix C), confirm that surface water flows are relatively short-lived following winter rains, ceasing to flow within two to three weeks following peak surface water flows.

The short duration of surface water flow following rainfall supports that the contribution to surface water flow from catchment runoff and other short-term storage such as shallow subsurface flow top up the baseflow contribution from groundwater in short term, following the winter rains.

The near-surface flow occurs in the variably saturated shallow subsurface where sufficient rainfall inputs can temporarily resaturate permeable materials where these are present on top of less permeable substrate (for example clayey saprolite or basement subcrop) and cause short-term flows from these perched conditions downgradient. Due to the large heterogeneity of the weathering zone materials this component of flow can often exfiltrate to the surface when encountering a barrier such as a basement outcrop or where the shallow subsurface zone otherwise pinches out.

These flows are thought of as a patchwork of locally occurring flows, largely non-contiguous, but able to support – in short term – streamflows activated by winter rainfalls. This flow component is likely to merge with baseflow in the slopes surrounding the drainage lines where these sufficiently cut into the regional watertable.

Given the short duration, the streamflow flows carry the surface and near-surface flow contribution until it is exhausted, and the streamflow becomes dependent on contribution from groundwater (i.e., baseflow only). An examination of TDS values in Figure 5-11 between May 1990 and May 1991 suggests that winter rains at Jack Rocks gauge lead to low TDS values (around 150 mg/L) at the start of winter streamflows consistent with the initial larger proportion of surface runoff and near surface flow (and rain) contribution. As flow subsequently diminishes, TDS values rise to just below 350 mg/L, more typical of groundwater, i.e., dominated by baseflow.

5.3.3 Baseflow

Discharge in the form of baseflow or seepage, at smaller rates, is then present for the subsequent period typically extending some weeks or months following the winter rains and peak storage (when groundwater levels are highest).

Given the shallow depth to groundwater in areas beneath the potential GDEs and wetlands, the regional groundwater continues to support the potential GDEs and wetlands, particularly during the summer months in absence of surface water flows. As long as groundwater within the topographical slopes surrounding the drainage lines or creeks does not considerably fall below the creek level (which would lead to hydraulic disconnection), or the flow gradient reduces such that the incoming flow is completely removed by riparian evpotranspiration, groundwater continues to exfiltrate to the creek, or supporting sufficiently shallow watertable in the riparian zone accessible for support of vegetation communities .

5.3.4 Salinity changes during streamflow

Major rainfall events that produce streamflows lead to changes in streamflow salinity. These are interpreted to reflect changing proportions of more saline groundwater and less saline runoff and near surface flow. A relationship between streamflow rates and TDS (Figure 5-11) clearly demonstrates increase in TDS with falling streamflows and the importance of surface and near surface flows.

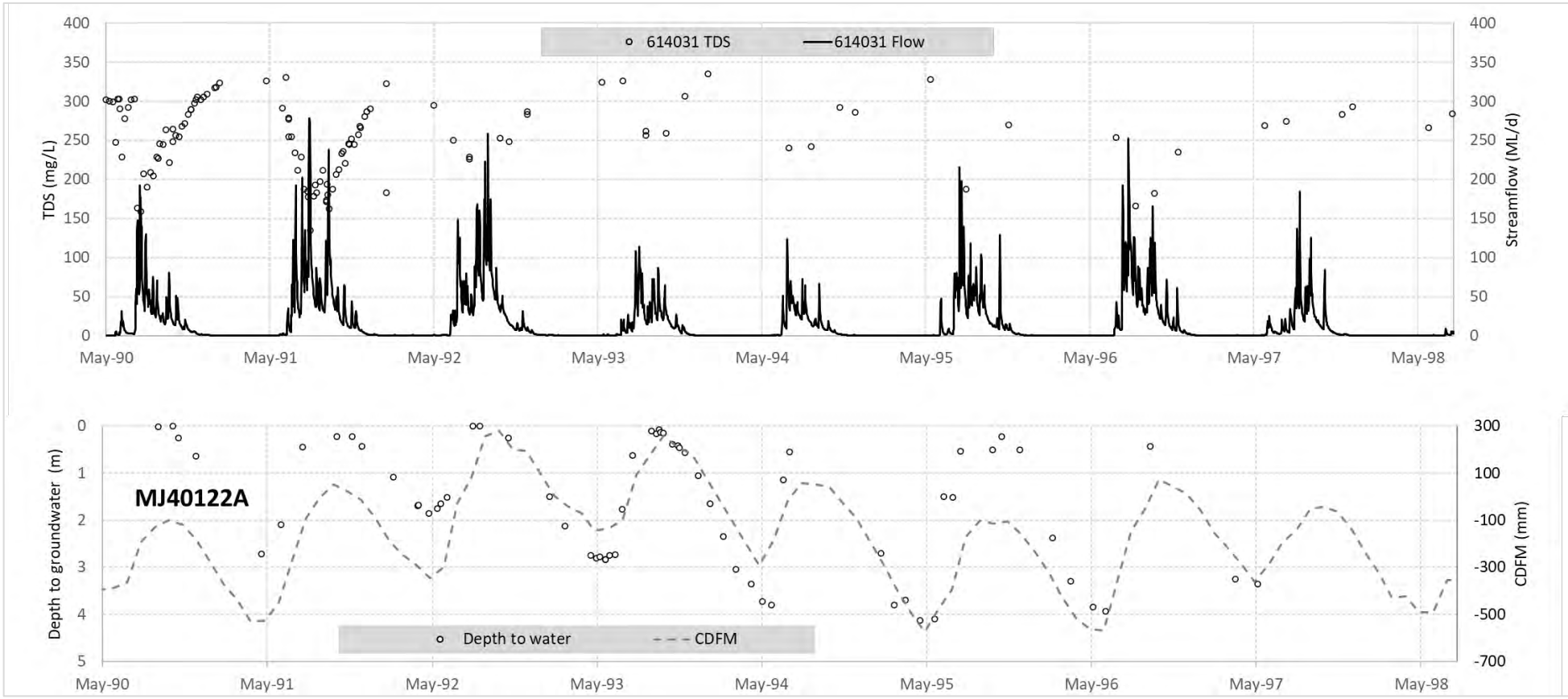


Figure 5-10 Example of streamflow and groundwater level response to seasonal rainfall (Jack Rocks gauge and bore MJ40122A)

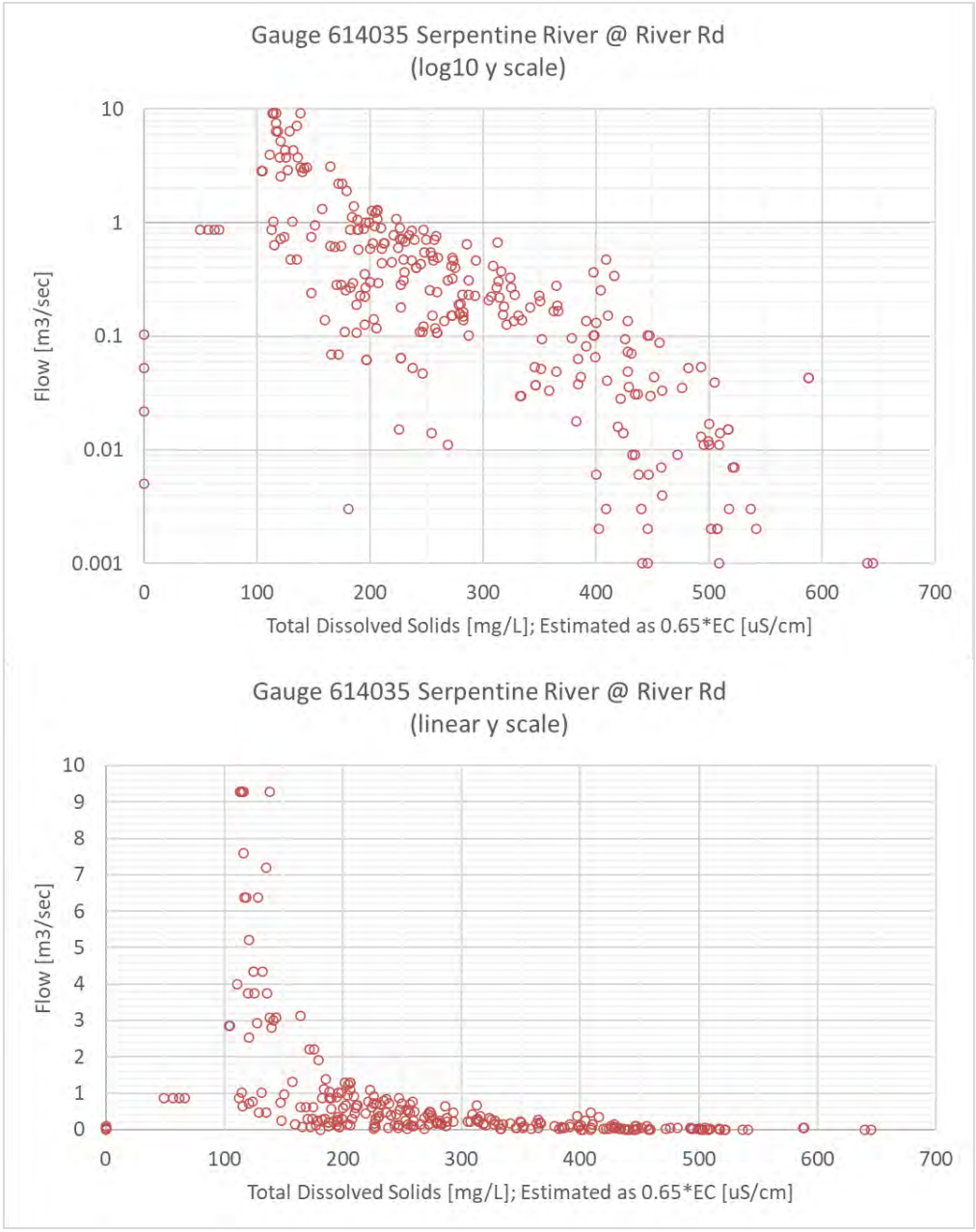


Figure 5-11 Example of relationship between streamflow rate and salinity (TDS)

5.3.5 Key components of stream aquifer interaction

The key water components active during the stream aquifer interaction (occasionally including the top profile that is unsaturated for most times) and the conceptual model of this interaction are sketched in Figure 5-12.

In summary there are three potential sources of water which support streamflows and the riparian zones, including wetlands, areas where the potential GDEs are also mapped:

– **Surface runoff** – the proportion of rainfall flowing down-slope on the surface. It is short-term and proportionally small due to thick forestation.
– **Occasional near-surface flow in variably-saturated shallow subsurface** – a patchwork of shallow subsurface flow within lateritic material/sands/gravels, which eventually discharges into the creek or riparian zone or merges with baseflow. This component of flow represents occurrences of lateral flow through otherwise mostly unsaturated zone, perched above the less permeable saprolite clays or basement material of low permeability. The proportion of flow may occasionally exfiltrate (for example on encountering outcrop, or less permeable soil) and then infiltrate again, or removed by e.g., evaporation or evapotranspiration.

– **Baseflow - groundwater discharge** where the topographic low points (e.g., creeks, wetlands) intersect the regional ground watertable. For shorter periods after rainfalls the flow overcomes evapotranspiration in the riparian zone and discharges as baseflow into the stream.

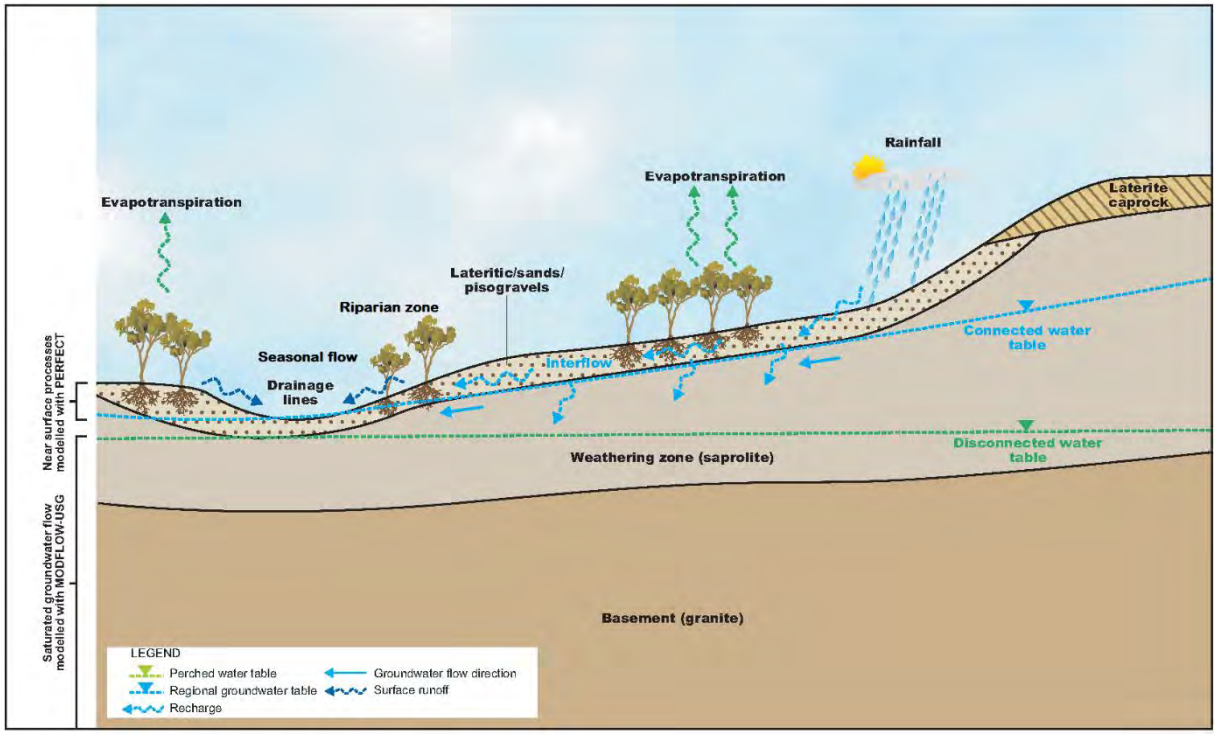


Figure 5-12 Conceptual representation of surface water groundwater interaction

5.3.6 Proportional representation of flow components

Attribution of flow components to streamflows has been examined on Jack Rocks gauge data which has a reasonable density of flow and EC data during 1981 and 1999 observation period. Grigg et al. (2020) provided a case that principal contribution to the Darling Range streams comes from groundwater (i.e., baseflow), which is also supported by baseflow estimates in section 5.2.1 (45% to 67% interpreted as baseflow).

In the following, we present a simple case calculation, based on Jack Rocks data, using TDS and streamflow data to estimate flow components.

The calculation is based on an example of several similar approaches, in this case on Gonçalvès et. al. (2020) who presented a methodology that uses hydrochemical data to constrain various flow components (they refer to baseflow and surface/hypodermic flow) with a monthly time step. Their methodology uses major ions to characterise hydrochemical end-members and also assumes fast responding reservoir to runoff and the near-surface flows; and slower responding reservoir to baseflow.

In absence of detailed hydrochemical data for Jack Rocks gauge, only TDS is applied as the hydrochemical constraint. Assuming the average TDS values for the two end-members, runoff/near-surface flow and baseflow, at 100 and 350 mg/L, respectively, it is possible to estimate attribution of these two flow components during 1981 and 1999 winters. The results of a several possible realisations obtained using the approach by Gonçalvès et. al. (2020) are presented in Figure 5-13.

In this case we present the following possible realisations which yield similar streamflow timeseries results:

– “Low baseflow”, and low recharge rate realisation (in this case using 46 mm/yr recharge rate)
– “High baseflow” – and higher recharge realisation (in this case using 113 mm/yr recharge rate)
– Baseflow aligned with the chloride mass balance (CMB) recharge estimate (in this case using 56 mm recharge rate)
– Baseflow aligned with the CMB recharge estimate and peak flows

A reasonable match (Figure 5-13) between measured and calculated data (both flows and TDS) using a simple parsimonius analytical model indicates a clear interaction between flow components and the ability of this simple model to reasonably represent streamflows. All presented realisations have similar correlation between observed and simulated results, with correlation coefficient (R^2) varying between 0.71 and 0.77.

The results also indicate that using a range of recharge rate values it is possible to obtain similar streamflow results, even when constrained by TDS. The recharge rate in this case varied between 46 and 113 mm/yr, with the balance of streamflow supplied from quickflow (mainly interflow) components. In these evaluated realisations baseflow contributes between 18% to 50% of streamflow.

This range could be potentially even larger given that the analytical solution can accommodate it and produce plausible streamflow estimates. Baseflow proportion is likely to vary more during shorter timesteps, e.g., quickflow would be dominant during the initial phases of the streamflow event, while baseflow will be dominant in the receding part of the event. This is also reflected in the simulated realisations in which the streamflow peak precedes the baseflow peak. More detail on these realisations is provided in GHD (2021b).

Streamflow salinity data can also provide indications of the prevailing flow regimes. The relationship (Figure 5-14) between the recorded streamflows and TDS for the same period indicates a relatively stable range of TDS at low flows and then linear decrease in TDS with rising flow rates.

Below average flow rates of 0.05 m^3/s the recorded TDS ranges between 280 and 345 mg/L. It is reasonable to assume that at these flow rates practically all contribution is coming from groundwater as baseflow. In this particular case the surface flow becomes active when the flow rate exceeds 0.05 m^3/s.

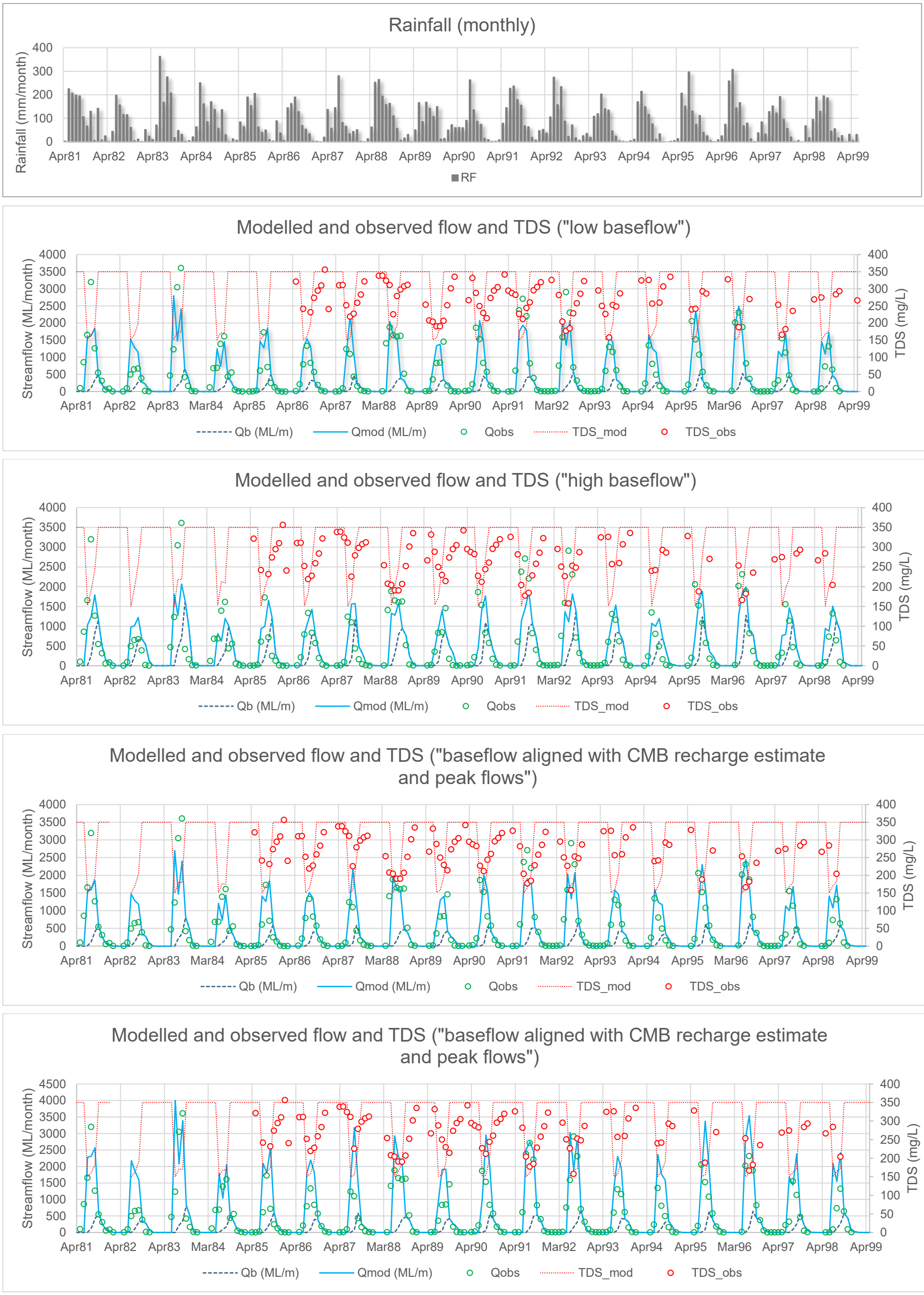


Figure 5-13 ***Application of simple analytical TDS-constrained baseflow-quickflow models to represent measured streamflows at Jack Rocks gauge (Qb – baseflow; Qmod – modelled streamflow; Qobs – observed streamflow; TDS_mod – modelled TDS; TDS_obs observed TDS)***

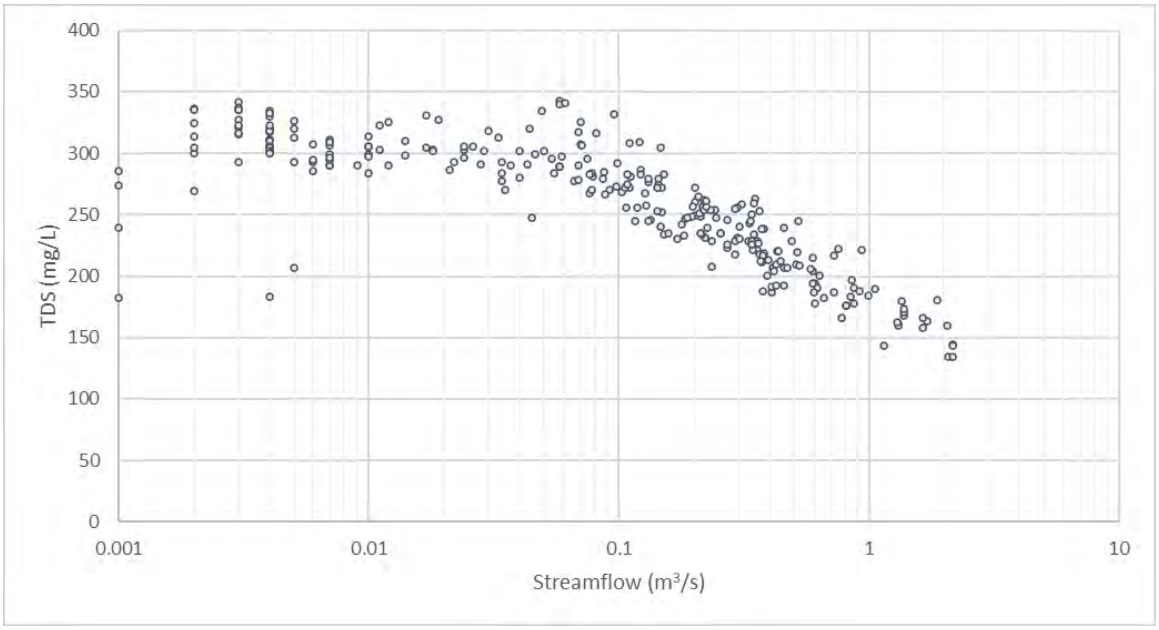


Figure 5-14 Relationship between average daily flow rates and TDS

5.4 Environmental values

5.4.1 Potential groundwater dependent ecosystems

Potential GDEs were derived from detailed flora and vegetation assessment completed to assess site-vegetation types of the Myara North mine region by Mattiske (2021a).

The site-vegetation type mapping was compared to extensive flora and vegetation studies completed in the northern jarrah forest region to identify vegetation complexes that support species and site-vegetation types that prefer and occur on seasonally moister and wetter soils of the swamps and lower slopes of the valley systems (Mattiske 2021a), with this approach considered a precautionary approach in the absence of detailed groundwater level data.

Mapping of potential GDEs in the Myara North mine region is presented in Figure 5-15, with detail provided in chapter 5 (flora and vegetation) of the Proposal Environmental Review Document. Potential GDEs cover 28% of the Myara North mine region.

