accendo AUSTRALIA

ENVIRONMENTAL REVIEW DOCUMENT

LOT 1002 PRESTON BEACH ROAD NORTH, PRESTON BEACH

NOVEMBER 2021

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solutions for the human | environment interface

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on the environmental review for this proposal.

Doyle's Lime Service proposes to construct and operate a limestone and sand quarry at Lot 1002 Preston Beach Road North, Preston Beach in the Shire of Waroona. The proposal would involve screening and crushing of the limestone, and grading and maintenance of Preston Beach North Road for access.

The Environmental Review Document (ERD) has been prepared in accordance with the EPA's ***Procedures Manual (Part IV Divisions 1 and 2)***. The ERD is the report by the proponent on their environmental review which describes this proposal and its likely effects on the environment.

The ERD is available for a public review period of **X** weeks from **DATE**, closing on **DATE**.

Information on the proposal from the public may assist the EPA to prepare an assessment report in which it will make recommendations on the proposal to the Minister for Environment.

Why write a submission?
The EPA seeks information that will inform the EPA's consideration of the likely effect of the proposal, if implemented, on the environment. This may include relevant new information that is not in the ERD, such as alternative courses of action or approaches.
In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information.
Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*.

Why not join a group?
It may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission
You may agree or disagree with, or comment on information in the ERD.
When making comments on specific elements in the ERD:

- Clearly state your point of view and give reasons for your conclusions.
- Reference the source of your information, where applicable.
- Suggest alternatives to improve the outcomes on the environment.

What to include in your submission

Include the following in your submission to make it easier for the EPA to consider your submission:

- Your contact details – name and address.
- Date of your submission
- Whether you want your contact details to be confidential.
- Summary of your submission, if your submission is long.
- List points so that issues raised are clear, preferably by environmental factor.
- Refer each point to the pay, section and if possible, paragraph of the ERD.
- Attach any reference material, if applicable. Make sure your information is accurate.

The closing date for public submissions is: DATE

The EPA prefers submissions to be made electronically via the EPA's Consultation Hub at https://consultation.epa.wa.gov.au

Alternatively submissions can be:

- Posted to : Chairman, Environmental Protection Authority, Locked Bag 33, Cloisters Square WA 6850, or
- Delivered to: the Environmental Protection Authority, Level 4, The Atrium, 168 St Georges Terrace, Perth 6000.

If you have any questions on how to make a submission, please contact the EPA Services at the Department of Water and Environmental Regulation on 6364 7000.

SCOPING CHECKLIST

Task No.	Required Work	Section
Inland Waters		
1.	Provide a detailed description of the design and location of the proposal with the potential to impact surface water or groundwater.	5.3
2.	Develop of conceptual model of the hydrogeological system including recharge and discharge mechanisms, aquifer connectivity, surface water/groundwater interaction and water chemistry; in particular, the potential for winter rainfall storage at the limestone ridges and groundwater movement to Lake Pollard.	5.3 & 5.5
3.	Conduct hydrogeological investigations, fit for purpose modelling and analysis to detail baseline hydrology and predictions of change (quality, levels and flows) and impact as a result of (stage 1) removal of vegetation and (stage 2) long term loss of deep soil profile and increased evapotranspiration of re-vegetation on shallow groundwater in relation to water dependent ecosystems (most specifically Lake Clifton, Lake Polar and Martins Tank) and the Yalgorup National Park, and include any potential impacts on westerly groundwater flows and wetland values to the west of the quarry. Provide a sensitivity analysis of the predictions from the modelling undertaken.	5.3 & 5.5
4.	Map the extent, magnitude and rate of changes in hydrology (addressing groundwater levels, flows, quality and surface water inputs) as a result of (stage 1) removal of vegetation and (stage 2) long term loss of deep soil profile and increased evapotranspiration of re-vegetation on shallow groundwater in relation to water dependent ecosystems and most specifically Lake Clifton, Lake Pollard and Martins Tank, and include potential impacts to the westerly groundwater flow and wetland values to the west of the quarry. Fit for purpose geochemical modelling (e.g. PHREEQC) should be utilised where appropriate to support any risk assessment process.	5.3 & 5.5
5.	Map habitats, flora and fauna vulnerable to changes in hydrology (drawdown or groundwater level increase and water quality changes) in relation to predicted hydrogeological change, including interdunal swale habitats to the west of the proposed works.	5.5.7
6.	Use the results of the modelling and other steps to identify if there are risks of changes in both increased and reduced discharge on lake levels and lake water quality, including the risk of acid sulphate soils. Also identify the risks of changes on the interdunal habitats to the west of the proposed works.	5.3 & 5.5
7.	Provide a volumetric pre and post development conceptual water balance.	5.5
8.	Analyse, discuss and assess surface water and groundwater impacts. The discussion should include: • Changes in groundwater levels and changes to surface water flows associated with the proposal • Changes to water quality	5.5

Task No.	Required Work	Section
	• The nature, extent and duration of impacts • Impacts on environmental values of significant receptors, including but not limited to conservation significant wetlands (Lake Pollard and Martins Tank Lake) and the Yalgorup National Park.	
9.	Discuss the proposed management, monitoring and mitigation to prevent groundwater and surface water impacts, at local and catchment scale, as a result of implementing the proposal.	5.6 & 5.7
10.	Demonstrate in the ERD how the EPA's objective for this factor will be met.	5.6 & 5.7
11.	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the WA Environmental Offsets Guidelines (2014).	5.6
12.	Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines. Spatial data defining the area of significant residual impacts should also be provided (e.g. vegetation type, vegetation condition, specific fauna species habitat).	NA
Flora and Vegetation		
13.	Identify and characterise flora and vegetation in accordance with the requirements of EPA Guidance. The survey should take into account areas that are likely to be indirectly impacted as a result of the proposal (including by any reduction in groundwater), including the proposed access road upgrade and Yalgorup National Park and in buffer vegetation between the proposal area and Lake Pollard. Particular consideration should be given to the potential occurrences of the Priority 3 ecological community 'Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain'. If multiple surveys have been undertaken to support the assessment, a consolidated report should be provided including the integrated results of the surveys. Where surveys were undertaken prior to scoping, justification should be provided to demonstrate that they are relevance and consistent with EPA Guidance. Ensure species database searches and taxonomic identifications are up-to-date.	6.3
14.	Undertake baseline mapping of weed affected areas in any area likely to be directly or indirectly impacted by the proposal.	6.3
15.	Provide an analysis of the vegetation and significant flora species present and likely to be present within the development envelope and indirect impact areas outside of the development envelope.	6.3
16.	Provide figures of the proposed clearing and predicted indirect impact to vegetation (specifically any groundwater dependent ecosystems) and significant flora species including threatened/priority ecological communities, threatened/priority flora, and significant flora and significant vegetation as defined by EPA guidance.	6.3
17.	Discuss, and determine significance of, potential direct and indirect impacts to significant flora and vegetation as a result of the proposal at a local and regional level.	6.5

Task No.	Required Work	Section
18.	Discuss the implications of upgrading Preston Beach North Road in context of existing EPA policies, in particular Strategic Environmental Advice of the Dawesville to Binningup Area (Report 1359).	6.5
19.	Demonstrate that all practicable measures have been taken to reduce both the area of the proposed disturbance footprint and the development envelope based on proposal design and understanding of the environmental impacts.	6.5 & 6.6
20.	Discuss proposed management, monitoring and mitigation methods to be implemented demonstrating that the proposal has addressed the mitigation hierarchy in relation to impacts on flora and vegetation. Both groundwater monitoring and vegetation health monitoring should be implemented in the area of predicted drawdown to ensure that ecological functions of plant communities are maintained.	6.6
21.	Discuss management measures and outcome/objectives sought to ensure residual impacts (direct and indirect) are not greater than predicted.	6.6
22.	Discuss the residual impacts, if any, including as appropriate, monitoring programmes to further mitigate these residual impacts and to deal with circumstances where outcomes fall short of intended objectives.	6.6
23.	Provide an assessment on the physical and chemical characteristics of soil and soil profiles to be disturbed by the proposal, with particular focus on the ability to use such soil materials in post-mining rehabilitation works.	6.6
24.	Prepare a Rehabilitation and Closure Plan consistent with the DMP and EPA (2015) *Guidelines for Preparing Mine Closure Plans*. The plan should include but not be limited to: • Closure objectives and completion criteria addressing post mining landforms and soil profile design, native vegetation and habitat for conservation significant flora and fauna and base the conclusions on the availability of suitable substrates • Establish and measure vegetation and fauna reference and analogue sites to inform completion criteria.	**Appendix B** and **C**
25.	Demonstrate that the proposal has been designed to avoid and minimise impacts including the placement of any access roads and infrastructure within vegetated areas and that placement has had regard to utilising existing areas of disturbance.	6.6
26.	Describe the proposed rehabilitation methodology, including but not limited to: • Topsoil management • Retention or reuse of vegetative material • Return of species and communities (where feasible) consistent with the pre-existing composition of the affected area • Timeframes for rehabilitation, including sequencing of excavation and progressive rehabilitation.	6.6
27.	Identify completion criteria, including criteria for reconstructed soils and soil profiles (identification and profile reconstruction), landform stability, drainage/erosion control and species and communities.	6.6