5.4.2 Aquatic ecosystems

Fauna habitat

The detailed fauna survey of the Myara North mine region identified that the drainage lines supporting relatively low dense vegetation have a linkage value as preferred habitat for medium sized mammals such as Quenda and Quokka (GHD 2021f).

Aquatic fauna

Limited historical aquatic fauna surveys were completed for parts of the Myara North mine region as part of the Wungong Catchment Trial (WRM 2013). Aquatic fauna values from these surveys as well as surveys of other catchments across wider Northern Jarrah Forests region were used to inform a desktop assessment of the aquatic fauna values of the Myara North and Holyoake mine regions as summarised in the report Aquatic Fauna Desktop Assessment - Myara North and Holyoake Regions (WRM 2021).

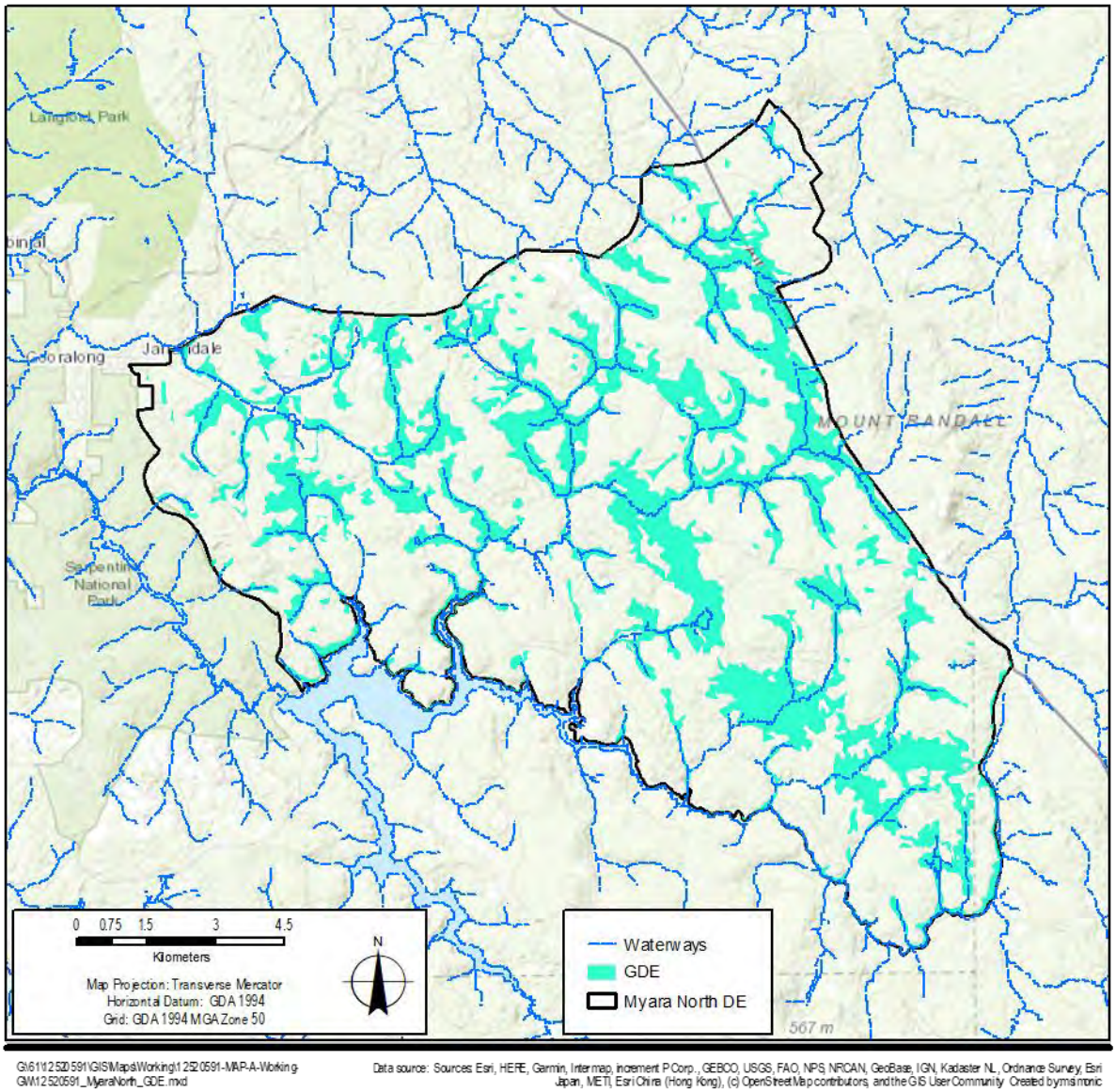


Figure 5-15 Spatial distribution of potential GDEs in Myara North mine region

WRM (2021) identified that the aquatic fauna habitats are likely to be dominated by first-order seasonal creeklines and ephemeral headwater swamps/damplands. In higher rainfall years, baseflow in higher-order streams may maintain isolated pool refuges over summer. Aquatic fauna communities are expected to be characterised by a high degree of seasonality and high level of species endemism.

A targeted Carter's Freshwater Mussel (EPBC and BC Act Vulnerable) survey completed as part of the Phase 2 detailed and targeted fauna survey of the Myara North mine region (GHD 2021f) did not identify any signs of mussels.

Carter's Freshwater Mussel population has previously been located (Klunzinger et al. 2012) at Serpentine River Pipehead Dam. The species is known to reside in the Serpentine Dam on the southern boundary of Myara North mine region.

The fauna survey identified that while mussels may disperse upstream from the Dam during winter/spring flows, all streams are seasonal, and any dispersing mussels are unlikely to survive the extended dry summer period. Therefore, significant populations are unlikely in the Myara North mine region.

6. Holyoake hydrological setting

This section summarises the results of the baseline groundwater, surface water and environmental technical investigations that were completed across the Holyoake area. The aim of investigations was to establish baseline hydrological conditions, including water quality (surface water and groundwater).

6.1 Hydrogeological characterisation

6.1.1 Information base

Alcoa and DWER have collected limited groundwater level and groundwater quality data within the Holyoake mine region, however regions neighbouring Holyoake were investigated in more detail.

GHD, as part of the current investigation installed 17 new groundwater monitoring bores in 2020, to supplement 8 existing Alcoa groundwater bores. The subsequent baseline monitoring program comprised monthly water level dips and physico-chemical parameter measurements from October 2020. Groundwater samples collected for laboratory analysis of a broader suite of parameters in October 2020 and February 2021.

6.1.2 Aquifer units

Aquifer system information for the proposed Holyoake mine region was investigated using hydrogeological drilling and installation of groundwater monitoring bores by GHD. Details of geological logs are presented in GHD (2020b).

A summary of the geological logs is provided below and monitoring bore locations are presented in Appendix A, Figure A 8. A review of the GHD geological logs indicates a thicker lateritic profile than that of the Myara North mine region and depth to fractured bedrock was deeper, with a generalised profile as described below:

– **Lateritic/ duricrust caprock**: 1 to 7.5 m deep with an average of 1 to 2 m. The caprock comprises minor soils with pea-gravel and cemented duricrust or laterites and is less developed than in Myara North. One bore returned a well sorted sand from surface with an absence of caprock.
– **Saprolite**: Highly variable depths from 1 to 32 m, comprising completely weathered clay. Generally, clay is mottled or pallid towards the top becoming greener with depth indicating transition to weathered bedrock. Several bores also returned a uniform silty clay lens up to 20 m thick within this succession.
– **Weathered zone**: Weathered basement zone (which includes saprock) is characterised by a gravelly texture and decreasing clay content but with a higher clay content that in Myara north. Groundwater flow was minor with measured flows during drilling of only 4 L/minute, significantly less than in Myara North.
– **Fractured basement**: Depth to fractured granite varies from 6 to 36 mbgl. Two notably shallower bores intercepted a quartzite and dolerite intrusions whereas one deep bore recorded a schist at 33.5 m.

Slug tests (GHD 2021a) were conducted on GHD monitoring bores, and the results are summarised and presented in Figure 6-1. The monitoring bore slotted intervals reflect the horizons with water strikes, which were generally identified within the transition zone from weathered bedrock to fractured granite.

Highest hydraulic conductivity values were returned from bores screened in the basement saprock to highly weathered granite and likely related to discrete high permeable zones within this unit. Hydraulic conductivity ranges from <0.1 to just over 1.0 m/day with an average of 0.3 m/day as shown in Figure 6-1. The average hydraulic conductivity for Holyoake mine region is lower in comparison to Myara North mine region. This is consistent with the described lithology and drilling, where higher groundwater flows, associated with the basement/saprock profile, were more common.

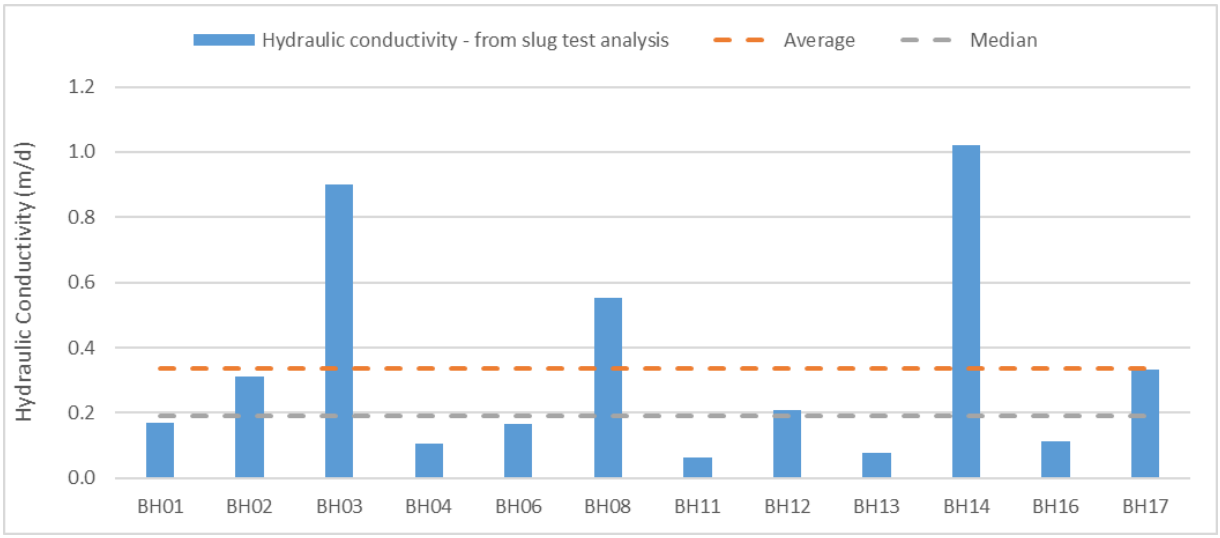


Figure 6-1 Holyoake slug testing results (hydraulic conductivity)

6.1.3 Groundwater levels and flow

Groundwater levels, flow and discharge

The newly instated monitoring bores, which are located close to, or within the valley floors and creek lines, indicate that the depth to groundwater is generally greater than 10 meters below ground level (valley floor level), with one of the 17 locations exhibiting depth to groundwater less than 5 m (BH12). The average depth to groundwater is 14.5 meters below ground level.

At a regional scale, an inferred relationship between topography and depth to groundwater indicate that groundwater flows towards the north-west, where it would discharge in or along the major drainage lines, including the lower lying areas of the South Dandalup Dam and associated lower lying tributaries (e.g., South Dandalup River).

Groundwater level trends and observations

There is lack of historical monitoring data within the Holyoake mine region to assess long-term groundwater level changes. A total of six bores were identified that have longer-term monitoring data, combined with more recent data (2020/21), and extrapolation from knowledge about the neighbouring regions, provide a basis for estimation of long-term groundwater trends.

Summary of historical groundwater level trends and salinity is presented in Table 6-1. The groundwater levels of the six monitoring bores show declining groundwater levels since 1990s, of close to 9 meters, which is considered to reflect the reducing rainfall patterns, which also appears to be declining since 1990s.

The installation of 17 new groundwater monitoring bores within and in proximity to the Holyoake mine region facilitated a better understanding of groundwater levels across the mine region, with the data providing a more spatially representative dataset for groundwater within the whole of Mine DE. Key observations from the new monitoring bores include:

– Data from the new bores, which are predominately located close to, or within the valley floors/ creek lines, highlighted that groundwater levels are more variable and generally deeper than in the Myara North mine region.
– The groundwater is more than 10 meters below ground level (valley floor level), with one of the 17 locations exhibiting depth to groundwater levels less than 5 m (BH12). The average depth to water is 14.5 meters below ground level.
– The average seasonal groundwater level decline for all new bores is 0.7 m, significantly less than Myara North mine region (1.9 m for Myara North mine region bores), which may reflect based on the observations in Myara North mine region and Holyoake mine region, the bores with shallower depth to water, tend to have a greater seasonal range in groundwater levels.

Table 6-1 Holyoake mine region- summary of historical groundwater level trends and salinity

Monitoring well ID	Groundwater levels			Groundwater salinity		
	1990 SWL (mBGL)[1]	2020 SWL (mBGL) [1]	Change SWL (m)	1990 TDS (mg/l) [1]	2020 TDS (mg/L) [1]	Change TDS (mg/L)
MJ46071A	10	17	-7	250	300	50
MJ46071B	10	17	-7	NA	NA	NA
MK46051A	17	22	-5	NA	NA	NA
MK46101A	10	25	-15	150	200	50
MK49162A	9	20	-11	2000	2000	0
ML49131A	10	20	-10	1000	1400	400
Notes	SWL - Standing Water Level					
	TDS – Total Dissolved Solids					
	1 - average values estimated from graphs observations (semi-quantitative)					
	NA - Not applicable, no data or unreliable data					

6.1.4 Groundwater quality

Groundwater salinity

Groundwater quality within the Holyoake mine region is typically fresh, consistent with the current site setting within the state forest. The limited historical data (Table 6-1) suggests a slight rise in TDS consistent with the noted general decline in groundwater levels.

Historical and current monitoring data indicates an average salinity of around 400 mg/L, however the dataset is quite variable, for example of the 16 new monitoring bores, three bores have an elevated TDS of between 1,000 to 1,500 mg/L (BH03, BH05 and BH12).

Two of these sites (BH03 and BH05) are located relatively close together (1.8 km) along the same drainage line in the far north-east of the project area and may reflect local hydrological and hydrogeochemical conditions.

Other groundwater quality parameters

The groundwater quality sampling for this assessment included the analysis for a wide range of water quality parameters. The data from the two comprehensive monitoring rounds indicated no discernible seasonal change in groundwater quality, although some effects of sampling following the drilling of the new groundwater monitoring bores was noted.

The results showed low nutrient levels, albeit marginally higher than in Myara North mine region. Metal concentrations were also marginally higher than Myara North mien region but still typical of ‘natural’ conditions and representative of the geological setting.

Low concentrations of PFAS were detected in five of the sampled bores, however all detections were below the drinking water assessment criteria. Low-level detection of PAH (pyrene) was noted in most bores during the first minoring round. PAH concentrations reduced in the second sampling round, possibly indicating that the drilling was the original source, or that the PAHS source was related to short-term impacts from bush fires.

6.2 Surface water characterisation

6.2.1 Surface water flow

Holyoake gauging stations

There are several flow-gauging sites relevant to the broad region of the Holyoake mine region (Appendix A, Figure A 6), details of which are summarised in Table 6-2 Gauging stations relevant to Holyoake. It is noted that all gauged sites are situated outside of the Holyoake mine region, and there are large areas of the proposed mining catchment for which no flow-gauging data is available.

Table 6-2 Gauging stations relevant to Holyoake

Site ID	Site name	Flow record	GS catchment area (km)	Average annual rainfall (mm)	Annual average streamflow (ML) [3]	Runoff (mm)
South Dandalup tributary						
614043	Pindalup	1984 to 1998	7 km^2	1130.5	59	8.4
614059 [1]	Skeleton Road	1988 to 1998	19 km^2	1,112.2	2519	133
614060 [1]	Gordon Catchment	1988 to 2018	2 km^2	948.8	17	8.5
Murray River and tributaries						
614045	Chadoora (Swamp Oak Tributary)	1984 to 1997	5 km^2	1130.5	20	4.0
614047	Davis Brook – Murray Valley Plntn (Murray River Tributary)	1954 to 2002	66 km^2	1130.5	6407	97.1

Note:

1 Annual average rainfall for 614059 and 614060 derived from SILO 5 km daily grid data (1970-2020), remaining sites derived from SILO extraction for Karnet station (1970-2019)

Long-term trends in annual flow

Long-term annual flow data for the area neighbouring the Holyoake region is restricted to the Gordon catchment for the South Dandalup River (Figure 6-2). The Baden Powell gauging station is the only other site in proximity to the Holyoake area, with data from other stations predating 2000.

As with Myara North there is an observed step change in streamflow in the Gordon catchment after 2000 (Figure 6-2), with similar step changes observed in Baden Powell annual flow data (data not shown).

Long-term trends in flow seasonality

Similar to the long trends in flow seasonality in Myara North the box plots of monthly flow data (grouped by pre 2000 and post 2000) for Gordon (South Dandalup River) show a delay in flow commencement and typically earlier cease to flow for periods after 2000 (Figure 6-3).

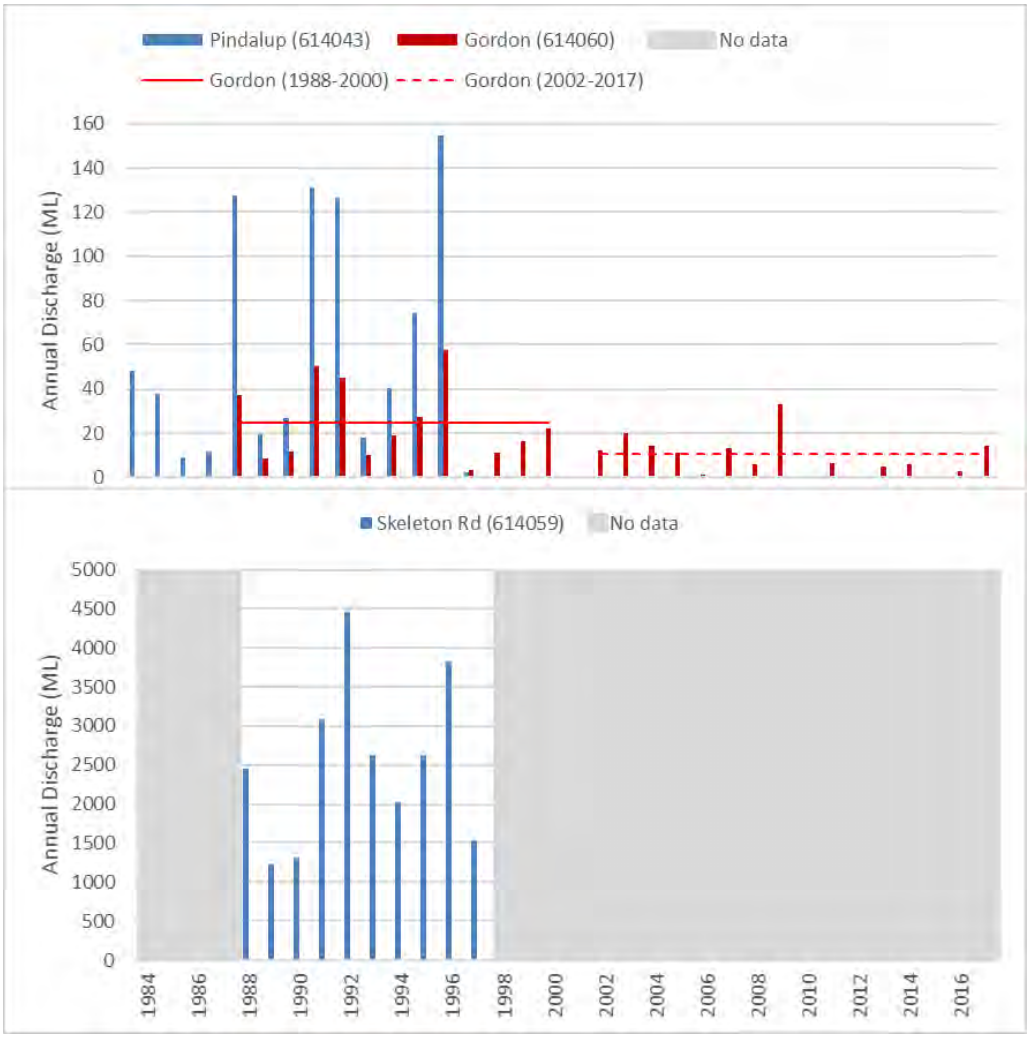


Figure 6-2 *Annual flows at relevant South Dandalup catchment gauging stations*

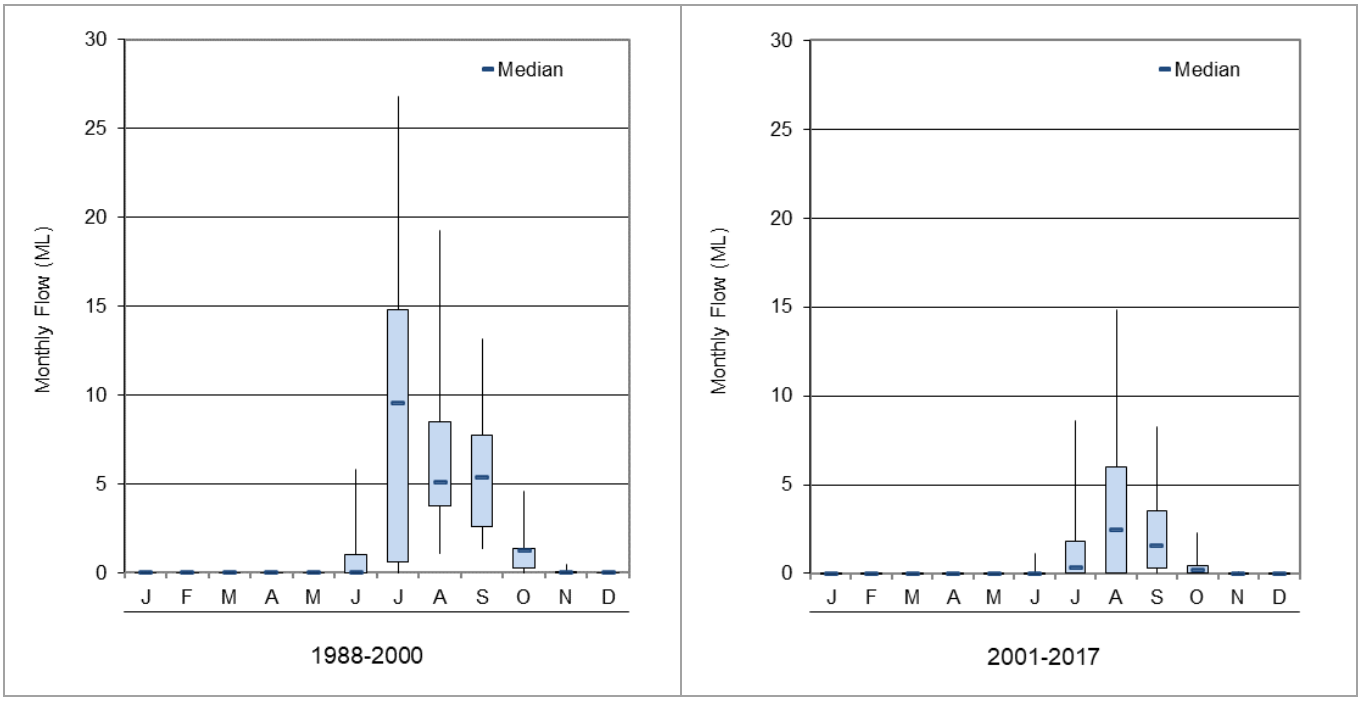


Figure 6-3 *Flow seasonality, Gordon (South Dandalup) for periods 1988-2000 and 2001-2017*

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Short-term trends in surface water level and flow conditions

During the 2020 baseline monitoring period flow conditions at surface water sampling locations were recorded during monthly surface water sampling events (GHD 2021a, Appendix C). Surface water level loggers were installed late September at three Holyoake surface water monitoring locations, two at the downstream extent of representative catchments prior to discharge to the South Dandalup Dam, and one in Swamp Oak Brook downstream of the Holyoake DE in the Murray River catchment.

Key observations from the surface water flow observations include dry conditions observed across multiple sites for all sampling events, including the central South Dandalup tributary through the Holyoake DE, with its upstream location observed to flow during one sampling event. No water level data was recorded at the Swamp Oak Brook monitoring location, while water levels at the other logger locations observed variable response to seasonal rainfall events.

Baseflow and interflow

Data analysis by GHD for the gauging stations located in the study area indicates that baseflow and interflow represents between 37% and 80% of streamflow, depending on location and baseflow separation methodology. The analysis was undertaken for the full streamflow record, varying between sites, between 1980 and 2018. These gauging stations are for much smaller catchments than those used for Serpentine Catchment (section 5.2.1) and represent a wider range or results.