Task No.	Required Work	Section
28.	Demonstrate in the ERD how the EPA's objective for this factor will be met.	6.6 & 6.7
29.	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the WA Environmental Offsets Guidelines (2014).	6.6
30.	Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines. Spatial data defining the area of significant residual impacts should also be provided (e.g. vegetation type, vegetation condition, specific fauna species habitat).	NA
Terrestrial Fauna		
31.	In accordance with EPA Guidance: • Carry out a desktop study of previous surveys and regional studies to predict the expected fauna assemblage of the proposal area and determine the level of survey required. • Conduct a Level 1 fauna survey including local and regional mapping of habitats (including rare or unusual habitat types) inside and outside ft eh development envelope. Where existing local information is inadequate or incomplete, comprehensive Level 2 fauna surveys are required. • Where conservation significant fauna have been identified in the desktop study or surveys, Level 2 targeted surveys are required. Identify potential impacts to conservation significant fauna species within the development envelope and immediate surrounds. Include mapping of the locations of any conservation significant fauna in relation to the proposal and fauna habitat. • Assess the likelihood of the habitats to support short-range endemic (SRE) invertebrate species. If the area is prospective for these species, undertake SRE invertebrate fauna sampling as per EPA Guidance. Include mapping of the locations of any known and potential SRE invertebrate species in relation to the proposal and fauna habitat. • Prepare a comprehensive listing of fauna species likely to occur in habitats to be directly or indirectly impacted.	7.3
32.	Where the results from previous surveys are relied on for context, justification should be provided to demonstrate that they are relevant, representative of the development envelope, and were carried out using methods consistent with EPA Guidance.	7.3
33.	Consider habitat types that provide important ecological function within and adjacent to the proposal area e.g. riparian vegetation, wetlands, areas of conservation significance or geological features which may support unique ecosystems. Particular consideration should be given the following: • Discuss the predicted level and significance of impacts to the Conservation Category and RAMSA wetland Lake Pollard including hydrology, aquatic fauna and migratory waterbirds. Where significant impacts to Lake Pollard are identified, surveys for aquatic fauna and migratory waterbirds may be required.	7.3 & 7.5

Task No.	Required Work	Section
34.	Assess direct and indirect impacts on fauna, conservation significant fauna and fauna habitats, including percentages of habitat types to be impacted within the proposal area and on a regional scale. Provide figures showing the likely extent of loss of habitat types and the extent of habitat areas expected to recover from both direct and indirect impacts. Particular consideration should be given to the following: • Impacts on the threated western ringtail possum, including potential direct impacts from traffic on roads and operations • Impacts to herpetofauna, which may include targeted surveys to priority reptile species *Ctenotus ora* and *Lerista lineata*	7.5
35.	Predict the residual impacts from the proposal on terrestrial fauna, including SRE fauna, for direct and indirect impacts after considering and applying avoidance and minimisation measures.	7.6
36.	Discuss proposed management, monitoring and mitigation measures to be implemented for the proposal to ensure residual impacts are not greater than predicted.	7.6
37.	Demonstrate in the ERD how the EPA's objective for this factor will be met.	7.6 & 7.7
38.	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model (page 11) and WA Offset Template (Appendix 1) in the WA Environmental Offsets Guidelines (2014).	7.6
39.	Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines. Spatial data defining the area of significant residual impacts should also be provided (e.g. vegetation type, vegetation condition, specific fauna species habitat).	NA
Social Surroundings		
40.	Characterise the land use and amenity values of the Yalgorup National Park and Lots 1000, 3045, 2657,2275 and 2240 immediately north of the proposal (recently acquired for inclusion in the national park), particularly noting the sensitive receptors and important areas for human use that could be affected by noise and dust emissions, visual amenity issues and alterations to the landforms from excavation of the limestone ridge. Include relevant maps to show the locations of the sensitive receptors likely to be affected by the proposal.	8.3
41.	Characterise noise impacts on sensitive receptors via a noise assessment in accordance with EPA Guidance. Demonstrate that noise can be managed such that it complies the *Environmental Protection (Noise) Regulations 1997* at sensitive receptor locations.	8.3 & 8.5
42.	Characterise the environment by providing baseline data of dust emissions and assess the potential for dust impacts as sensitive receptor locations.	8.3 & 8.5
43.	Characterise the environment by providing a description of the visual landscape units that may potentially be visually affected. This should include, but not limited to: landforms; vegetation; waterways (including wetlands) and can be undertaken by way of 3-dimensional modelling and/or photographs.	8.3