6.2.2 Surface water quality

Historical water quality data

Historical surface water quality monitoring within the proposed Holyoake mine region has primarily been undertaken by DWER, with Alcoa monitoring limited to one site on Davis Brook (DV04) with sufficient data for review. Data is limited to salinity, pH and some turbidity data. As with Myara North mine region, data for many sampling locations is not continuous, and records range from short periods in the 1970s, to periods from the mid 1970s through mid-1980s, or mid-1980s to mid-1990s.

The historical data identifies that surface water is typically fresh, with median EC typically below 350 µS/cm. Limited pH data is available for gauging locations which indicates that median pH of tributaries is neutral.

Baseline turbidity for monitoring locations in the South Dandalup catchment (Holyoake mine region) are marginally higher than Myara North mine region, with median values ranging between 0.9 and 7.3 NTU.

Baseline surface water laboratory results

Baseline surface water sampling events were completed monthly at selected Holyoake mine region surface water monitoring locations between August 2020 and January 2021.

The results of the baseline monitoring program identify that surface water quality is generally similar across the Holyoake region, reflecting the similar hydrological and hydrogeological conditions. As with groundwater quality the surface water quality is typically fresh and consistent with the site setting within state forest.

The surface water physico-chemical samples collected and tested in-situ as well as those tested in the laboratory are similar to historical observations across the Holyoake mine region. Surface water is non-saline with neutral pH. Surface water samples typically had low to moderate turbidity and low total suspended solids. A short continuous turbidity logger record at two sites identified pulses of elevated turbidity that were sustained for up to several hours before returning to background levels. Unlike the fleeting pulses measured at Myara North mine region, these longer pulses are representative of an actual turbidity event. The pulses correspond to storm events, with higher peaks earlier in the season and lower peaks later in the season. The source of the turbidity is unknown. Prescribed burns covering a significant proportion of the catchment were conducted in late 2018.

An extended suite of surface water quality parameters were sampled during the first three months of sampling in August, September and October 2020. Total nutrient levels in surface water of the Holyoake mine region were higher compared to Myara North mine region. Metals concentrations were representative of the similar geological setting, with ANZECC guideline exceedances reported for zinc and copper in limited samples. Microbiological

parameters were detected at all sampling sites, with comparatively higher maximum detections reported at Holyoake mine region than in Myara North mine region.

Low concentrations of PFAS were detected at five sites, however all detections were below the drinking water assessment criteria.

For other contaminants of potential concern, including MBAS surfactants, BTEX compounds, TRH, PAH, OC pesticides and explosives, all samples analysed returned results less than the laboratory limit of reporting.

6.3 Conceptual understanding of surface water and groundwater connectivity

Long-term observations of streamflows and groundwater level observations from the downgradient part of the Holyoake mine region are not available. In their absence, section 6.2.1 presents data from outside of the Holyoake mine region for illustration of likely streamflows expected within the Holyoake mine region.

Despite the lack of observational data within the Holyoake mine region, the nature of and the processes involved in surface water and groundwater connectivity are considered identical to Myara North mine region (described in section 5.3). The notable potential differences are related to:

– Groundwater in Holyoake mine region is deeper than in Myara North mien region. This means that access to watertable for phreatophytic communities is potentially more limited which would also limit their lateral extent. This is also illustrated by the proportion of potential GDEs of the Holyoake mine region which constitutes 17% compared to 28% in Myara North mine region.
– Due to the deeper groundwater levels, surface flows are also likely to be smaller and flow events shorter than in Myara North mine region, since less baseflow would be available to support streamflows. This is supported by baseline surface water monitoring completed in 2020. It is however possible that during the historical period before the last two decades the groundwater levels in Holyoake mine region were shallower and surface flows greater than observed in 2020.

6.4 Environmental values

6.4.1 Potential groundwater dependent ecosystems

Potential GDEs were delineated from detailed flora and vegetation assessment of the Holyoake mine region by Mattiske (2021b), and are presented in Figure 6-4 and detailed in chapter 5 (flora and vegetation) of the Proposal Environmental Review Document.

6.4.2 Aquatic fauna

Fauna habitat

The detailed fauna survey of the Holyoake mien region identified that the drainage lines supporting relatively low dense vegetation have a linkage value as preferred habitat for medium sized mammals such as Quenda and Quokka (GHD 2021g).

Aquatic fauna values

Desktop assessment of the aquatic fauna values of the Holyoake mine region were summarised in WRM (2021). The desktop assessment identified that the Holyoake mine region is expected to support similar diversity of aquatic habitats to the Myara North mine region. Aquatic fauna communities are also expected to be characterised by a high degree of seasonality and high level of species endemism.

A targeted Carter's Freshwater Mussel (EPBC and BC Act Vulnerable) survey completed as part of the detailed and targeted fauna survey of the Holyoake mine region (GHD 2021g) did not identify any presence of mussels. Carter's Freshwater Mussel shells were recorded at two locations during Phase 1 of the Holyoake mien region fauna survey (GHD 2021g), with shells located outside of the Holyoake mine region in the original infrastructure corridor survey area.

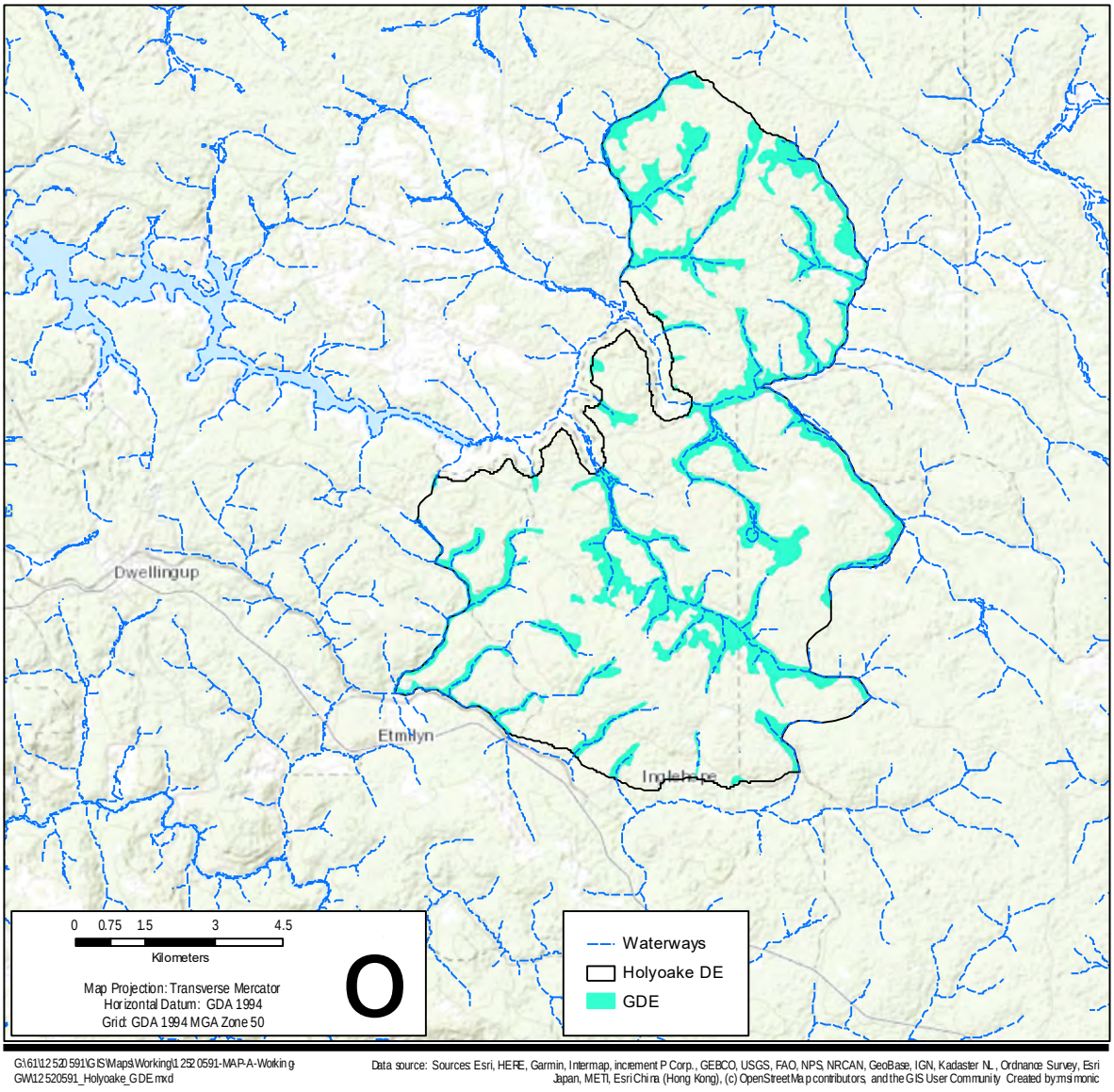


Figure 6-4 Spatial distribution of potential GDEs in Holyoake mine region

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7. Catchment and reservoir hydrology and hydrodynamics

7.1 Hydrology and beneficial use

7.1.1 Serpentine

The Serpentine River and its tributaries, including 39 Mile Brook and Gooralong Brook, are seasonal watercourses that are intermittently connected to both the regional (or in some instances perched) groundwater and the interflow vadose zone.

Surface water flows in these watercourses comprise predominantly baseflow, with short-term contribution from surface flow (surface runoff and near-surface flow) in response to rainfall events. Discharge in the form of baseflow or seepage, at smaller rates, is then present for the subsequent period typically extending some weeks or months following the winter rains and peak storage (highest groundwater levels).

Review of groundwater levels in long term groundwater monitoring bores identifies an average groundwater level decline of approximately 4.5 m since the 1990s (section 5.1.2), with all but two monitoring bores showing declining groundwater levels of between 1 to 10 m.

Streamflows in the Serpentine River and its tributaries have also declined significantly since 2000 (section 5.2.1), with long term streamflow records showing a 50% reduction in streamflow at River Road (Serpentine River) and 80% reduction at Jack Rocks (39 Mile Brook).

Flow from the Serpentine River and tributaries, excluding Gooralong Brook, contribute flow to the Serpentine Dam reservoir. Flow from Gooralong Brook flows through the Jarrahdale townsite, joining the Serpentine River downstream of the Pipehead Dam.

The Serpentine Dam has a full supply capacity of 137.7 GL and collects water from a 664 km^2 catchment. Directly downstream of Serpentine Dam, the 2.6 GL full supply capacity Pipehead Dam is fed by a 28 km^2 catchment consisting entirely of State Forest and Serpentine National Park. Water from Serpentine Dam is released into the Pipehead catchment, and after chlorine disinfection and fluoridation, is piped into the Integrated Water Supply System (IWSS).

Both catchments are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage (MWSSD) Act (1909)*. Both dams are primarily classified as Priority 1 Public Drinking Water Source Areas (PDWSA's), with some private land in the Serpentine Dam catchment area classified as Priority 2. Priority 1 source protection areas have the fundamental water quality objective of risk avoidance. Priority 2 source protection areas have the fundamental water quality objective of risk minimisation.

The dams are also protected by a Reservoir Protection Zone (RPZ), which is delineated by a two kilometre buffer area around the top water level of the reservoir, including the reservoir itself, and not extending outside the catchment area.

Water Corporation's current allocation licence for Serpentine Dam and Serpentine Pipehead Dam (licence 56737) totals 53.89 GL/annum and is issued for the purpose of providing water for public potable water supply and irrigation.

7.1.2 South Dandalup

The South Dandalup River and its tributaries, are seasonal watercourses.

Long-term groundwater levels in a limited set of groundwater monitoring bores in the Holyoake DE have showed declining groundwater levels of close to 9 meters since 1990s (section 6.1.3). Annual streamflow in the adjacent Gordon sub-catchment (gauging station 614060) have also been observed to decline in the period since 2000

(section 6.2.1), with the decline in streamflow considered to be representative of streamflow in watercourses in the Holyoake DE.

The South Dandalup Dam (SDD) has a full supply capacity of 208.2 GL, making it the largest reservoir supplying the IWSS. The South Dandalup Pipehead Dam (SDPD) acts as a pumpback for SDD, adding to the available water for supply to the IWSS. Water from the SDPD is chlorinated before pump back to the SDD. The water abstracted from SDD is further disinfected by chlorination and fluoridated before supplying the IWSS.

The SDD catchment area covers 311 km^2 and is proclaimed under the *MWSSD Act 1909*. Like Serpentine Dam, the catchment is predominantly classified as a priority 1 PDWSA, with a small area of private land managed as a priority 2 source protection area.

Water Corporation's current allocation licence for SDD (licence 56734) is 26.9 GL/annum. This licence is issued for the purpose of providing potable water for public water supply to the IWSS. Alcoa currently have two licences (No. 83356 and 153635) to abstract a total of 100 ML/a from SDD, which is used to supply water (primarily for dust suppression) to the Huntly Mine.

7.1.3 Upper Wungong Brook

Part of the upper Wungong Brook catchment lies within the north-eastern extent of the Myara North DE. As with other surface watercourses in the Myara North study area the upper Wungong Brook and its tributaries are seasonal watercourses that are intermittently connected to both the regional (or in some instances perched) groundwater and the vadose zone.

Longer term groundwater monitoring of two groundwater bores in the upper Wungong Brook catchment, identified strong seasonal variation in groundwater level (section 5.1.2) and indicates a groundwater level decline which is well pronounced in the upper slopes (7 m over the last three decades) and less so along the valley floors (1 m decline over the last three decades).

Similar to surface watercourses within the Myara North DE, streamflow in the upper Wungong River and its tributaries has declined significantly since 2000 (section 5.2.1).

7.2 Reservoir water quality and hydrodynamics

7.2.1 Serpentine and Serpentine Pipehead

Historical turbidity data for the Serpentine and Serpentine Pipehead reservoirs was estimated from the turbidity data collected for the period 2000-2020 at the offtake (GHD 2021f). The historical turbidity data indicates that offtake turbidity was generally less than 1 NTU throughout the 20 year period, including during mining disturbance within the PDWSAs and RPZ.

The data does not display any increasing trend with turbidity associated with cumulative mining disturbance or the effects of large bushfires within the PDWSAs or RPZ. While it is noted that dispersion and mixing across the reservoir may flatten turbidity spikes, any significant turbidity events would be noticeable at the outlet.

7.2.2 South Dandalup

Historical turbidity data for the South Dandalup reservoir was estimated from the turbidity data collected for the period 2000-2020 at the offtake (GHD 2021f). As with the Serpentine and Serpentine Pipehead reservoirs (section 7.2.1) the offtake turbidity data was generally less than 1 NTU, with no significant turbidity events from catchment disturbance observed within the data.

7.3 Proposed river crossings

Transition of the Huntly Mine into the Myara North DE and the Holyoake DE will require construction of new waterway crossings over Big Brook, Serpentine River, and South Dandalup River and tributaries. The waterway crossings will comprise haul road crossings or conveyor crossings.

The Myara North conveyor crossings at Big Brook and Serpentine River are located on former reservoir inundation areas, lying at an elevation of approximately 203.3 mAHD and 207.7 mAHD which correspond to Serpentine Reservoir levels at 45% and 68% capacity, respectively. The former inundation areas are now covered by native vegetation regrowth, as reservoir water levels have been less than 70% capacity since 1999 and less than 60% capacity since 2010.

The conveyor crossings will be provided with drainage controls to capture potential water contaminants, as follows:

– A series of three sumps located on each side of the waterway, each with a holding capacity of 1% Annual Exceedance Probability (AEP) storm event of seven-day duration.
– The first of the three sumps lined with high-density polyethylene (HDPE) to capture hydrocarbons in the event of a diesel spill and prevent infiltration.
– A three-stage sump configuration with a controlled outlet that is only opened after sampling confirms water quality to ensure no release of hydrocarbon-contaminated or turbid water into the stream channel.
– Emergency overflows constructed above the maximum reservoir level (RL 212.39 m) in the third stage of the sumps which are rock pitched to slow water velocity preventing scour and associated turbidity.

Each conveyor will be constructed on an earth causeway across the waterways, with the following design:

– Multiple culverts or arch to accommodate 0.2% AEP storm event of 72 hour duration.
– Wing walls installed on culverts or arch to protect causeway embankment.
– Access road bitumen sealed to reduce generation of sediment and turbidity.
– Minimum cross fall on the causeway of 3% to allow free draining of the sealed surface.
– Fully enclosed conveyor and road to reduce windblown dust generated from the conveyor or travelling light vehicles and to reduce the size of the catchment requiring treatment by the sumps.

The haul road crossing over the Serpentine River would be as for the conveyor crossing with the following changes to cater for 190 tonne haul trucks rather than light vehicles and a conveyor:

– Dual lane road that meets DMIRS safety specifications.
– Wider and higher earth causeway.
– Higher load capacity and longer culverts.

8. Assessment of potential mining impacts

8.1 Impacts to water dependent ecosystems and upstream tributaries

8.1.1 Groundwater level changes

Numerical modelling was completed to assess groundwater level changes due to the Proposal on groundwater flow processes and interaction of those processes with intermittent streamflows in the Myara North mine region (GHD 2021c) and Holyoake mine region (GHD 2021d). The numerical modelling used a combination of numerical groundwater with streamflow routing and soil water balance models (MODFLOW-USG and PERFECT).

Within both mine regionss, the modelling indicates that changes in recharge and surface flow dynamics due to bauxite mining have the potential to raise the groundwater levels in mined areas by several metres. Predicted change in groundwater levels is noted to follow seasonal variation.

Within the Myara North mine region, groundwater level mounding during the clearing and mining period has the potential to increase groundwater levels by several metres, with more than 10 m rises immediately below cleared and mined areas in some instances compared to unmined conditions. Areas of greatest rise lie directly beneath the most densely mined areas. This agrees well with historical observations of groundwater level change around other mined areas, for example at MK42132A location, near cleared area south of the Myara North mining region, a rise of 12 m was observed, with MK43041A, MK43071A, and MK43072A also showing similar increases. If bores situated some distance away from the cleared areas show water level increases of this magnitude, the groundwater rise directly underneath the cleared areas would be even more pronounced.

Within the Holyoake mine region, groundwater level mounding during the clearing and mining period has the potential to temporarily raise groundwater levels by several metres, again with more than 10 m rises below cleared and mined areas compared to unmined conditions. Groundwater levels in and around mined and cleared areas rise over the first 15 years. The climate change model, that considers a step decrease in recharge and runoff by 30% shows groundwater levels to be projected deeper but with similar mounding effects. In locations close to mining, mining essentially offsets and delays climate related groundwater level declines.

Within both the Myara North mine region and the Holyoake mine region the extent of mounding is predicted to be generally localised to cleared and mined areas.

The magnitude of mounding decreases towards low-lying areas and groundwater receptors (potential GDEs). Mounding within most of the potential GDEs is predicted to be less than 1 m, however in some localised areas, groundwater rise during mining is predicted also in 1 m to 2 m and 2 m to 5 m bands. The predicted mounding bands in potential GDE areas for dry, typical, and wet climate during mining and post mining are presented in Figure 8-1 and Figure 8-2.

The groundwater level mounding effects in the Myara North mine region and the Holyoake mine region recede over the post-mining rehabilitation period with the following key observations made:

– In the Myara North mine region, residual groundwater level mounding of between 1 to 5 m is predicted by the end of the simulation in 2060 for drier periods, and up to 10 m during wetter periods.
– In the Holyoake mine region, residual groundwater level mounding is predicted to be typically 1 to 10 m, but up to 20 m beneath the most densely mined areas.
– The magnitude of mounding diminishes to approximately 1 m in valley floor areas away from mining.

The predicted change in groundwater levels are within the historical groundwater level range of potential GDEs located in the valley floor systems, and therefore the temporary change in groundwater levels is not anticipated to have an adverse impact on potential GDEs.

The predicted change in groundwater levels are a snapshot in time relative to the baseline scenario. Due to the trend decline in groundwater levels, the rise is less when compared to current or historic groundwater levels.

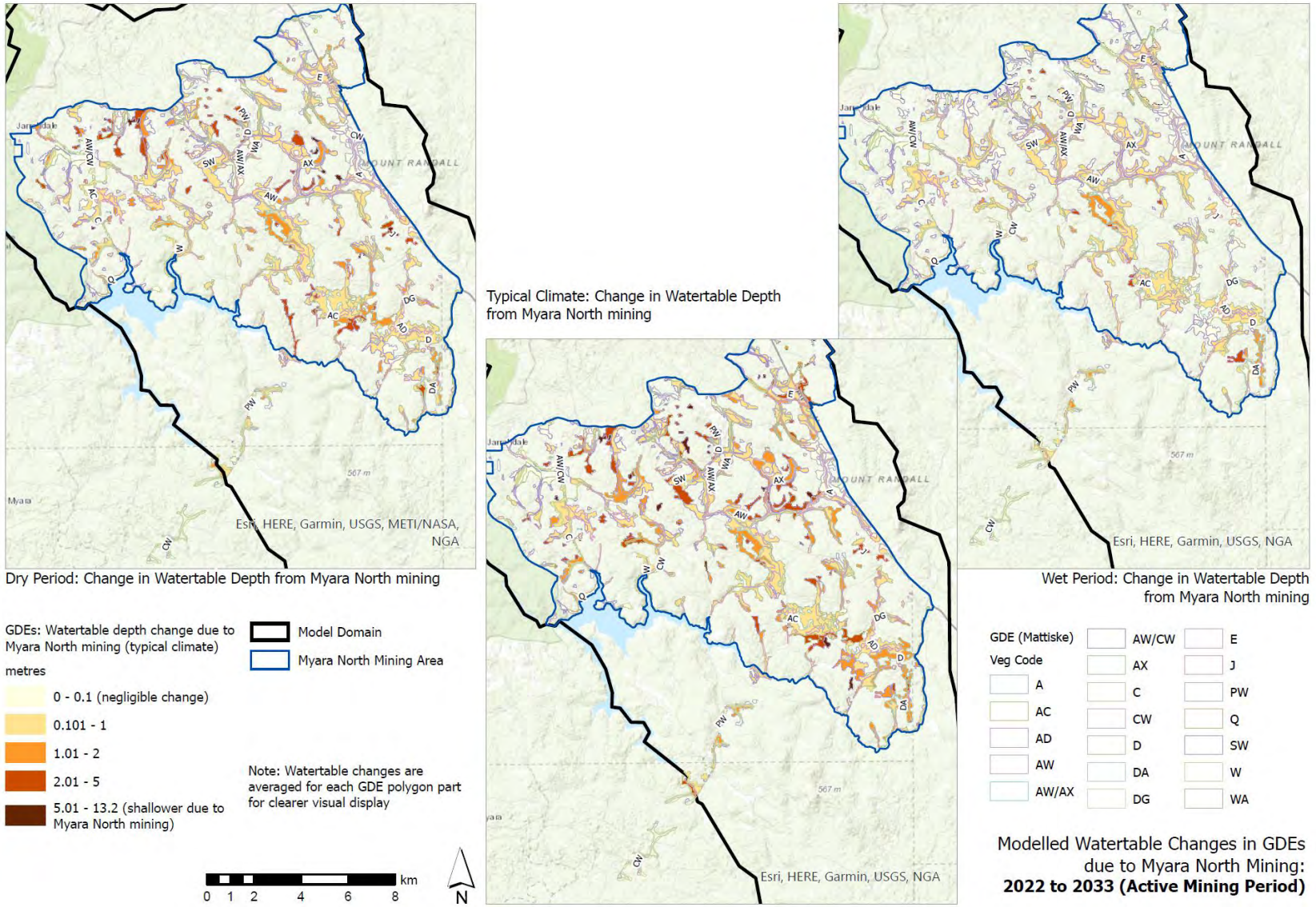


Figure 8-1 Modelled change in depth to groundwater within mapped GDEs, Myara North, 2022 to 2033 (during mining)

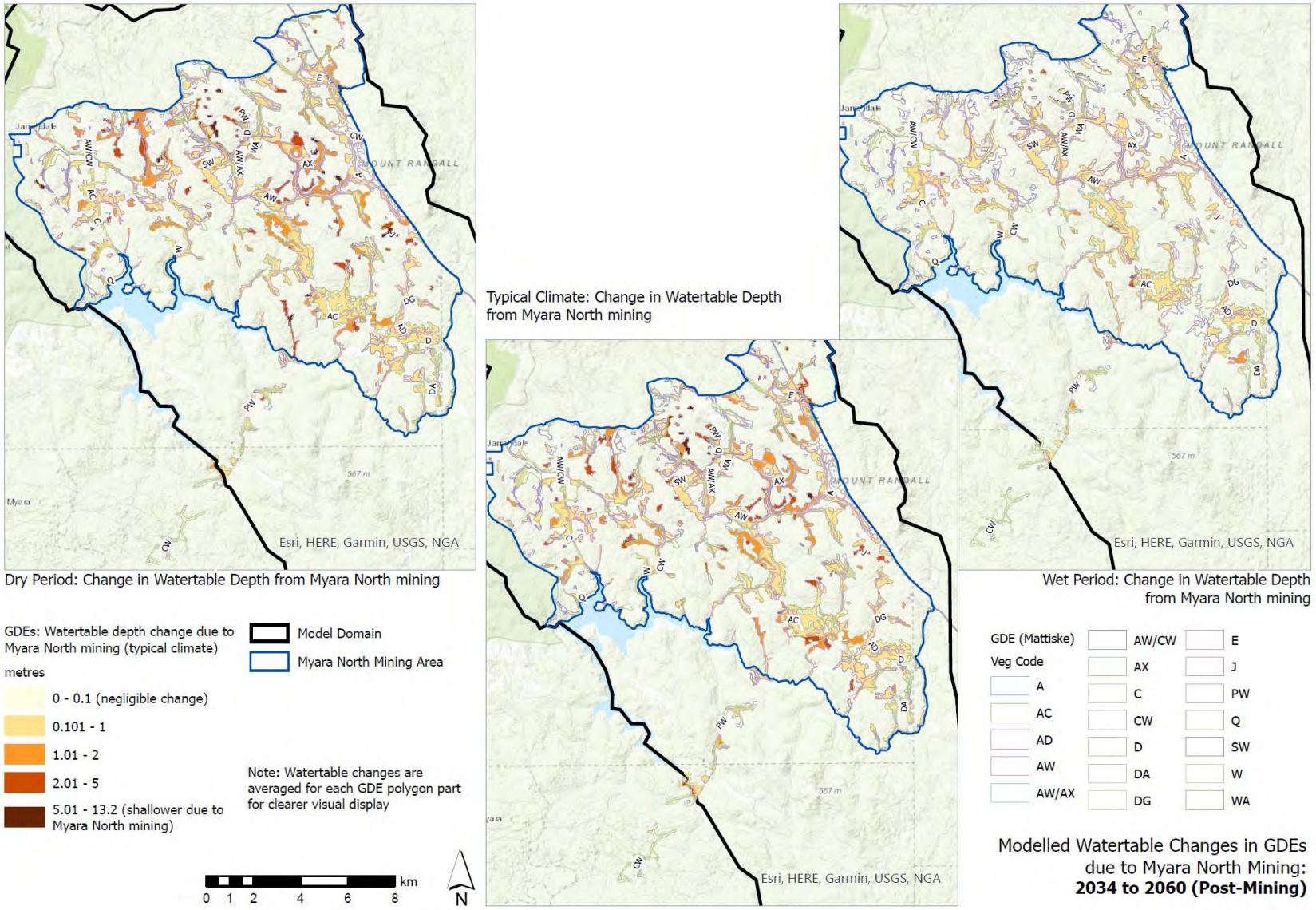


Figure 8-2 ***Modelled change in depth to groundwater within mapped GDEs, Myara North, up to 2060 (post mining)***

8.1.2 Streamflow changes

Historical impacts

Historical mining impacts on streamflow provide an indication of future mining impacts. Historical mining in the McCoy and O'Neil regions represented approximately 15% of the Big Brook stream gauge catchment area. The clearing associated with this mining commenced in 2002 and ceased in 2014.

Rehabilitation commenced in 2006 and is ongoing. Referring to Figure 8-3 and Figure 8-4, there is a slight change in gradient of the double-mass runoff curve since the commencement of mining, indicating an increase in runoff from the mined area relative to nearby unmined catchments. Mining in the Serpentine River catchment commenced in 2010 but represents less than 2% of the stream gauge catchment area and is therefore considered "largely unmined" for comparison purposes.

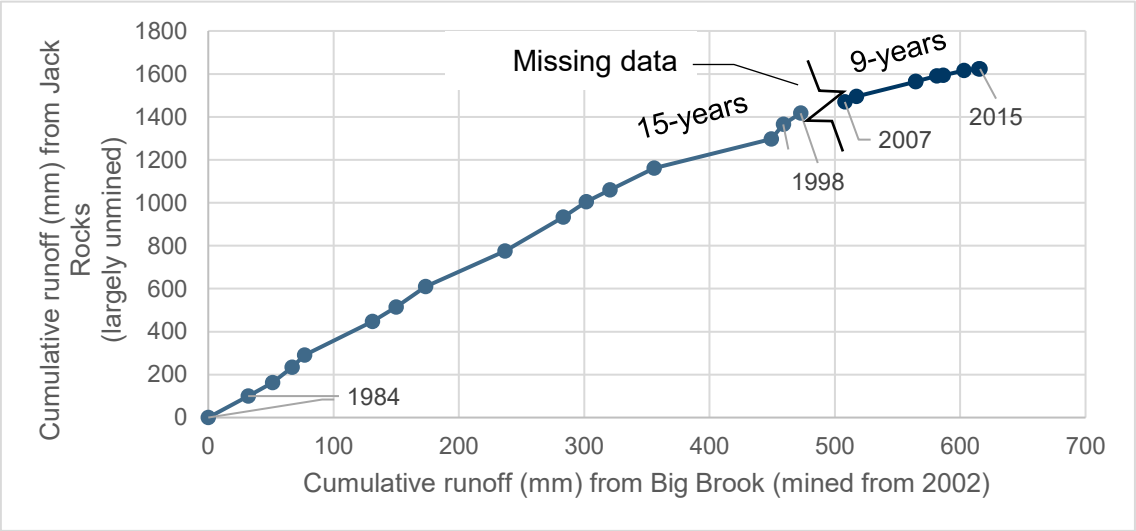


Figure 8-3 *Mining impacts to Big Brook runoff compared to Jack Rocks*

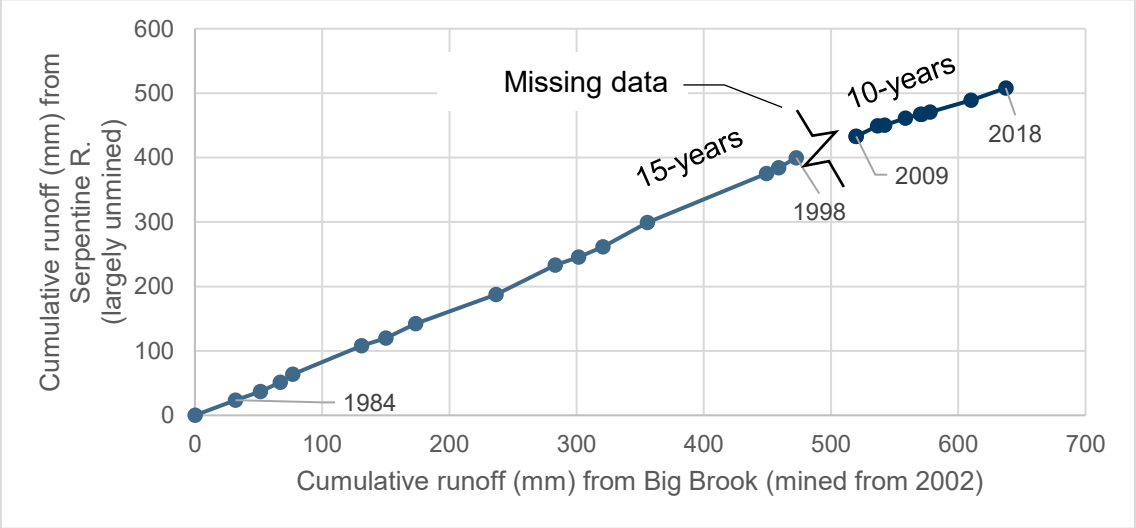


Figure 8-4 *Mining impacts to Big Brook runoff compared to Serpentine River*

Future impacts

The changes in recharge and flow dynamics due to bauxite mining and the increase in groundwater levels predicted from the numerical modelling, has the potential to increase streamflows during clearing, mining and rehabilitation periods.

Serpentine Reservoir (Myara North)

Within the Myara North DE, mining will result in an estimated average increase in streamflows of the Serpentine Reservoir from the modelled catchments of 1.3 GL/year over the active clearing and mining period. The following patterns of streamflow change are predicted as a comparison for mined and unmined cases (Figure 8-5):

– Higher annual flows are predicted to occur in the first decade of mining, typically 1 GL/yr but ranging as high as 2 to 3 GL/yr in some years (Figure 8-5).
– From 2030 onwards, during the post-rehabilitation period, annual flow decreases occur, ranging from nil in dry years, to 1 GL/yr in wetter years
– In some dry years marginally higher annual flows to the reservoir are simulated to occur due to higher residual groundwater level from the mining and clearing period.
– The modelled climate change (not shown in Figure 8-5), simulated as 30% decrease in recharge and surface flows, indicates reduced inflows into the reservoir but also reduced impact from mining (Figure 8-6).

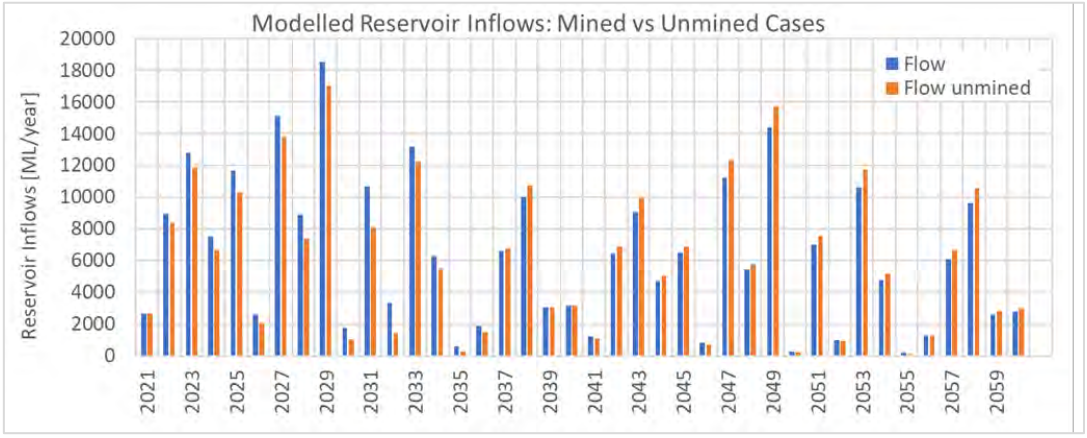


Figure 8-5 ***Modelled streamflow to Serpentine Reservoir (mined vs unmined)***

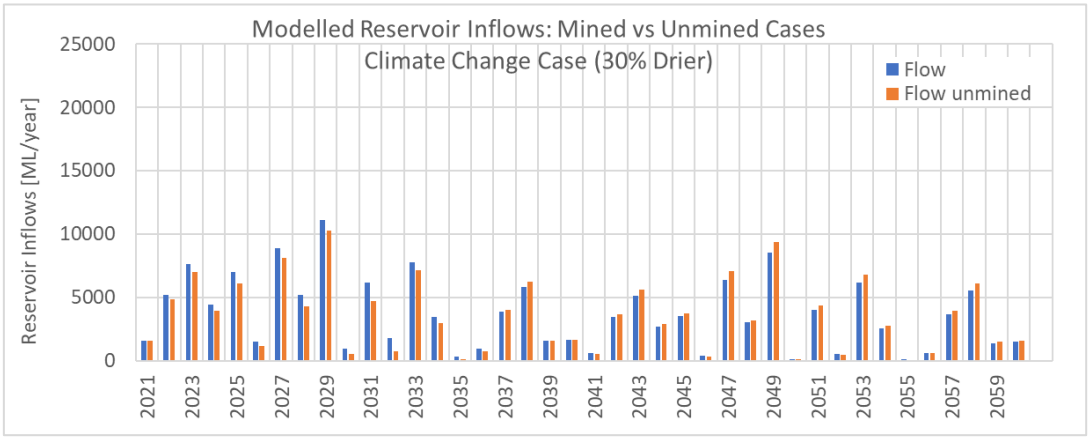


Figure 8-6 ***Modelled streamflow to Serpentine Reservoir (mined vs unmined), climate change case***

Wungong Brook (Myara North DE)

Within the Wungong Brook Catchment the streamflows are predicted to slightly increase during mining (on average between 0.05 to 0.1 GL/yr, followed by minor flow reduction (on average 0.02 GL/yr) during post-mining period (Figure 8-7), similar to catchments feeding the Serpentine Reservoir.

During mining the predicted flows are on average 0.6 GL/yr, while post-mining they will be approximately 0.35 GL/yr. These represent only minor change when compared to non-mining scenario (0.09 and -0.005 GL, respectively).

Climate change, modelled as 30% decrease in recharge and surface flows will result in reduced flows in the Wungong Brook, typically by over 50% (Figure 8-8).

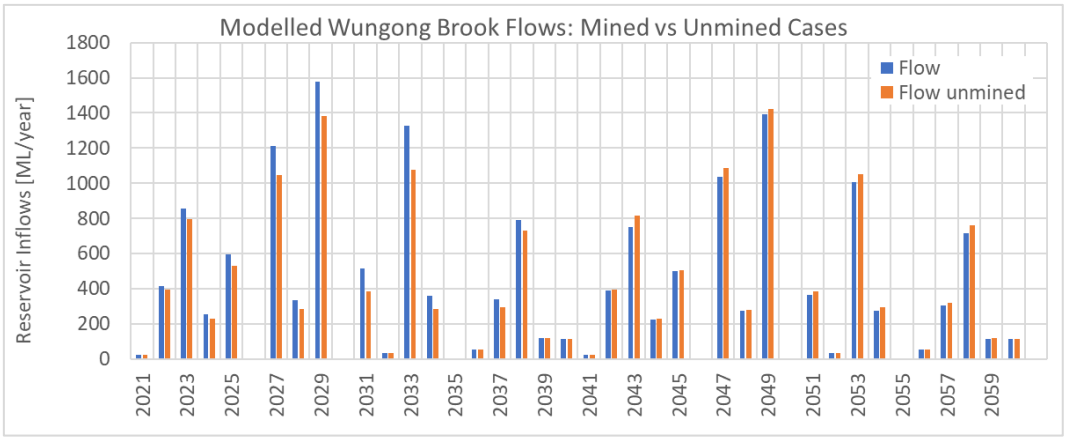


Figure 8-7 ***Modelled streamflow to Wungong Reservoir (mine vs unmined)***

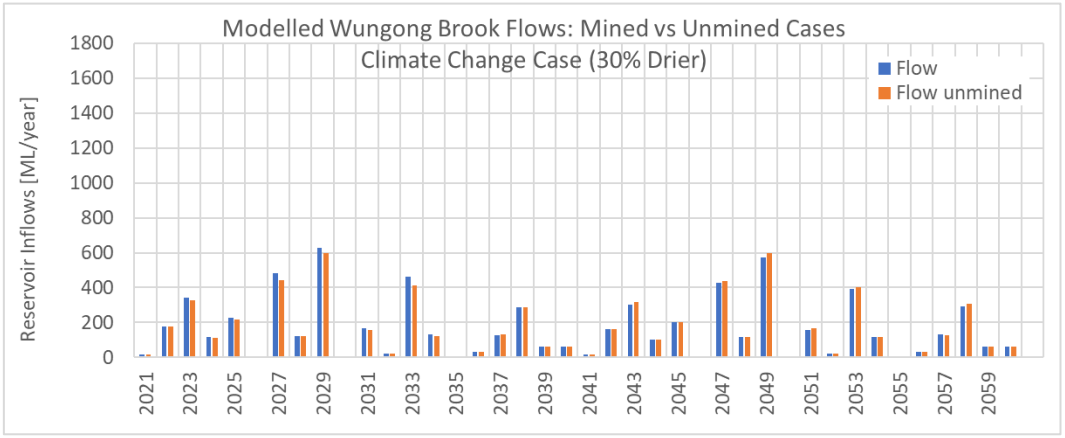


Figure 8-8 ***Modelled streamflow to Wungong Reservoir (mined vs unmined), climate change case***

Gooralong Brook (Myara North DE)

The streamflow change in Gooralong Brook is predicted to follow the same pattern as Wungong Brook and streamflows to the Serpentine Reservoir. Slight increase in streamflows is predicted during mining and clearing, followed minor reductions in the rehabilitation and post-mining (Figure 8-9).

During mining the predicted flows are on average 2.3 GL/yr, while post-mining they will be approximately 1.7 GL/yr. These would constitute only a minor change when compared to non-mining scenario (2.25 and 1.74 GL, respectively).

The climate change effect, represented as 30% reduction in groundwater recharge and surface flow, however this is attributable to climate change rather than the effect of mining. The climate change scenario suggests average flows of 1.42 and 1.0 GL/yr for mining and post-mining periods, respectively. The differences between mining and non-mining scenarios are minor, flows under non-mining scenario would be 1.40 and 1.06 GL/yr.

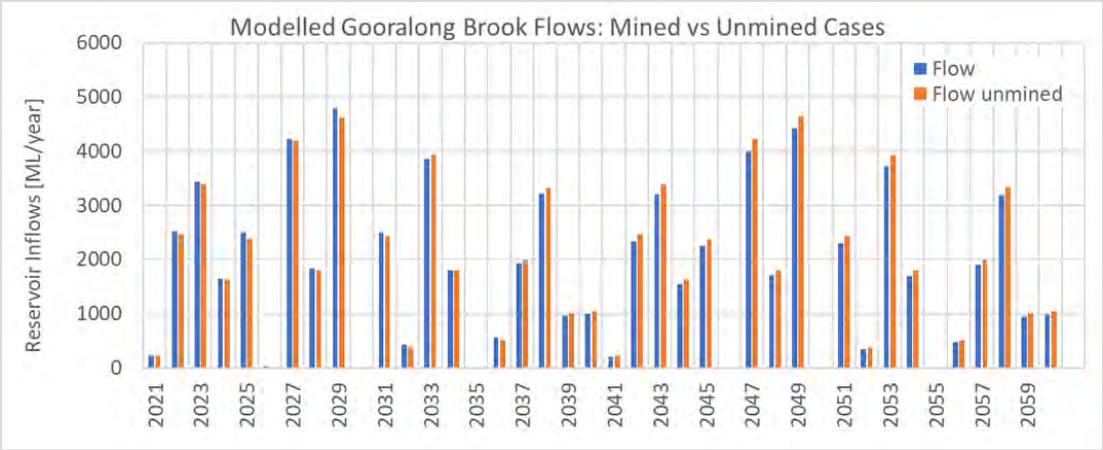


Figure 8-9 Modelled streamflow, Gooralong Brook (mined vs unmined)

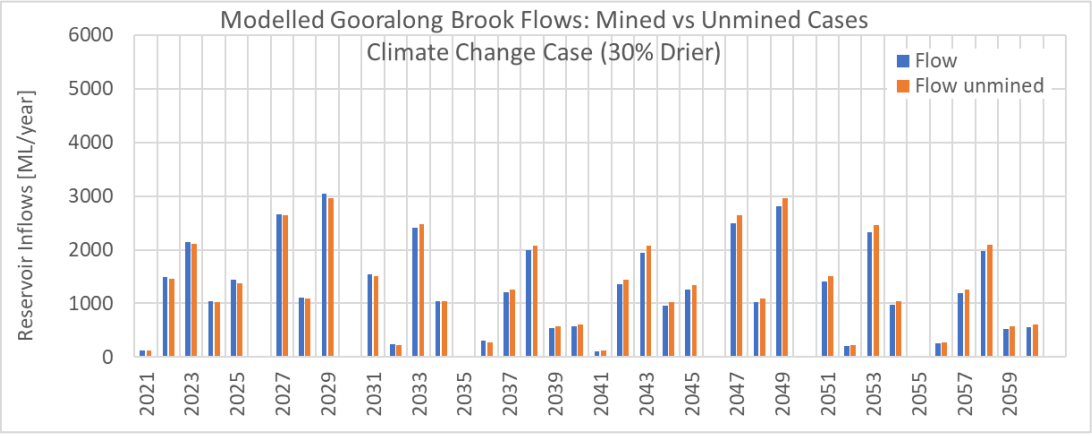


Figure 8-10 Modelled streamflow, Gooralong Brook (mined vs unmined), climate change case

South Dandalup Reservoir (Holyoake DE)

Within the Holyoake DE, numerical groundwater modelling identified average increases in streamflows to the South Dandalup Reservoir from the modelled catchments of 0.1 GL/year during the active clearing and mining period from 2029 to 2033, and 0.2 to 0.3 GL/year in the post-mining period (GHD 2021d). The annual variability is shown in Figure 8-11.

Streamflows in the Holyoake DE are predicted to be marginally higher during and after mining compared to the base case without mining.

The potential impact of the climate change – drying conditions – will result in further reduction of streamflows, which are predicted to reduce by approximately 30% (Figure 8-12), i.e., equivalent to reduction of recharge. Mining will still provide minor increase of streamflows.

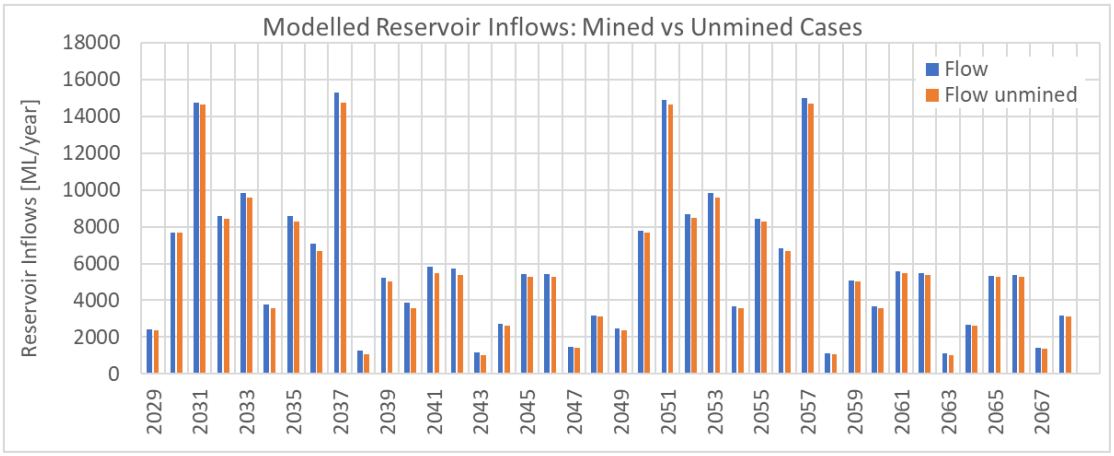


Figure 8-11 Modelled streamflow to South Dandalup Reservoir (mined vs unmined)

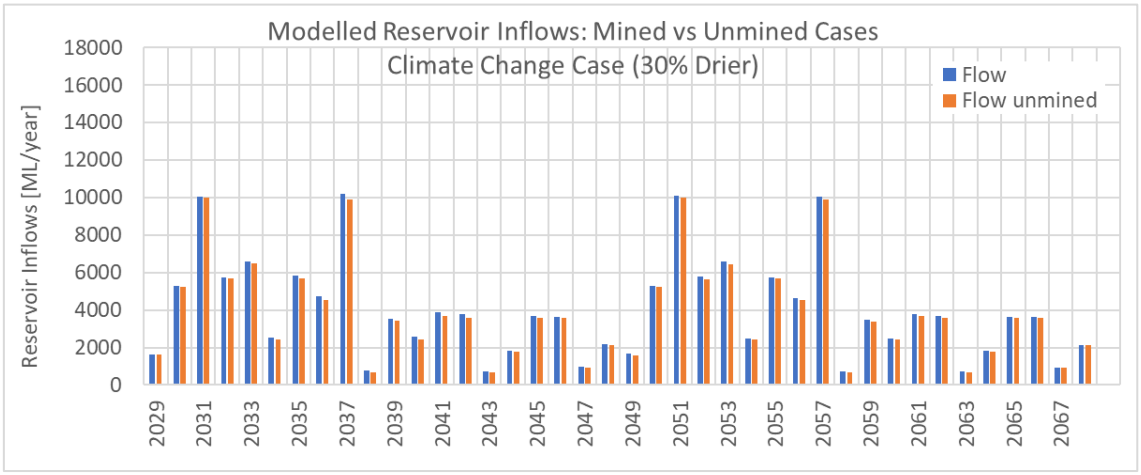


Figure 8-12 Modelled streamflow to South Dandalup Reservoir (mined vs unmined), climate change case

Davis Brook (Holyoake DE)

Mining in the Holyoake DE is predicted to increase flows in the Swamp Oak Brook during mining and partly post mining. In absolute values the increases will be small, on average 0.06 GL/yr and 0.17 GL/yr during and post mining (Figure 8-13). During some years of mining the increases will be more notable, for example between 2034 and 2042 the increases may represent a multiple of flows that would have occurred for the unmined case. During dry years of the post-mining period the flows are predicted to be very similar to unmined cases, but in wetter years flows may increase 25% to 50%.