Task No.	Required Work	Section
44.	Identify and discuss the potential sources and impacts of noise, dust and alteration to landforms from the proposal. In particular, address potential impacts to the Yalgorup National Park, the properties proposed for future inclusion to the national park, and the impacts on the Lake Pollard walk trail.	8.5
45.	Identify and discuss any impacts on the future use of the access way by the Department of Biodiversity Conservation and Attractions (DBCA) staff and visitors to the national park.	8.5.4
46.	Identify the types and sizes of trucks, and the road upgrades required to accommodate operations and ensure the safety of other road users and campers using the Martin Tank campsite. Demonstrate how the road will be maintained to provide for the ongoing safety of road users and campers using the Martin Tank campsite.	8.5.4
47.	Design and undertake a visual impact assessment (VIA) for before, during and after the proposed excavation activities, to assess the impacts of the proposal on visual amenity in accordance with the Western Australian Planning Commission (2007) *Visual Landscape Planning in Western Australia: a manual for evaluation, assessment, siting and design*, and in consultation with the DBCA.	8.3 & 8.5
48.	The VIA will identify and describe the aspects of the proposal which may potentially affect the visual landscape character and scenic quality values both temporarily and permanently, using agreed (by the EPA, in consultation with the DBCA) reference and vantage points of surrounding areas including travel routes and use area's viewer positions and perceptions.	8.3 & 8.5
49.	Predict the residual amenity impacts from the proposal on the landscape sensitive receptors and important areas for human use after considering and applying avoidance and minimisation measures. Impact predications are to include, but not be limited to: • The likely extent, severity and duration of the impacts form noise, dust, light-spill, and alterations to the landscape, landform and to amenity • Simulations/modelling of the predicted residual impacts from the proposal, including changes to the landscape from the agreed reference and vantage points.	8.5
50.	Identify management and mitigation measures for the proposal including closure and rehabilitation outcomes to ensure residual impacts are not greater than predicated. The ERD is to include: • A description of the management and mitigation measures • Management zones and strategies for managing visual landscape character relative to each stage of the proposed operation • Environmental management plans outlining the environmental outcomes/objectives, other key regulatory requirements; management actions, monitoring (including methodology, frequency, location and rational), trigger criteria, contingency actions, review, reporting, and consultation.	8.5
51.	Demonstrate in the ERD how the EPA's objective for this factor will be met.	8.5 & 8.6

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1 INTRODUCTION

1.1 Purpose and Scope

Doyle's Lime Services (the proponent) are proposing to develop a limestone and sand quarry on Lot 1002 Preston Beach Road North, Preston Beach, Western Australia (herein referred to as the Proposal). The Proposal will involve the extraction, screening and crushing of limestone, and grading and maintenance of Preston Beach North Road for access.

The Environmental Protection Authority (EPA) has determined that the abovementioned Proposal will be formally assessed under Part IV of the *Environmental Protection Act 1986* (WA) (the EP Act).

The purpose of this Environmental Review Document (ERD) is to describe and assess the significance of the environmental impacts that have the potential to occur as a result of the construction and operation of the Proposal. Impacts are considered in the context of the key environmental factors identified by the EPA in the Environmental Scoping Document (ESD).