The potential climate change effect on Davis Brook flows is reduction of overall flows when compared to the current case. M, mining effects will remain the same (i.e., higher flows in wetter years, similar flows in dry years (Figure 8-14). The flow increases for the climate change case would still occur, but will be reduced, i.e., 0.01 GL/yr and 0.06 GL/yr during and post-mining.

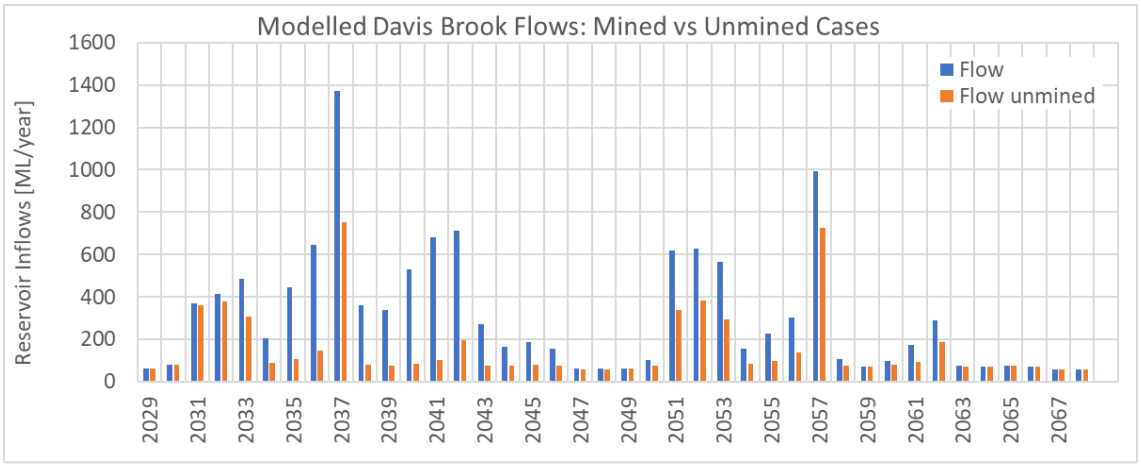


Figure 8-13 Modelled flows, Davis Brook (mined vs unmined)

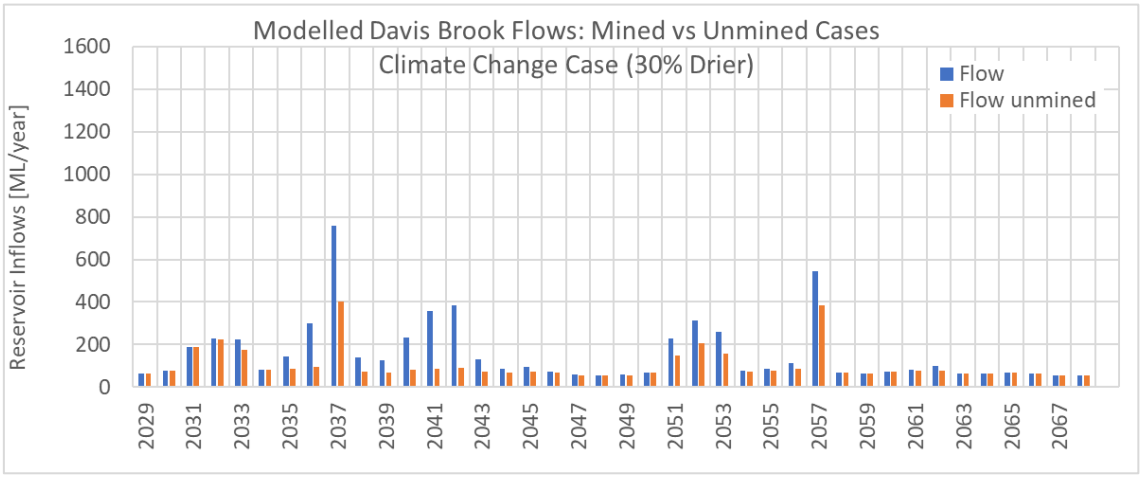


Figure 8-14 Modelled flows, Davis Brook (mined vs unmined), climate change case

Swamp Brook (Holyoake DE)

Mining in the Holyoke DE is predicted to introduce minor flow increases in Swamp Brook, 0.01 GL/yr and 0.02 GL, during mining and during the post-mining period (Figure 8-15). Slightly increased flows will occur during both, the wet and dry years.

The drying climate is predicted to reduce the flows by almost 50% (Figure 8-16), while preserving the overall effect of mining on streamflows (slight increase of flows during and post-mining).

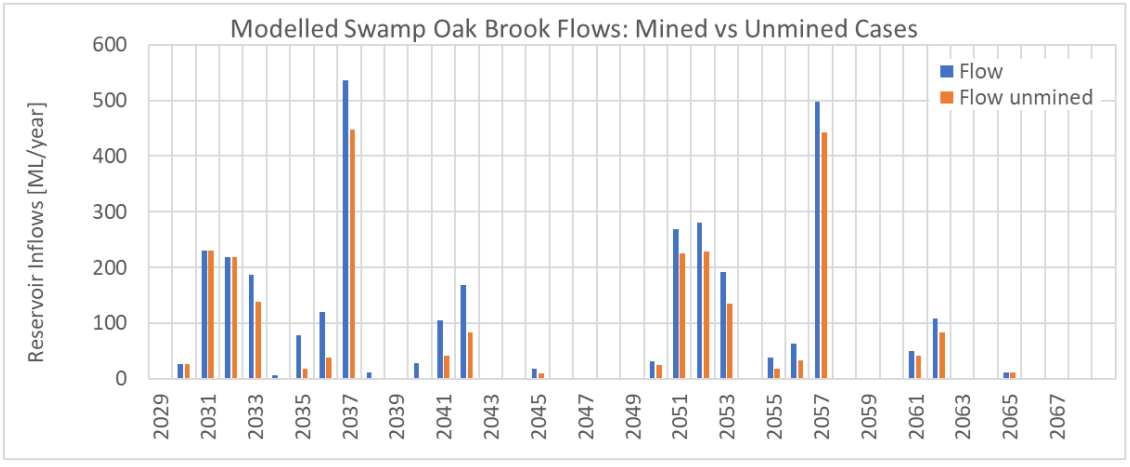


Figure 8-15 Modelled flows, Swamp Oak Brook (mined vs unmined)

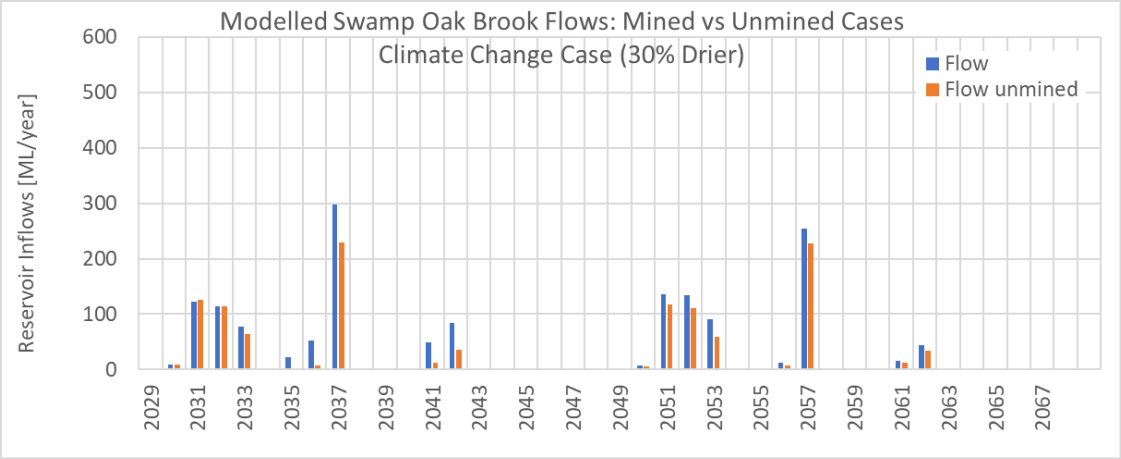


Figure 8-16 Modelled flows, Swamp Oak Brook (mined vs unmined), climate change case

8.2 Water quality changes

8.2.1 Salinity

Estimates of potential changes to the TDS of streamflows entering the reservoir(s) are made using the modelled changes in streamflows along with observed groundwater salinity (measured as TDS). This is achieved by comparing modelled streamflow volumes and their proportional groundwater discharge component between mined and unmined cases. Modelled streamflows are converted to salt loads using observed TDS ranges.

Observed groundwater TDS (for example average 417 mg/L for the Myara North DE, with lower and higher estimates of 180 and 650 mg/L, respectively, is assumed to be reflective of the potential near-stream groundwater that discharges into the stream. For the Holyoake DE, the lower and higher estimates of groundwater TDS are 430 and 850 mg/L, respectively.

Equally the surface component of streamflows (surface runoff and nears surface intermittent flow) is assumed to be consistently low (adopted 100 mg/L in this case) compared to that of groundwater. It is also assumed the salinity contribution from surface flows between mining and non-mining cases is negligible.

The numerical model was used to forecast changes in salinity (salt load as TDS) of surface watercourses within the Myara North DE (GHD 2021c) and the Holyoake DE (GHD 2021d). The model predictions indicate some variability in salinity increases.

For the Myara North mining region, the predicted TDS change is -1 mg/L to -10 mg/L for mining and 3 to 20 mg/L post-mining periods compared to the non-mining case, with annual variations shown in Figure 8-17
Modelled reservoir inflow TDS change, Serpentine Reservoir (that uses the upper groundwater TDS estimate). When considering the drying climate case, the predicted average change is -1 to -7 mg/L and 3 to 24 mg/L for mining and post-mining cases, respectively.

For the Holyoake mining region, the predicted TDS increase is 3 to 7 mg/L and 11 to 17 mg/L for mining and post-mining periods compared to the non-mining case. The annual variations are presented in Figure 8-18.

When considering the effect of drying climate, the predicted average change is 3 to 7 mg/L and 6 to 13 mg/L for mining and post-mining cases, respectively. The lower TDS increase under the climate change scenario is attributed to the deeper groundwater level in response to reduced recharge, and hence reduced groundwater contribution to streamflows.

The robustness in estimating the predicted salinities is demonstrated in Figure 8-19, which indicates that the use of the upper groundwater TDS values is appropriate for salinity estimates.

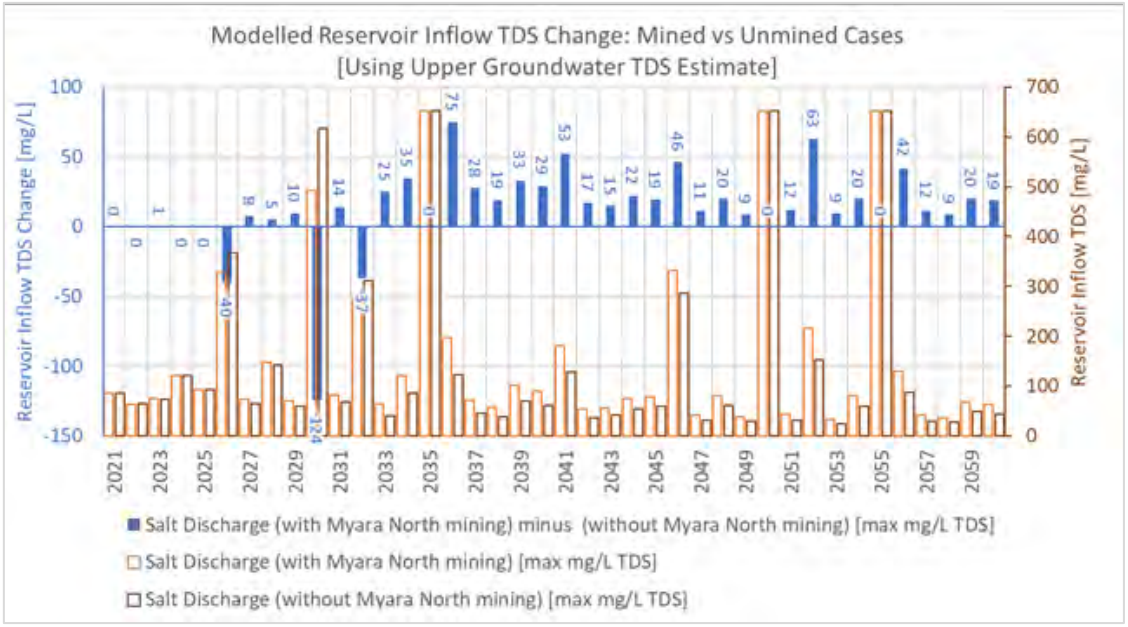


Figure 8-17 Modelled reservoir inflow TDS change, Serpentine Reservoir

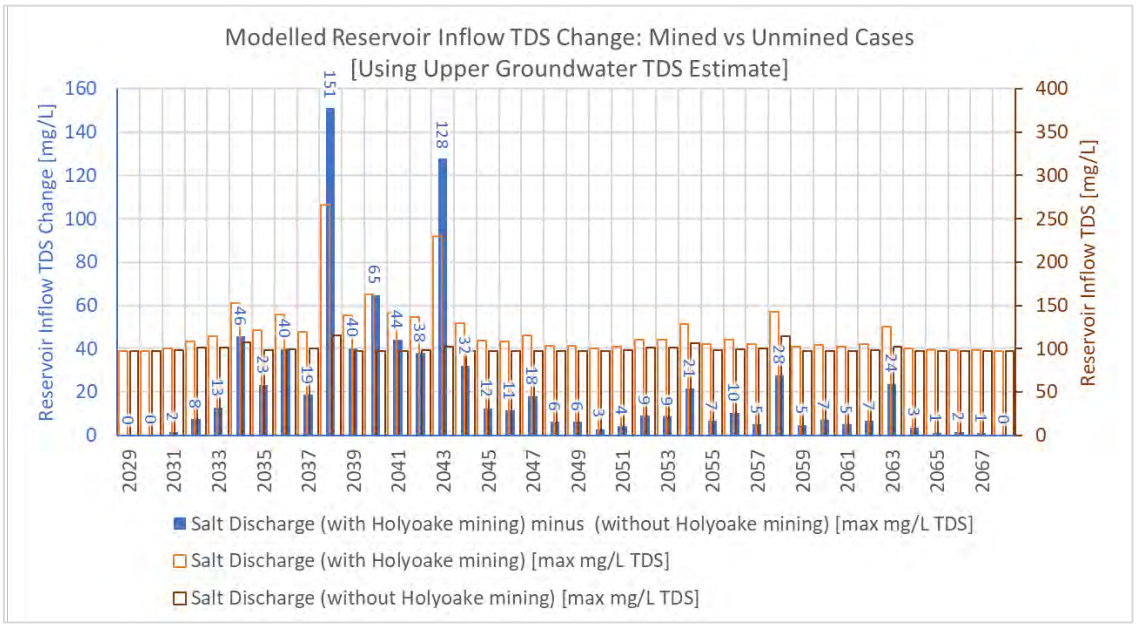


Figure 8-18 Modelled reservoir inflow TDS change, South Dandalup Reservoir

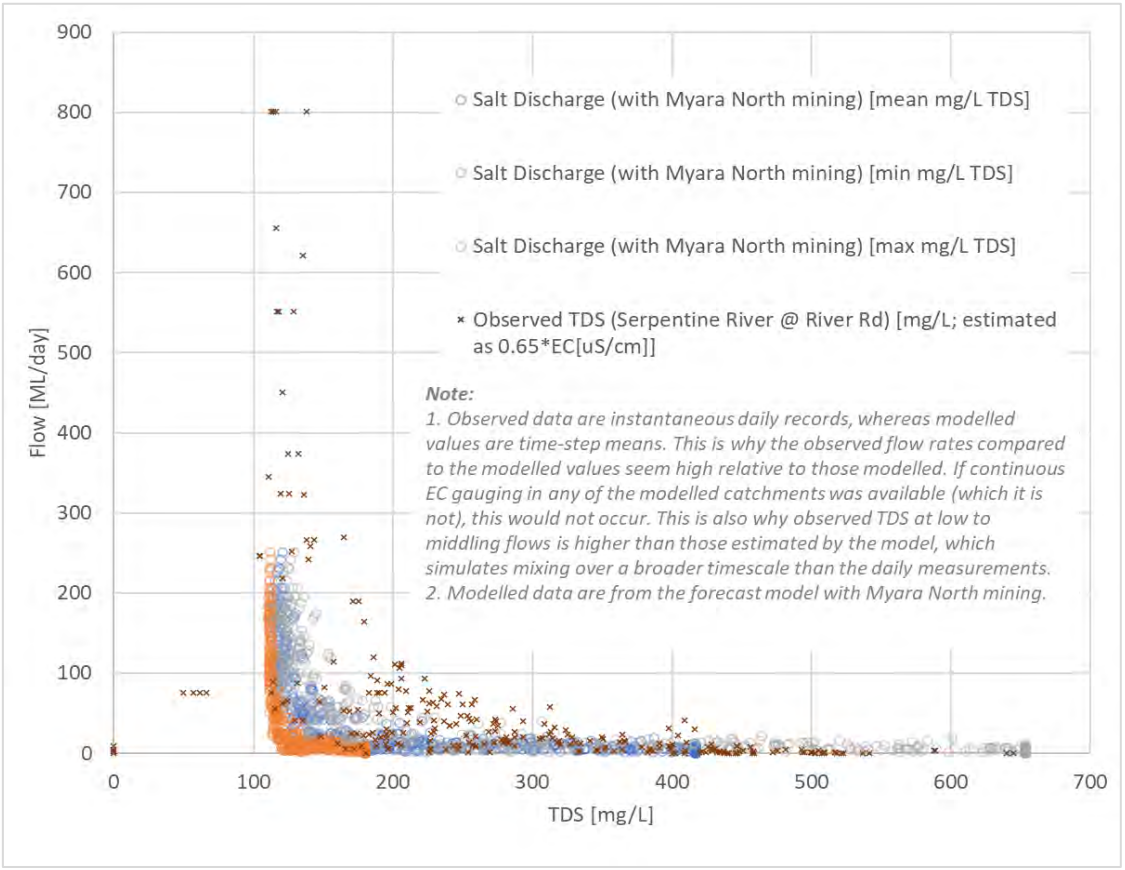


Figure 8-19 Relationship between streamflows and TDS

Uncertainty analysis of the base climate case indicates relatively narrow uncertainty in projected TDS loads to the reservoir, except in the driest of years, when groundwater discharge becomes a significant component of remaining streamflow. The analysis estimates are from 2 to 23 mg/L increased average annual TDS of surface streams entering the reservoir during active mining, and from 10 to 55 mg/L in the post-mining period (Myara North).

Average annual TDS over these two periods is estimated to range from 100 to 130 mg/L and from 105 to 163 mg/L, respectively, when mining occurs in Holyoake.

8.2.2 Sediment and turbidity

Erosion, sedimentation, and turbidity occur naturally and because of clearing activities. Naturally occurring sedimentation and turbidity spikes are associated with large storm events. Where clearing and mining has occurred, exposed soils are subject to erosive action, mobilising sediment and suspended solids. The amount of erosion is a factor of soil properties (erodibility), catchment slope and length, rainfall intensity (erosivity), and vegetative cover. Historical mining activities have used drainage infrastructure to control sedimentation and turbid discharge, however failure or exceedance of some structures has resulted in sedimentation and turbid discharge occurring.

In the absence or failure of drainage controls, sediment laden discharge has the potential to impact the flora and fauna of downstream tributaries through the process of sedimentation, accumulating in areas of low velocity and smothering bottom-dwelling organisms and their habitats. Further downstream in the reservoir, turbidity reduces the penetration of light and therefore the ability of algae and other aquatic plants to photosynthesize and clogs the gills of fish (DWER, 2017. Fine sediment and the nutrients it transports are also associated with seasonal blue-green algal blooms in other waterbodies. As a consequence of excess sediment, the abundance and distribution of aquatic plants and animals change, natural food webs are disrupted and aquatic diversity declines (DWER, 2017.

With drainage controls that prevent the discharge of sediment and turbid runoff, no turbidity or sedimentation impacts to streams and reservoirs will occur.

8.3 Impacts to reservoirs

8.3.1 Serpentine

Streamflow

The changes in recharge and flow dynamics due to bauxite mining and increase in groundwater levels predicted from the numerical groundwater modelling, has the potential to increase streamflows during clearing, mining and rehabilitation periods.

Within the Myara North DE mining will result in an estimated average increase in streamflows of the Serpentine Reservoir from the modelled catchments of 1.3 GL/year over the active clearing and mining period from 2023 to 2033. This additional streamflow produced by mining will partially counterbalance the water use from mining, described in section 8.5.3, and to a lesser extent decreases due to climate change.

The following patterns of streamflow change are predicted as a comparison for mined and unmined cases (Figure 8-5):

– Higher annual flows are predicted to occur in the first decade of mining, typically 1 GL/yr but ranging as high as 2 to 3 GL/yr in some years (Figure 8-5).
– From 2030 onwards, during the post-rehabilitation period, annual flows decreases occur, ranging from nil in dry years, to 1 GL/yr in wetter years
– In some dry years marginally higher annual flows to the reservoir are simulated to occur due to higher residual groundwater level from the mining and clearing period.
– The modelled climate change (not shown in Figure 8-5), simulated as 30% decrease in recharge and surface flows, indicates reduced inflows into the reservoir but also reduced impact from mining (Figure 8-6).

Salinity

The Myara North DE numerical groundwater model was also used to forecast changes in salt load (TDS) of surface waters inflowing to the Serpentine reservoir from the catchments modelled, arising from the Myara North DE mining. Model scenarios under “current” climatic conditions (last 20 years), and a drying climate under climate change (30% step reduction in recharge, runoff, and interflow from the last 20 years’ conditions) indicate the following:

– Variable years of salinity increases and decreases during the land clearing and mining (including clearing for roads and infrastructure a year before clearing for mining pits) period (2022 to 2033), with an average reduction of between -1 mg/L and -10 mg/L for the current climate case and between -1 mg/L and -7 mg/L under the climate change case.
– In the post-mining period (2034 to 2060), the modelling estimates an increase in average TDS load of between 3 mg/L and 20 mg/L for the current climate case, and between 3 mg/L and 24 mg/L for the climate change case. This indicates relatively small differences in salinity load impact from Myara North mining activities between the climate scenarios modelled.

Sediment and turbidity

Sediment and turbidity impacts to the reservoir are described in section 8.5.

Hydrocarbons

Hydrocarbon impacts to the reservoir are described in section 8.5.

PFAS, PFOA and PFOS

PFAS, PFOA and PFOS impacts to the reservoir are described in section 8.5.

Other water quality impacts

– Explosives residue
– Carbide residue
– Contamination from spills and/or leaks from storage and handling of hazardous materials and waste

8.3.2 Serpentine Pipehead

8.3.3 Sediment and turbidity impacts to the reservoir are described in section 8.5.South Dandalup

Streamflows

Numerical groundwater modelling completed to assess impacts of mining on near surface groundwater flow processes and interaction of those processes with intermittent streams flows in the Holyoake DE identified average increases in streamflows to the South Dandalup Reservoir from the modelled catchments of 0.1 GL/year during the active clearing and mining period, and 0.2 to 0.3 GL/year in the post-mining period (GHD 2021e, Figure 8-11).

The potential impact of the climate change – drying conditions – will result in further reduction of streamflows, which are predicted to reduce by approximately 30% (Figure 8-12), i.e., equivalent to reduction of recharge. Mining will still provide minor increase of streamflows.

Salinity

The outcomes of the Holyoake DE numerical groundwater model (GHD 2021e) were also used to forecast changes in salt load (TDS) of surface waters inflowing to the South Dandalup reservoir from the catchments modelled, arising from Holyoake DE mining. During the clearing and mining period the salinity increases averaged between 5 mg/L and 11 mg/L for the current climate case (last 20 years climate looped) and between 3 mg/L and 7 mg/L for the climate change scenario (30% reduction in recharge, runoff and interflow from the current conditions). For the post-mining period the salinity increases averaged between 11 mg/L and 24 mg/L under current climate conditions, and between 6 mg/L and 13 mg/L for the climate change scenario.

Sediment and turbidity

Sediment and turbidity impacts to the reservoir are described in section 8.5.

Hydrocarbons

Hydrocarbon impacts to the reservoir are described in section 8.5.

PFAS, PFOA and PFOS

PFAS, PFOA and PFOS impacts to the reservoir are described in section 8.5.

Other water quality impacts

Water quality impacts from the following potential contaminants of concern are described in section 8.5:

– Explosives residue
– Carbide residue
– Contamination from spills and/or leaks from storage and handling of hazardous materials and waste
– Fertilisers during rehabilitation

8.3.4 Upper Wungong Brook

Streamflows

Numerical groundwater modelling completed to assess impacts of mining on near surface groundwater and streams flows in the Myara North DE identified slight increases in streamflows within the Wungong Brook catchment during mining (on average between 0.05 to 0.1 GL/yr, followed by minor flow reduction (on average 0.02 GL/yr) during post-mining period (Figure 8-7), similar to catchments feeding the Serpentine Reservoir.

During mining in the Myara North DE the predicted flows are on average 0.6 GL/yr, while post-mining they will be approximately 0.35 GL/yr. These represent only minor change when compared to non-mining scenario (0.09 and -0.005 GL, respectively). Climate change, modelled as 30% decrease in recharge and surface flows will result in reduced flows in the Wungong Brook, typically by over 50% (Figure 8-8).

Salinity

Salinity changes were not calculated for the Upper Wungong Brook catchment, however given that clearing associated with mining activity represents just 2.4% of this catchment, compared to 3.5% for the Serpentine catchment, Wungong Brook salinity changes are expected to be similar to or less than those predicted for Serpentine.

Sediment and turbidity

Sediment and turbidity impacts to the reservoir are described in Section 8.5.

Hydrocarbons

Hydrocarbon impacts to the reservoir are described in Section 8.5.

PFAS, PFOA and PFOS

PFAS, PFOA and PFOS impacts to the reservoir are described in Section 8.5.

Other water quality impacts

Water quality impacts from the following potential contaminants of concern are described in section 8.5:

– Explosives residue
– Carbide residue
– Contamination from spills and/or leaks from storage and handling of hazardous materials and waste

8.4 Impacts to Peel-Yalgorup System Ramsar Site

8.4.1 Myara North

The north-west portion of the Myara North DE (24.72 km^2) is located within the Gooralong Brook sub-catchment. Downstream of the Myara North DE the Gooralong Brook flows through the Jarrahdale townsite before discharging into the lower Serpentine River approximately 5.5 km downstream of the Serpentine Pipehead Dam.

The Gooralong Brook - Mundlimup gauging station (site 614073), located downstream of the Jarrahdale townsite, reports average annual flow for the period 1951 to 1998 of 10,594 ML (Table 5-2). It is noted that this flow record precedes the observed step change in streamflow reported after 2000 (Section 5.2.1), with streamflow declines of between 30% and 80% reported for other Myara North study area gauging stations in the period post 2000.

Average annual flow in the lower Serpentine River at Lowlands gauging station (gauging station 614114) for the period 1998 to 2020 is 13,535 ML.

Further, DWER (2017) report that average annual summer flow release volume from the Serpentine and Pipehead Dam reservoirs to the lower Serpentine River is between 800 and 860 ML/year (for low inflow and standard inflow years respectively).

While the north-west portion of the Myara North DE comprises a significant proportion of the Gooralong Brook catchment at the Gooralong Brook - Mundlimup (~48%), it comprises just 2.4% of the unregulated lower Serpentine River catchment area.

8.4.2 Holyoake

As noted in Section 4.6.2, the majority of the Holyoake DE (11,808 ha or 63% of total) is located within the South Dandalup Dam catchment. There is no release to the South Dandalup River downstream of the South Dandalup Dam.

The southern 2,461 ha of the Holyoake DE (13% of total) lies within the catchments of Davis Brook (1,792 ha) and Swamp Oak Brook (669 ha), which are un-regulated tributaries to the Murray River, comprising approximately 26% of the Davis Brook catchment and 9% of the Swamp Oak Brook catchment respectively.

Davis Brook has a catchment of approximately 6,900 ha and has a gauging station the Murray Valley Plantation (614047) approximately 1.5 km upstream of the confluence with Murray River. Swamp Oak Brook has a catchment of approximately 7,100 ha, with a gauging station on its upper reach at Chadoora (614045) recording limited historical flow.

During the baseline monitoring period (GHD 2021a) a single sample was collected from site DV04 on Davis Brook in August, with the site dry during all other monthly monitoring events. Samples were collected in August and September at site HSW02 downstream of Chadoora, two downstream monitoring sites (6141470 or HSW03) were dry for all monthly monitoring events, and a water level logger at HSW03 recorded no surface water flows.

The Murray River is gauged at the Baden Powell station (614006) which has a catchment of 6,760 km^2 (approximately 676,000 ha). The station lies immediately downstream of Lane Poole Reserve, approximately 1.7 km downstream of the confluence with Davis Brook and approximately 5.6 km downstream of the confluence with Swamp Oak Brook.

The southern section of the Holyoake DE comprises <1% of the Murray River at Baden Powell station.

8.5 Impacts to drinking water

8.5.1 Public health

Sediment and turbidity

Turbidity is a key water quality concern for drinking water sources. Whilst not hazardous in itself, turbidity is able to reduce the efficacy of the chlorine treatment processes to inactivate or remove pathogens. Historically, mining has generated turbid runoff from the failure of drainage controls. As described in section 7.2, offtake monitoring data does not display any increasing trend with turbidity associated with mining disturbance.

Turbidity of water at customer taps should be less than 5 NTU, and it is desirable that turbidity be <1 NTU at the time of disinfection (NHMRC, 2011. As part of the DWRA, GHD (2021 undertook hydrodynamic modelling of suspended solids (SS) inputs to the reservoirs, in the form of 1 µm diameter inorganic particles (clay) and 5 µm diameter inorganic particles (silt). The proportion of these particles in the modelled inputs was allocated to simulate natural waterways for un-mined catchment areas, and to simulate mining sumps for inputs from mined catchment areas. The model was simulated for a range of existing and future mining conditions, drainage failure scenarios (5%, 30%, 75%), climatic seasons (winter, summer), and storm intensities (1 Exceedance per Year, 10% Annual Exceedance Probability, 1% Annual Exceedance Probability), for the Serpentine, Serpentine Pipehead, and South Dandalup reservoirs.

Results indicate that for the Serpentine Main Dam, baseline turbidity exceeds 1 NTU at the offtake but never 5 NTU, adopting a 1:1 TSS:NTU relationship. Turbidity concentrations are sensitive to changes in sump failure suspended solids concentrations, as mining comprises a sufficient proportion of the catchment landscape to do so. In contrast, South Dandalup Dam is not sensitive to sump failure suspended solids concentrations, as the future clearing area is a small proportion (4.8%) of the overall catchment area. This relationship is assumed to exist for the upper Wungong Brook, where the future clearing area is 2.4% of the reservoir catchment.

It is important to note that the 30% and 75% drainage failure rates are an order of magnitude higher than what has been observed in the Huntley and Willowdale mine to date for a single rainfall event. Failures are also assumed to be complete and total failures directly connected to the reservoir without any capture or settlement in overland flow paths or streams.

Due to the hydrodynamic barrier effect induced by the Serpentine Pipehead primary inflow and outflow in proximity to the dam wall, there was little change in turbidity predicted for this reservoir.

The following figures illustrate the cumulative frequency of SS (turbidity) concentrations for existing and future mine scenarios compared to the baseline.

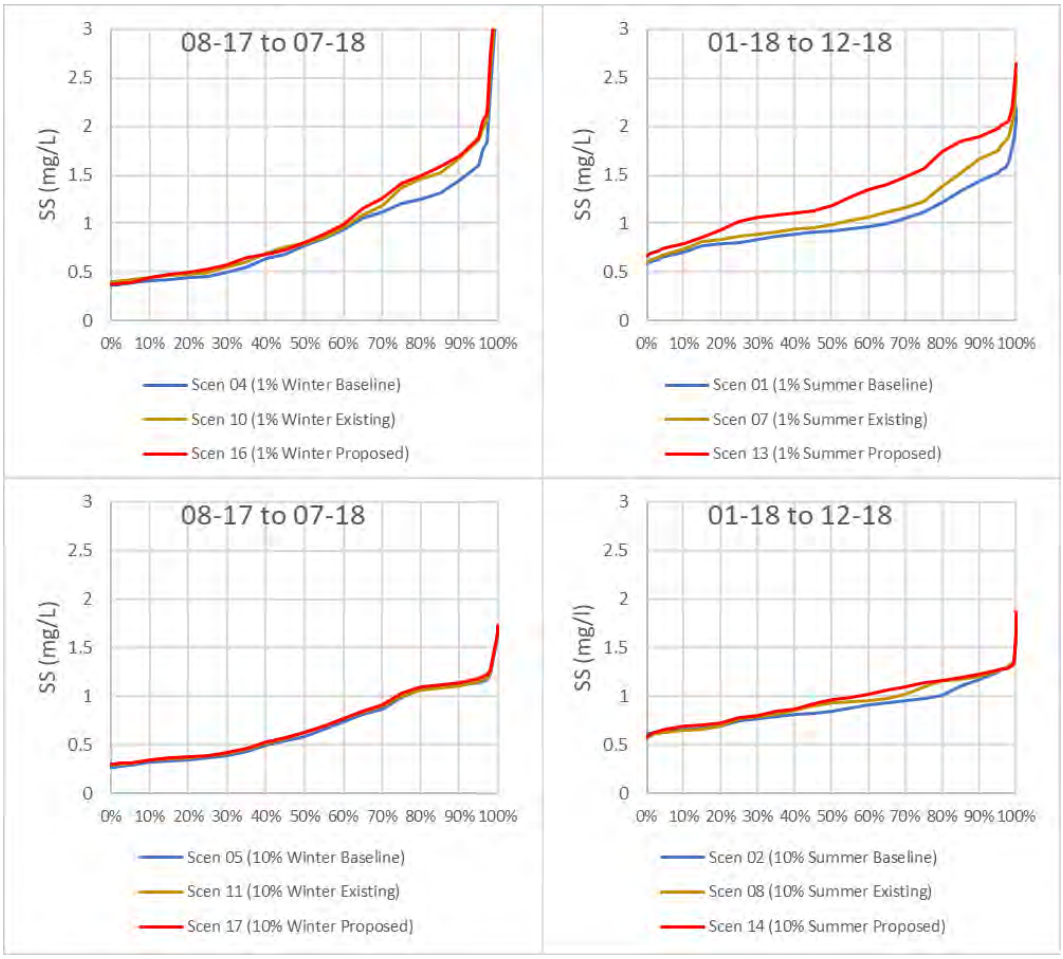


Figure 8-20 Percentile plots of simulated Serpentine withdrawal SS (silt + clay) of winter[2] and summer[3] 1% and 10% AEP inflow event scenarios with 30% sump failure SS levels

[2] Percentiles over 1 year from 1 August 2017 to 31 July 2018.
[3] Percentiles over 1 yar from 1 January to 31 December 2018.

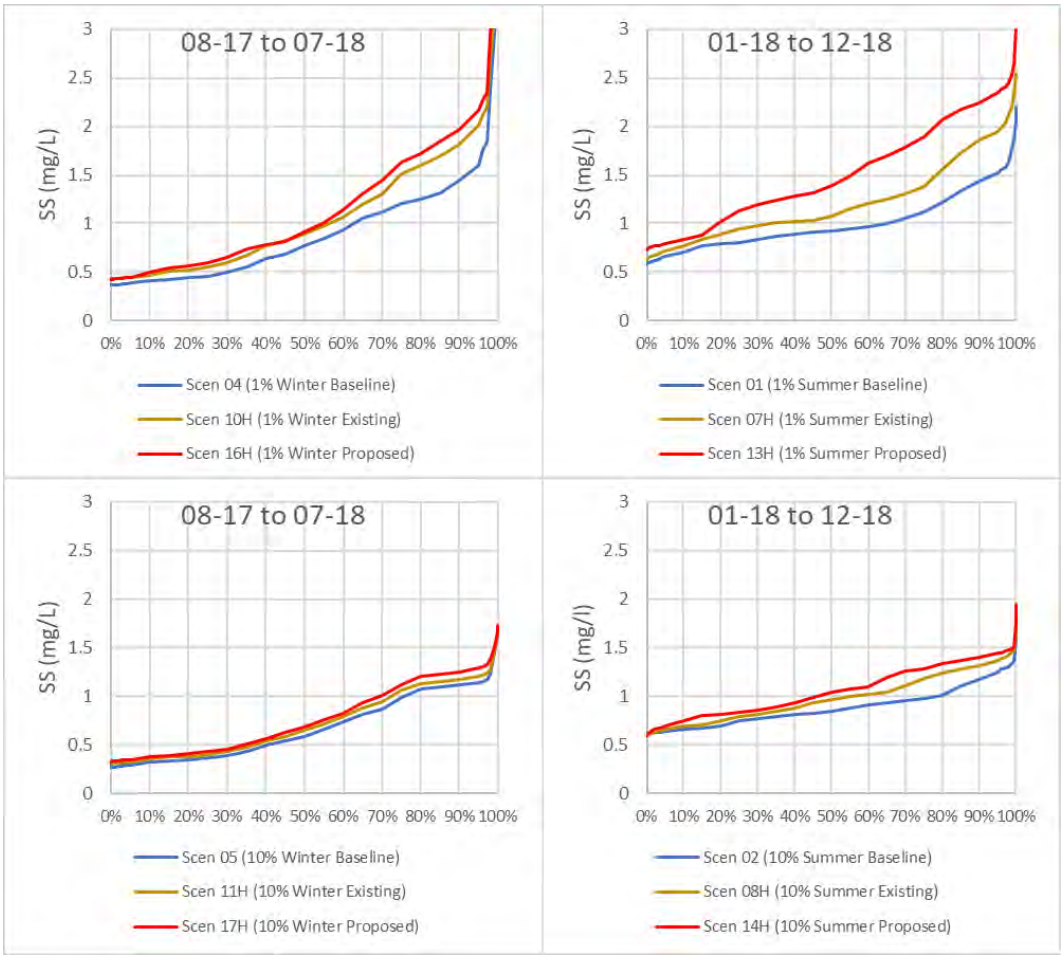


Figure 8-21 Percentile plots of simulated Serpentine withdrawal SS (silt + clay) of winter and summer 1% and 10% AEP inflow event scenarios with 75% sump failure SS levels

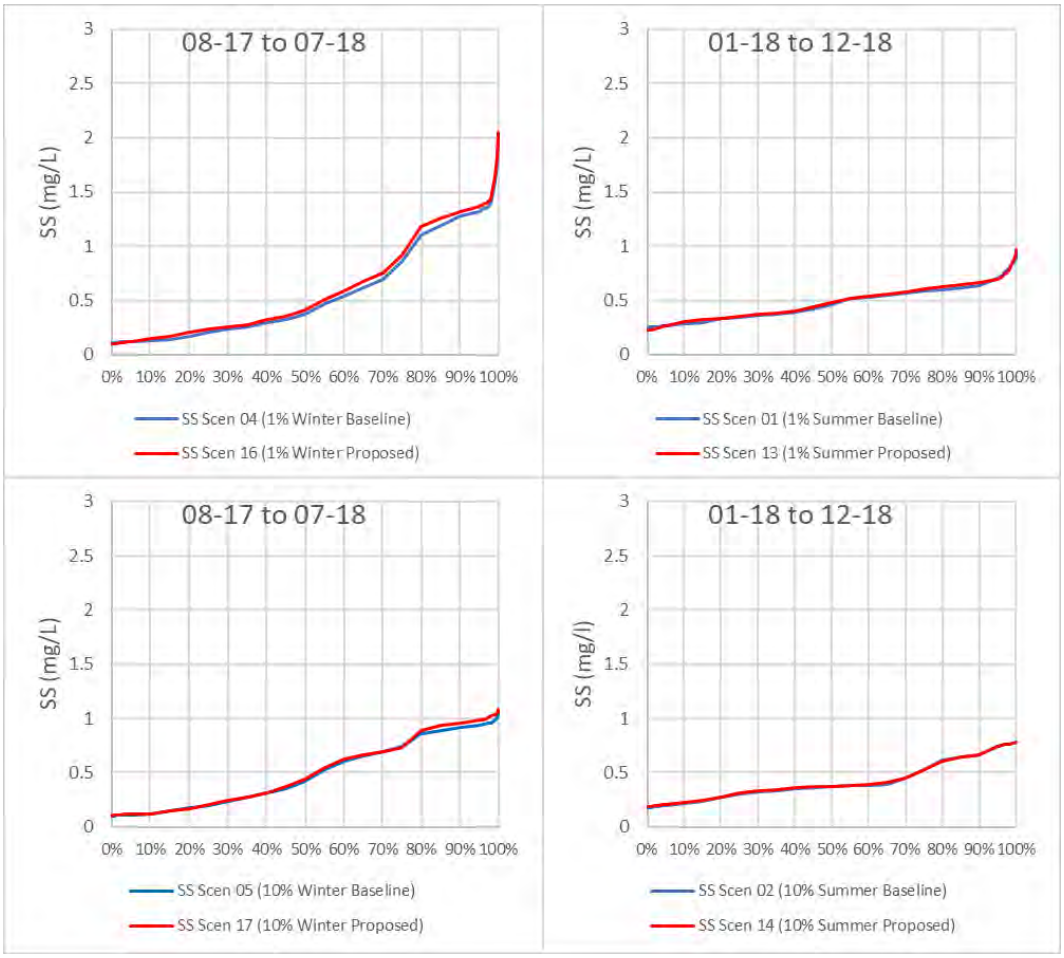


Figure 8-22 Percentile plots of simulated South Dandalup withdrawal SS (silt + clay) of winter and summer 1% and 10% AEP inflow events with 30% sump failure SS levels.

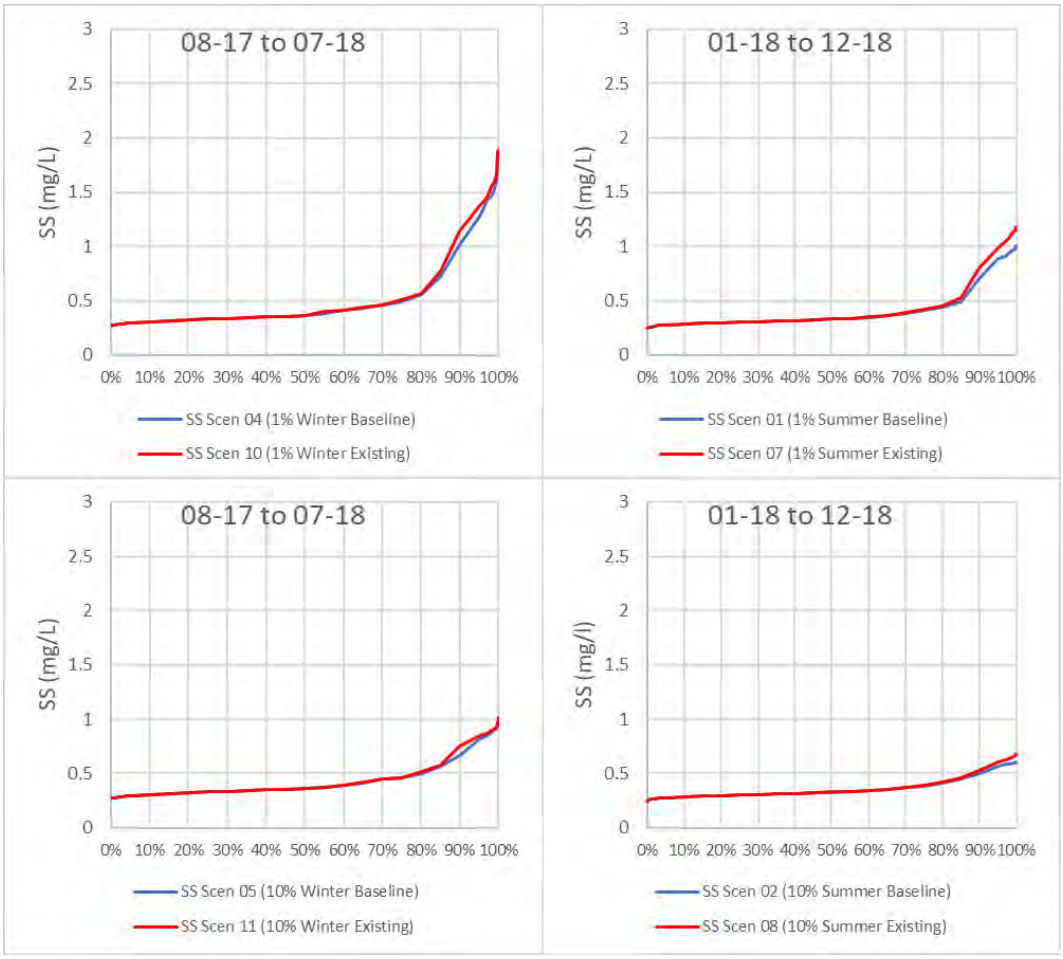


Figure 8-23 ***Percentile plots of simulated South Dandalup withdrawal SS (silt + clay) of winter and summer 1% and 10% AEP inflow events with 75% sump failure SS levels.***

Hydrocarbons

The ADWG (NHMRC, 2011 recommends:

– A health based guideline limit for benzene of 1 µg/L, consistent with WHO guidance for this parameter;
– A health based guideline limit for xylenes of 600 µg/L and an aesthetic based limit of 20 µg/L; and
– An aesthetic taste and odour threshold for diesel of 5 µg/L.

Carting of diesel fuel to machinery using small (15 kL) tankers has been identified as the highest risk hydrocarbon discharge event. GHD (2021 simulated a full tanker spill discharging directly to a stream at each reservoir. The modelled processes leading to decreased diesel concentrations were river dilution, reservoir mixing and dispersion, and withdrawals from the dams.

Noting that benzene constitutes 0.5% of the mass of fuel diesel, and xylene 0.03%, the simulation results at the offtake indicate that:

– For the Serpentine and South Dandalup reservoirs, the peak diesel concentration is predicted to be less than 1 µg/L, well below ADWG guidelines.
– For the Serpentine Pipehead reservoir, the peak diesel concentration is predicted to be less than 5 µg/L, well below ADWG heath based guidelines and at the threshold for the aesthetic guideline.

Microbes

Human activity in a drinking water catchment can result in release of microbial pathogens into the drinking water. In addition to the presence of workers throughout the DE's, Alcoa are proposing to construct Sewage Treatment Plants (STP) in the Myara North and Holyoake DE's. The risk of illness for exposed populations is estimated and

expressed as Disability Adjusted Life Years (DALYs). The health based target for drinking water favoured by WSAA is a risk of 10^{-6} DALYs per person per annum.

Four potential hazardous events were identified:

1. A raw sewage overflow event located within the STP within the Serpentine or South Dandalup catchment areas during heavy rainfall.
2. Treated effluent accumulates at the surface of the designated treated wastewater irrigation area and is subsequently washed out by heavy rainfall.
3. Treated effluent leaches into a subsurface perched aquifer during a period when rainfall exceeds evapotranspiration, flows to a steep creek or a downstream seepage face over tens of metres, and then in the reservoir or a creek.
4. An asymptomatic staff member with cryptosporidiosis defecates in bushland in any of the three catchment areas, shortly before a heavy rainfall event.

After allowing for dilution and overland transport losses, only scenario 4 for the Serpentine Pipehead catchment exceeds the health based target. This hazard requires attention during detailed design, to define how to reduce the risk to an acceptable level.

A highly conservative scenario when all four hazardous events are combined will also exceed the health based targets threshold at South Dandalup and Serpentine Pipehead dams.

PFAS, PFOA and PFOS

Impacts associated with PFAS, PFOA and PFOS are discussed in the DWRA.

8.5.2 Service interruptions

Should the risks identified in the DWRA eventuate, there may be a disruption to the withdrawal of water from the affected reservoir. The impact of such a disruption depends on the nature of the hazard, duration of the disruption, which reservoirs are affected, and how the IWSS is operated. It is beyond the scope of this report to assess the likelihood and consequence of such a disruption.

8.5.3 Mine water demands

Mining and construction activities require access to clean water. Water supply for Myara North is to be sourced from South Dandalup, Bandsiadale and/or Serpentine Dams. There may be a short period during initial clearing and construction activities where pipelines and pumping infrastructure will not be in place. Alcoa are investigating different options and sources for this interim water supply.

For the Myara North mine region, mining is expected to consume up to approximately 3 GL/year of water for the first 6-24 months (interim long haul trucking), primarily for dust suppression on haul roads and minor water demand for mine facilities (e.g., ablutions, vehicle washing). Alcoa are investigating alternatives to using water for dust suppression. For the interim long haul trucking scenario, once the conveyor is constructed (if the preferred option post detail design) then the frequency of haul truck movements will reduce and the water demand would reduce to approximately 1 GL/year. For the life of mine long haul trucking scenario, water demand would remain at approximately 3 GL/year for the duration of mining (2023-2030). Investigations are underway for the capture and reuse of runoff water from the Myara North facilities area. Increases in streamflow due to mining described in section 8.3.1 will partially counterbalance the water demands from mining.

Water supply for the Holyoake DE is expected to be supplied from the South Dandalup and Banksiadale Dams. Water demands are yet to be estimated.

8.6 Cumulative impacts

8.6.1 Timber harvesting and other forest industries

8.6.1.1 Impacts on water yields and salinity

Timber harvesting has historically caused a larger disturbance to LAI within the Northern Jarrah Forest, with annual clearing about an order of magnitude greater than that of mining, however harvesting will be relatively distributed across the forest and surface water catchments. In light of the decision to end logging of native forests in then the upcoming Forest Management Plan 2024-33 and in the absence of long-term harvesting plans it was not possible to incorporate timber harvesting into groundwater modelling for the Myara North or Holyoake mine regions to predict the effect on stream salinity. However, given the distribution of timber harvesting between catchments and the demonstrated regrowth that occurs in a comparable timeframe (or less) to that of mining is it likely that there would be limited changes to stream salinity in any single drinking water catchment, and that freshwater quality will be maintained.

8.6.1.2 Impacts on water quality

Timber harvesting has potential for spills or leaks of diesel and oils during harvesting operations, which would involve refuelling and potentially maintenance of harvesting equipment and heavy vehicles. There is also potential for ongoing, low level oil leaks from vehicles and equipment, and rare collisions that result in fuel or oil spills. As with mining, most spills and leaks, particularly those from major incidents and involving large volumes, are expected to be identified quickly and the contaminated soils excavated and disposed off-site at a licensed waste facility.

Smaller spills and leaks may potentially be missed and the contaminants leach through the unsaturated zone. As with mining, small volumes of diesel and oil that escape detection and remediation are unlikely to result in substantial migration of hydrocarbons that reach streams and can be transported into reservoirs. Accordingly, the storage and handling of hazardous materials during timber harvesting is expected to pose a low risk to water quality.

Further impacts associated with mining, timber harvesting and other forest industries are discussed in the DWRA and ERD.

8.6.2 Rehabilitation

8.6.2.1 Impacts on water yields and salinity

Rehabilitation of approved mining regions will overlap temporally with clearing, mining, and rehabilitation of the proposed mine development envelope. Spatially this is closest for the Myara and Myara North mining regions. Rehabilitation restores groundwater levels, streamflow, and salinity from the peaks that occur prior to rehabilitation. Therefore, cumulative impacts of rehabilitation of water yields and salinity are expected to be minor.

There is potential for past mine rehabilitation that has a higher leaf area index (LAI) to decrease recharge relative to un-mined forest. Contemporary rehabilitation from 2016 onwards has achieved about 1000 stems/ha in tree establishment, whereas from 1998-2015 it achieved about 1400 stems/ha and from 1988-1997 about 3000 stems/ha. This indicates that the Jarrahdale Mine (mined 1963-1998) north of Myara North may contain areas of higher LAI that may reduce recharge relative to un-mined forest and potentially reduce streamflows in Upper Wungong Brook. Similarly, older regions of the Huntly Mine (e.g. White region mined in 1989-2006, Huntly 1&2 region mined in 1986-1997) may have areas of higher LAI that may reduce recharge relative to un-mined forest and potentially reduce streamflow in South Dandalup River, North Dandalup River and Conjurunup Creek.

8.6.2.2 Impacts on water quality

Certain rehabilitation techniques can introduce more erodible (and potential dispersive) clayey material into the shallow subsurface surface. Analysis of gully erosion at the Huntly, Willowdale and Boddington bauxite mines suggested a minimum catchment of 0.3 ha for gully development, with gully volumes typically remaining small (20-100 m^3) but potentially increasing for higher slopes (> 10°) and shallower topsoil/overburden placement

(< 200 mm). Erosion was highest in the first two to three years following rehabilitation completion until rehabilitation establishes, though there was a lack of long term data with which to compare the erodibility of rehabilitation to that of un-mined Jarrah forest (Mengler et al 2006). For the period at higher risk of erosion, the major triggers for gully erosion were identified as:

– directing excessive off-site runoff into the rehabilitation
– poor surface completion (e.g. ripping that does not adhere to contours) that concentrates flow or impairs infiltration
– insufficient depth of returned topsoil and overburden (< 200 mm combined)

Given that rehabilitation occurs progressively, erosion risk from rehabilitation of approved mining regions is not expected to accumulate with rehabilitation of the Myara North and Holyoake DE's. Further impacts associated with rehabilitation are discussed in the DWRA.

8.6.3 Climate change and fire

8.6.3.1 Climate change effects on water yields and salinity

Cumulative impacts to water yield and salinity from mining and climate change are assessed in section 8.1 to 8.5.

As presented, climate change is expected to have the greatest effect on groundwater and streamflow, exceeding the effects of mining and rehabilitation. Temporary removal of vegetation during mining and the associated increase in recharge is predicted to result in a localised and temporary counterbalance to the historic groundwater and streamflow decline observed across the catchments and wider Northern Jarrah Forest. However, as rehabilitation establishes the recharge is expected to return to the non-mining baseline and groundwater and streamflow to be subject to further decline in line with climate change forecasts for the South-West region.

8.6.3.2 Climate change effects on fire and associated water yields and salinity

The climate change projections described in section 4.1 are expected to extend the period at which vegetation is flammable, increasing the frequency and scale of forest fires, though drying may also reduce the rate of fuel accumulation (Burrows and Wardell-Johnson 2003). Detailed investigation has not been undertaken for the South-West region, however analysis for south-east Australia indicated an increase in cumulative forest fire danger index (FDI) by 0-8% for low severity climate change scenarios and 10-30% for high severity scenarios by 2050 (Maher *et al* 2010). In addition to cumulative fire danger, there is a predicted increase in number of days of high fire risk in south-east Australia, with 'very high' fire danger days predicted to increase by 5-23% for low severity scenarios and 20-100% for high severity scenarios by 2050 (Maher *et al* 2010). The analysis for south-east Australia, which also has a projected drying and warming climate, suggests that the South-West region is likely to be subject to increasing fire risk.

Climate change is also expected to increase the frequency of tropical cyclone incursion into the South West region, which can create un-seasonally high winds such as contributed to large wildfires in 1937 and 1978 (Maher *et al* 2020).

The drying climate may also affect the rate and pathways of recovery following fire, slowing down post-fire recovery including reproduction and recruitment (Burrows and Wardell-Johnson 2003).

Changes to vegetation due to a wildfire may therefore result in cumulative impacts to water yields and salinity beyond those from mining alone.

A large scale wildfire may affect thousands or tens of thousands of hectares of an individual river catchment in a short period, causing a substantial decrease in LAI and increase in recharge until vegetation re-establishes over a few years. Wildfire may also result in greater surface water runoff through removal of surface litter and the increased rainfall impaction and water repellence on soils. The net effects of a large scale wildfire are therefore expected to be an increase in streamflows and reservoir yields over a period of a few years, relative to an un-burnt catchment. Streamflows and reservoir yields are expected to return to un-burnt conditions as vegetation and soils recover from the wildfire effects. Large wildfires may therefore have a substantial effect on streamflow and reservoir yield, but the effects are expected to be highly variable and episodic rather than a long term trend such

as the forecast decline from climate change. Accordingly, the potential effects of wildfires are not incorporated into the groundwater modelling for the Proposal.

8.6.3.3 Climate change effects on fire on associated water quality

GHD (2021e) conducted a literature review of the impacts of bushfire within Australia and Western Australia. The evidence reviewed by Australian authors and the impact of 2005 Perth Hills and 2016 Waroona-Yarloop fires suggest that the Serpentine Dam, Pipehead Dam, South Dandalup Dam and Wungong Dam reservoirs may be susceptible to water quality impacts from bushfires. Such an event may include a high intensity wildfire that covers a large proportion of a catchment, occurs over steep terrain and in the year prior to heavy rainfall events.

The 2005 Perth Hills bushfire covered approximately 19% of the catchment of Mundaring Weir, which had a water volume of approximately 27 GL at the time. Turbidity in the catchment streams increased with ranges from 5 NTU to more than 1000 NTU. A turbid plume was observed within the upper end of Mundaring reservoir (Batini and Barrett 2007), with turbidity peaks of up to 37 NTU, attenuating towards the dam wall (Battin and Barrett 2007, WSAA 2020).

The 2016 Waroona-Yarloop bushfire burnt more than 90% of the catchment of Samson Brook Dam and Samson Brook Pipehead Dam (DWER 2019). The Samson Brook Dam had a water level of less than 1 GL at the time. The fire resulted in elevated levels of turbidity, pathogens and other contaminants, resulting in the Water Corporation keeping the dams offline for over a year (DWER 2019b).

A major wildfire and heavy rainfall sequence may result in widespread ash deposition, runoff and erosion that generate substantial discharges of ash and sediment into the catchment's reservoir (GHD 2021e). Depending on the severity and location of fire and rainfall, there is potential for the scale of discharges to exceed the attenuating capacity of the reservoir and cause elevated contaminant levels at the offtake that exceed drinking water quality criteria (GHD 2021e).

Climate change is expected to extend the period at which vegetation is flammable, increasing the frequency and scale of forest fires in the Jarrah forest, though drying may also reduce the rate of fuel accumulation. Analysis undertaken for south-east Australia, which is predicted to undergo similar drying and warming as is forecast for the South-West region, suggests a potential for increased cumulative forest fire danger index and increased number of high and very high fire risk days. Accordingly, there is potential for the frequency of wildfires to increase in the future.

Potential changes to the fire regime and fire management practices due to mining and rehabilitation are described in the ERD. The cumulative impacts of mining and fire, regardless of the cause, is described hereafter.

Whilst turbid runoff from cleared mining areas is managed through drainage control measures, turbid runoff leaving fire affected areas will flow freely into streams and the reservoir. The impacts of a large wildfire on water quality have been observed to be catastrophic to downstream water quality. Comparatively, water quality impacts from a widespread drainage failure scenario were assessed in the DWRA to be moderate.

The occurrence of wildfire events may result in cumulative impacts to water quality beyond those from mining alone. As with yield, large wildfires may have a substantial effect on stream and reservoir water quality, but the effects are expected to be highly variable and episodic. Further impacts associated with climate change and fire are discussed in the DWRA and ERD. As noted in the ERD, it is expected that the transition of mining into the Myara North and Holyoake regions will continue to enable DBCA's prescribed burning program to be effectively planned, funded and implemented, as has been demonstrated within the Huntly Mine to date. Accordingly, the Proposal is expected to maintain and support the State Government's program to limit fuel accumulation in the Northern Jarrah Forest, thereby reducing the likelihood of large wildfires occurring in the surface water catchments that lie within the mine regions.

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WRM (2021) Pinjarra Alumina Refinery and Huntly Mine Extension; Aquatic Fauna Desktop Assessment - Myara North and Holyoake Regions, unpublished report prepared for GHD on behalf of Alcoa of Australia Limited.

Appendices

Appendix A

Figures

Figure A 1 *Locality plan and development envelope*

Figure A 2 *Location and boundaries of Myara North*

Figure A 3 *Location and boundaries of Holyoake*

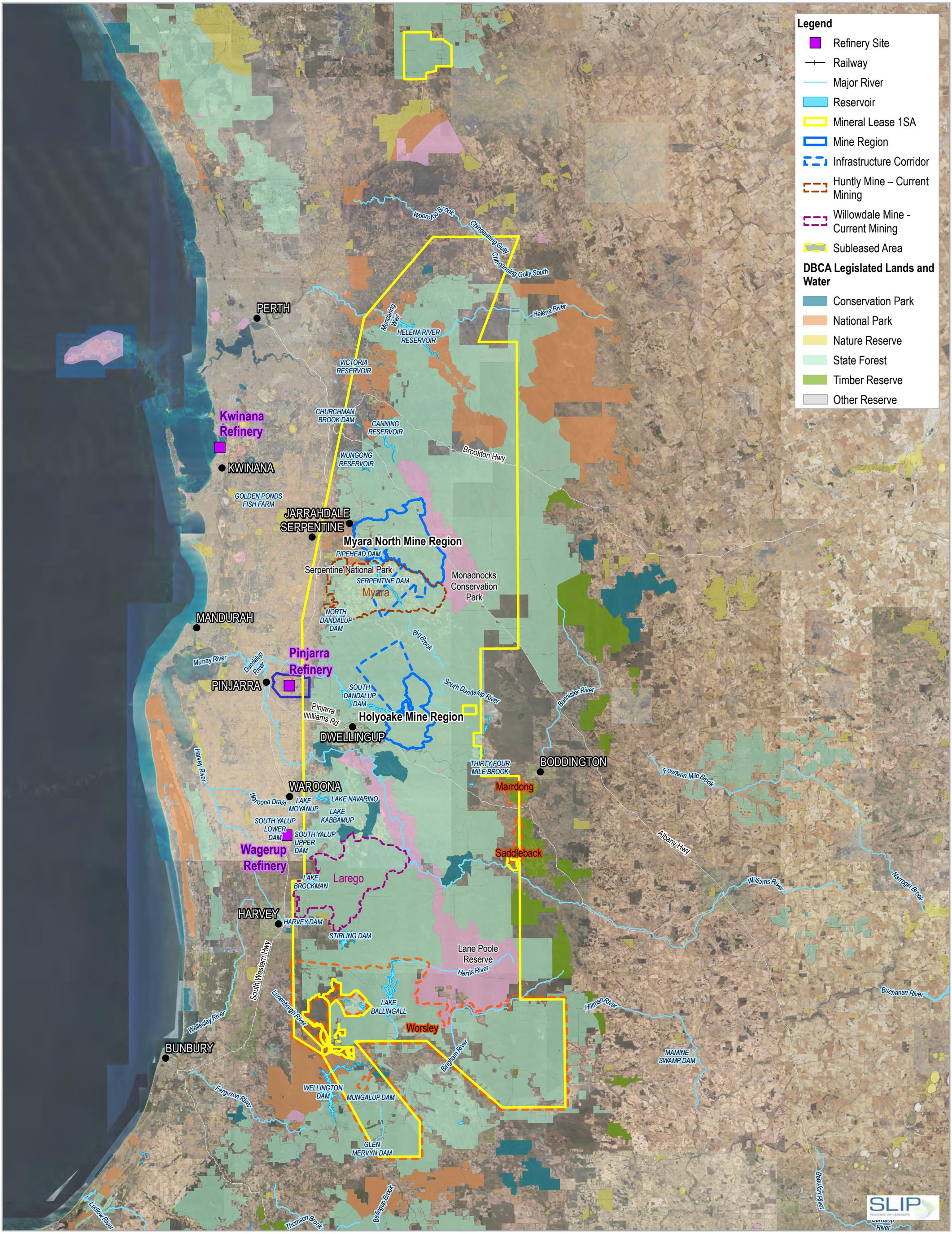
Figure A 4 *GSWA 250k Regional geology of Myara North and Holyoake*

Figure A 5 *Myara North surface water features*

Figure A 6 *Holyoake surface water features*

Figure A 7 *Myara North surface and ground water monitoring locations*

Figure A 8 *Holyoake surface and ground water monitoring locations*



Paper Size ISO A3

0 5 10 15 20

Kilometres

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

N

GHD

Alcoa of Australia Limited
Hydrology and Water Quality Assessment

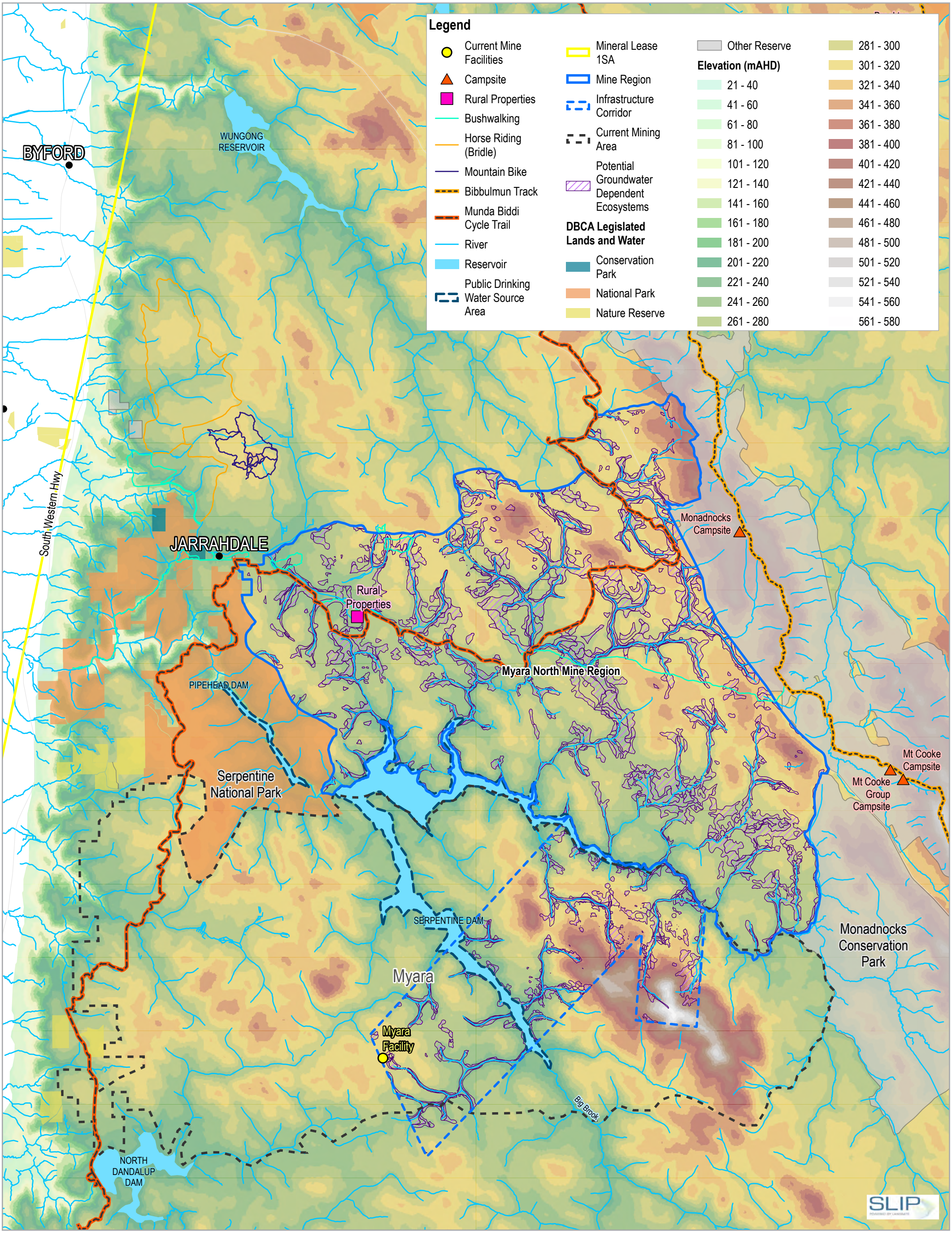
Project No. **12520591**
Revision No. **0**
Date **11/01/2022**

Locality Plan and Mining Regions

FIGURE A-1

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Print date: 11 Jan 2022 - 11:57

Data source: Alcoa/GHD: Pinjarra Refinery Development Envelope - 20200618; DoW: Watercourse - 20200221; DPLH: Zones and Reserves - 20200525; Landgate: Railway - 20190304, Roads - 20190114,WANow: Landgate / SLIPaccessed 20200204. Created by: rbrown3



Paper Size ISO A3

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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GHD

Alcoa of Australia Limited

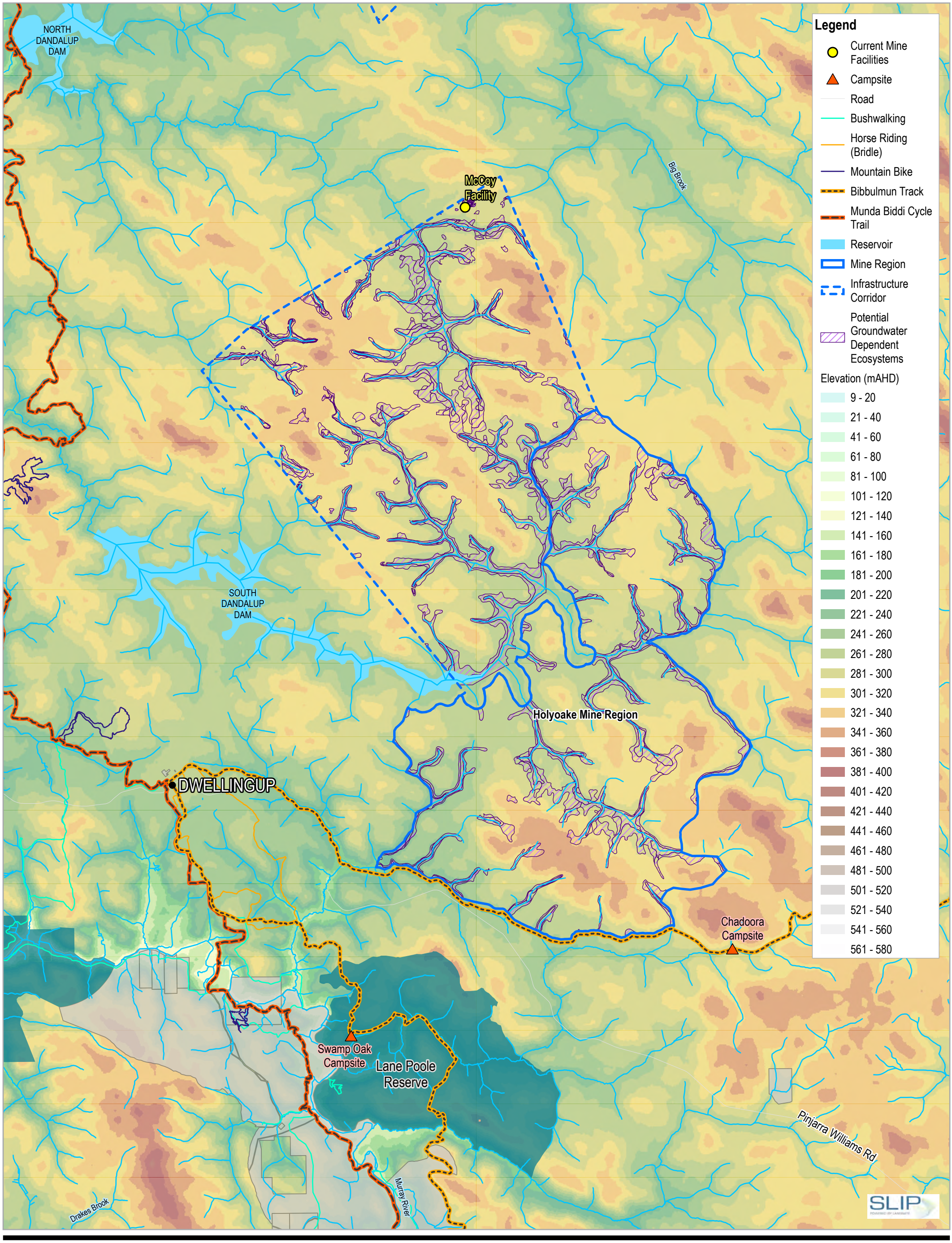
Location and boundaries of Myara North proposed development area

Project No. **12520591**
Revision No. **0**
Date **03/06/2021**

FIGURE A-2

\\ghdnet\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591_Hydrology\12520591_Hydrology\12520591_Hydrology.aprx\12520591_002_MyaraNorthLocalContext_RevA
Print date: 11 Jan 2022 - 11:12

Data source: Alcoa/GHD: Refinery Sites - 20200221, Mine Development Envelope, LiDAR Elevation - 20200626 Mining Areas - 20210125; DMIRS: Mining Tenement - 20180719; DBCA: Legislated Lands and Water - 20200301; DoW: Watercourse - 20200221; Landgate: Railway - 20190304, Roads - 20190114,World Light Gray Canvas Base: Esri, HERE, Garmin, USGSaccessed 20200204. Created by: rbrown3



Paper Size ISO A3

0 1 2 3 4

Kilometres

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

GHD

Alcoa of Australia Limited

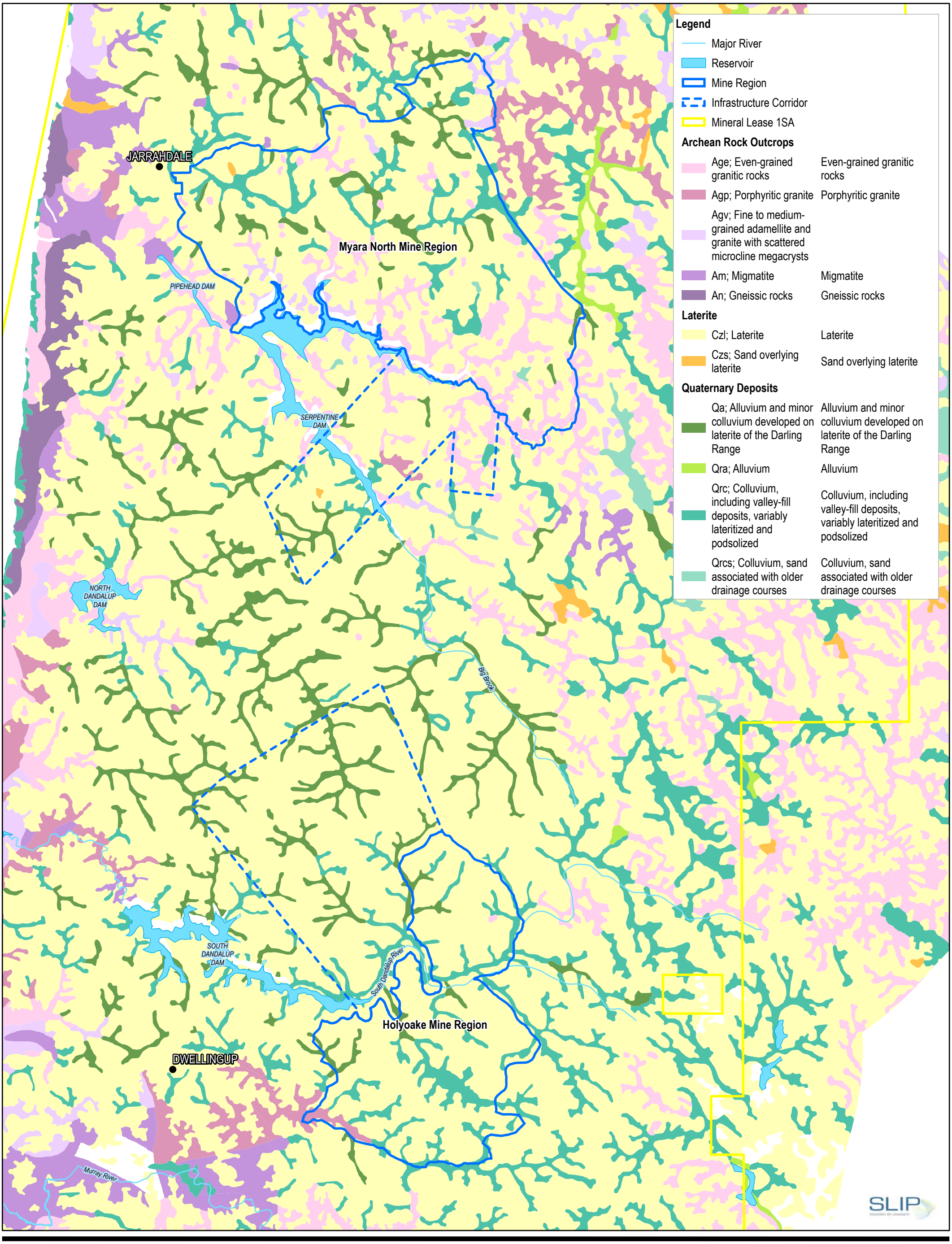
Holyoake Local Context

Project No. **12520591**
Revision No. **0**
Date **03/06/2021**

FIGURE A-3

\\ghdnet\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591_Hydrology\12520591_Hydrology\12520591_Hydrology.aprx\12520591_003_HolyoakeLocalContext_RevA
Print date: 11 Jan 2022 - 11:14

Data source: Alcoa/GHD: Refinery Sites - 20200221, Mine Development Envelope, LiDAR Elevation - 20200626, Mining Areas - 20210125; DMIRS: Mining Tenement - 20180719; DBCA: Legislated Lands and Water - 20200301; DoW: Watercourse - 20200221; Landgate: Railway - 20190304, Roads - 20190114,accessed 20200204. Created by: rbrown3



Paper Size ISO A3

0 5 10 15 20

Kilometres

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

N

GHD

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Hydrology and Water Quality Assessment

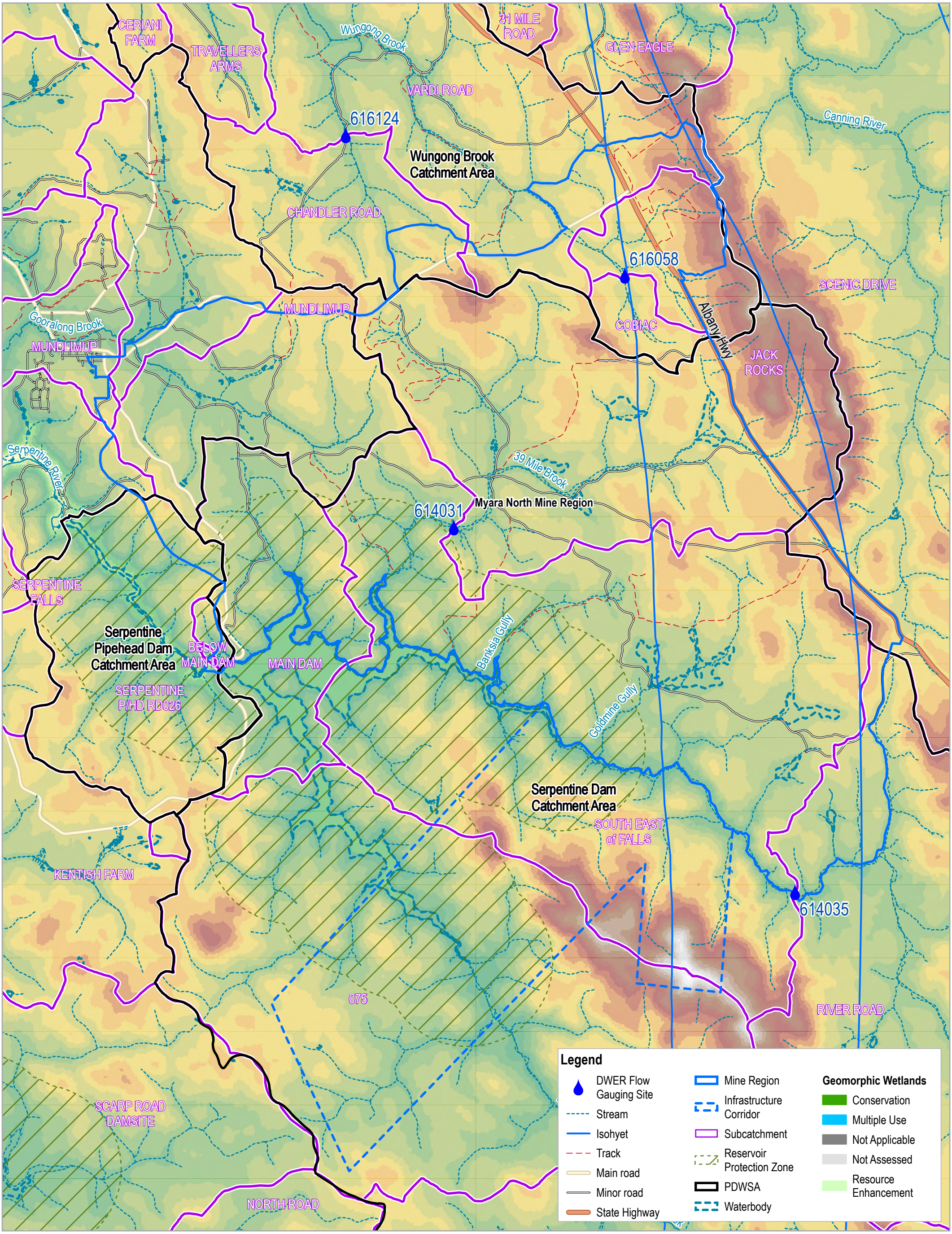
Hydrology and Water Quality Assessment GSWA 250K Geology Map

Project No. **12520591**
Revision No. **0**
Date **11/01/2022**

FIGURE A-4

\\ghdnet\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591_Hydrology\12520591_Hydrology\12520591_Hydrology.aprx\12520591_004_Geology_RevA
Print date: 11 Jan 2022 - 13:00

Data source: Alcoa/GHD: Pinjarra Refinery Development Envelope - 20200618; DoW: Watercourse - 20200221; DPLH: Zones and Reserves - 20200525; Landgate: Railway - 20190304, Roads - 20190114,accessed 20200204. Created by: rbrown3



Paper Size ISO A3

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Kilometres

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Map Projection: Transverse Mercator

Horizontal Datum: GDA 1994

Grid: GDA 1994 MGA Zone 50

N

GHD

Alcoa of Australia Limited

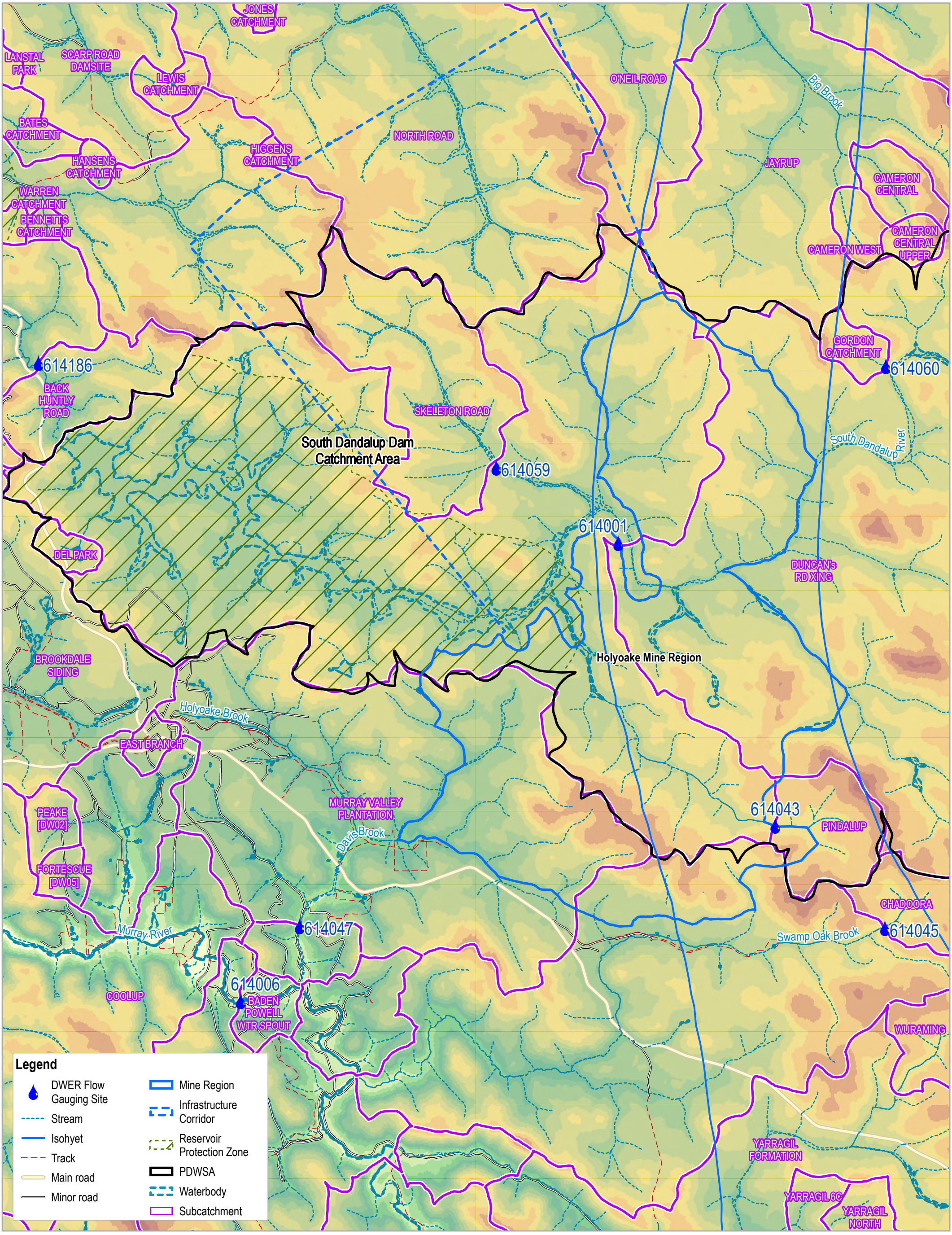
Myara North surface water features

Project No. **12520591**
Revision No. **0**
Date **11/01/2022**

FIGURE A-5

\\ghdnet\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591_Hydrology\12520591_Hydrology\12520591_Hydrology.aprx\12520591_005_MyaraNorthCatchmentsAndDrainage_Rev0
Print date: 11 Jan 2022 - 10:42

Data source: GHD: Subcatchments - 20200624; Alcoa: Myara North Boundary - 20200618, LiDAR Elevation - 20200626, Reservoir Protection Zone, Isohyet - 20200225, Streams - 20200617; GA: SRTM - 20200526; DBCA: Geomorphic Wetlands 20200117 - DWER: SW Monitoring Sites - 20200629; DoW: PDWSA - 20160607; Landgate: Roads - 20190128, . Created by: rbrown3



Paper Size ISO A3

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Kilometres

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Map Projection: Transverse Mercator

Horizontal Datum: GDA 1994

Grid: GDA 1994 MGA Zone 50

N

GHD

Alcoa of Australia Limited

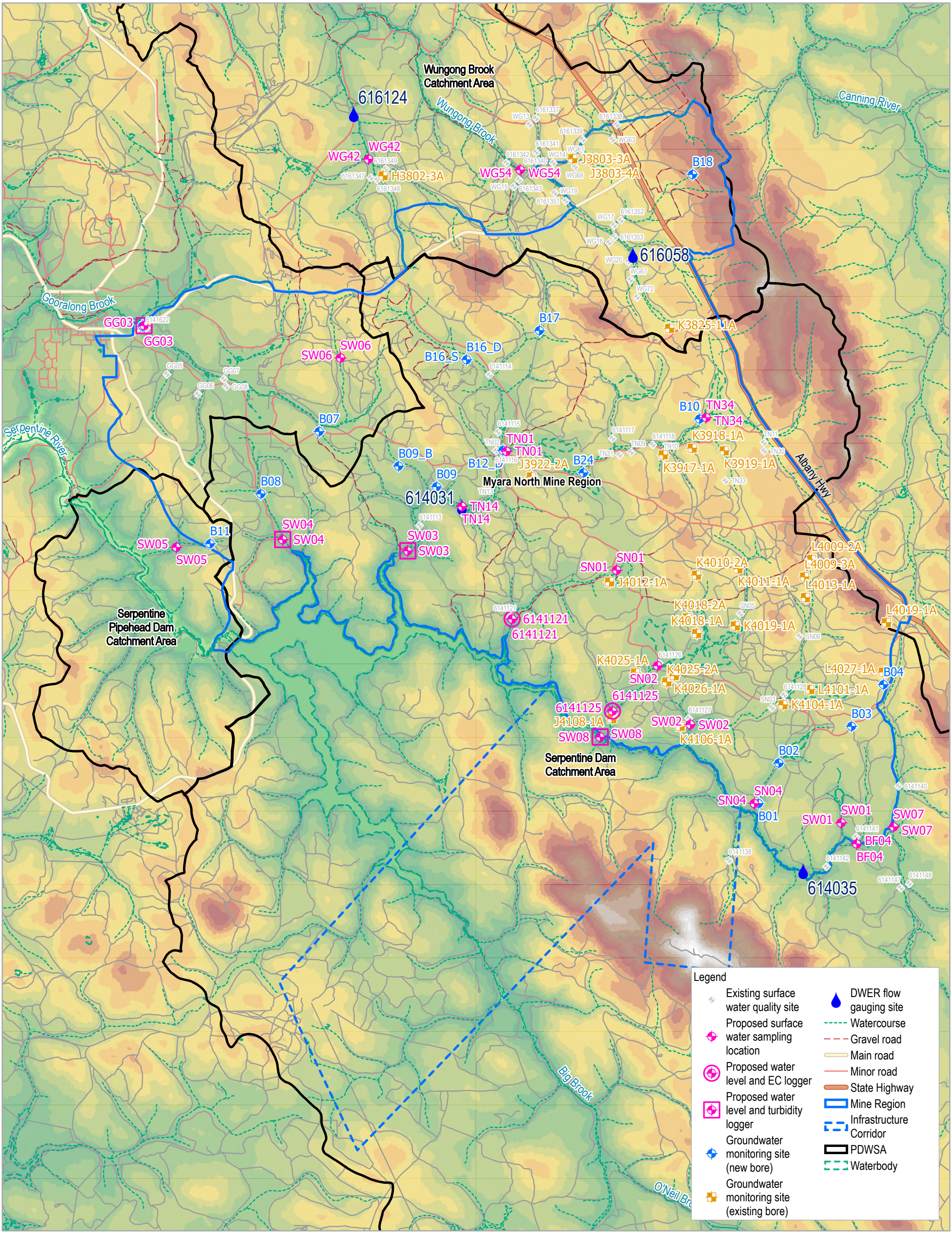
Holyoake
surface water features

Project No. **12520591**
Revision No. **0**
Date **11/01/2022**

FIGURE A-6

\\ghdnet\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591_Hydrology\12520591_Hydrology\12520591_Hydrology.aprx\12520591_006_HolyoakeCatchmentsAndDrainage_Rev0
Print date: 11 Jan 2022 - 10:46

Data source: Alcoa: Myara North Boundary - 20200618, LiDAR Elevation - 20200626, Reservoir Protection Zone, Isohyet - 20200225, Streams - 20200617; GA: SRTM - 20200526; DWER: SW Monitoring Sites - 20200629; DoW: PDWSA - 20160607, Subcatchments - 20130902; Landgate: Roads - 20190128, . Created by: rbrown3



Paper Size ISO A3

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Kilometres

1:80,000

Map Projection: Transverse Mercator

Horizontal Datum: GDA 1994

Grid: GDA 1994 MGA Zone 50

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GHD

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Myara North Water Monitoring Locations

Project No. **12520591**

Revision No. **0**

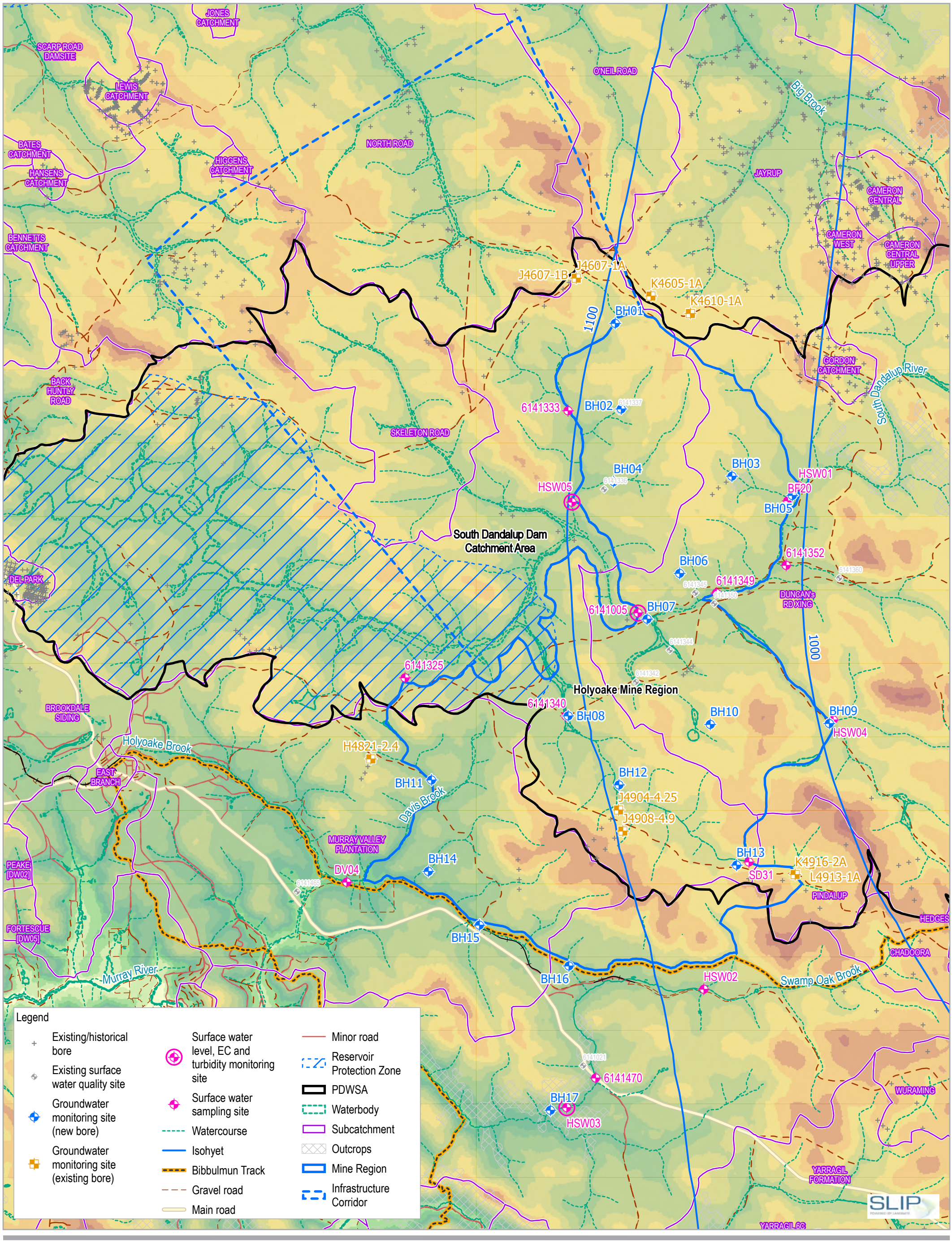
Date **11/01/2022**

FIGURE A-7

\\ghdnet\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591_Hydrology\12520591_Hydrology\12520591_Hydrology.aprx\12520591_007_SAQP_MyaraNorthWaterMonitoringLocations_RevA1

Print date: 11 Jan 2022 - 13:50

Data source: GHD: Proposed sites - 20200825, Subcatchments - 20200624; Alcoa: Myara North Boundary - 20200618, LiDAR Elevation - 20200626, Reservoir Protection Zone, Isohyet - 20200225, Streams - 20200617; GA: SRTM - 20200526; DWER: Existing Monitoring Sites - 20200629; DoW: PDWSA - 20160607; Landgate: Roads - 20190128, . Created by: rbrown3



Paper Size ISO A3

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Kilometres

1:80,000

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

N

GHD

Alcoa of Australia Limited

Holyoake Water Monitoring Locations

Project No. **12520591**
Revision No. **0**
Date **11/01/2022**

FIGURE A-8

\\ghdnet\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591_Hydrology\12520591_Hydrology\12520591_Hydrology.aprx\12520591_008_SAQP_HolyoakeWaterMonitoringLocations_RevA1
Print date: 11 Jan 2022 - 10:58

Data source: GHD: Proposed monitoring sites - 20200825, Subcatchments - 20200624; Alcoa: Holyoake Boundary - 20210125, LiDAR Elevation - 20200626, Reservoir Protection Zone, Isohyet - 20200225, Streams - 20200617; GA: SRTM - 20200526; DWER: SW Monitoring Sites - 20200629; DoW: PDWSA - 20160607; Landgate: Roads - 20190128, . Created by: rbrown3

Appendix B

Baseline Surface and Ground Water Monitoring Report – Myara North and Holyoake

GHD (2021a) Baseline Surface and Ground Water Monitoring Report – Myara North and Holyoake; Pinjarra Alumina Refinery Revised Proposal, unpublished report prepared for Alcoa of Australia Limited by GHD.

Appendix C

Hydrological Setting and Understanding - Myara North and Holyoake

GHD (2021b) Hydrological Setting and Understanding – Myara North and Holyoake; Pinjarra Alumina Refinery Revised Proposal, unpublished report prepared for Alcoa of Australia Limited by GHD.

Appendix D

Groundwater Modelling Report for Huntly Mine - Myara North

GHD (2021c) Groundwater Modelling Report for Huntly Mine - Myara North; Pinjarra Alumina Refinery Revised Proposal, unpublished report prepared for Alcoa of Australia Limited by GHD.

Appendix E

Groundwater Modelling Report for Huntly Mine - Holyoake

GHD (2021d) Groundwater Modelling Report for Huntly Mine – Holyoake; Pinjarra Alumina Refinery Revised Proposal, unpublished report prepared for Alcoa of Australia Limited by GHD.

Appendix F

Drinking Water Risk Assessment

GHD (2021d) Drinking Water Risk Assessment; Serpentine, Serpentine Pipehead, South Dandalup and Wungong Brook Catchments unpublished report prepared for Alcoa of Australia Limited by GHD.

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