The structure of this ERD follows the template provided in the *Instructions on how to prepare an Environmental Review Document* (EPA 2018).

1.2 Proponent

The proponent for the Proposal is Moresereel Pty Ltd (trading as Doyle's Lime Service). The proponent's details are provided below in **Table 1-1**.

Table 1-1. **Proponent identification.**

Proponent	Doyle's Lime Service
ABN	13 725 675 055
Address	PO Box 133, Capel 6271
Key Contact	Accendo Australia Kirsten Muir-Thompson Telephone: +61 418 950 852 Email: kirsten@accendoaustralia.com.au

1.3 Environmental Impact Assessment Process

Part IV of the EP Act provides for the consideration and assessment of proposals that may or will have a significant impact on the environment. The impact assessment process is administered by the EPA Services unit within the Department of Water and Environmental Regulation (DWER). EPA Services provides support to the EPA, which is an independent statutory body established under the EP Act.

The proponent referred the Proposal to the EPA Services under section 38 of the EP Act on 5 August 2016. On 28 September 2016, the EPA determined that the Proposal would be formally assessed, with the level of assessment set as ERD.

The EPA subsequently prepared an ESD which sets out the matters to be addressed in the ERD (refer to **Appendix A**).

This ERD is now published for a period of four weeks, during which time the public is invited to comment on the ERD. Refer to the *Invitation to make a submission* section at the beginning of this document for guidance on how to make a submission and the closing date for submissions.

Following the public review period, the EPA will undertake an assessment of the Proposal, considering the ERD, submissions received and the proponent's responses to any submissions received. The EPA will prepare an assessment report recommending whether the Proposal should be implemented and, if recommending approval, any conditions that should apply. The EPA's report will be publicly available and subject to appeal. Upon conclusion of the appeal period, the EPA's assessment report will be provided to the Minister for the Environment, who will decide whether the Proposal may be implemented and, if so, the conditions of approval.

1.4 Other Approvals and Regulation

This Proposal is subject to compliance with the relevant state legislation and regulations and is guided by the relevant over-arching policies and strategies. EPA Environmental Factor Guidelines, Technical Guides and Guidance Statements are also relevant and were utilised in the submission of this Proposal. Details of all relevant approvals in relation to this Proposal can be found in **Table 1-2**.

Table 1-2. Other approvals.

Proposal activities	Land Tenure/access	Type of approval	Legislation regulating the activity
Construction and operation of prescribed premises	Private freehold	Works Approvals and Operating Licences	EP Act - Part V
Extractive industry	Private freehold	Planning Approval and Extractive Industry Licence	*Planning and Development Act 2005* and Shire of Waroona *Town Planning Scheme No. 7*

1.4.1 Land Tenure

Lot 1002 is zoned Rural pursuant to the Shire of Waroona's *Town Planning Scheme No. 7*. Lot 1002 is held in freehold by a third party.

Most of Lot 1002 has been parkland cleared and grazed for many years. Historically it was used for intense winter grazing by cattle and as an airstrip for the aerial spreading of fertiliser and seed on local farming properties.

A road reserve runs along the eastern boundary of Lot 1002. The Yalgorup National Park surrounds Lot 1002.

1.4.2 Decision Making Authorities

The decision-making authorities (DMA) as identified by the EPA as being relevant to this Proposal are listed in the following **Table 1-3**.

Table 1-3. Relevant decision-making authorities for the Proposal.

Decision-making authority	Relevant legislation
1. Minister for Environment	*Biodiversity Conservation Act 2016*
2. Minister for Water	*Rights in Water and Irrigation Act 1914*
3. Chief Executive Officer, Department of Water and Environmental Regulation	Part V of the *Environmental Protection Act 1986*
4. Chief Executive Officer, Shire of Waroona	*Local Government Act 1995*
5. Chairman, Western Australia Planning Commission	*Planning and Development Act 2005 Peel Region Scheme*
6. Minister for Transport; Planning, Main Roads	*Main Roads Act 1930*

2 THE PROPOSAL

2.1 Background

As described in **Section 1.3**, the Proposal was considered likely to have significant impacts on the environment and so was referred to the EPA under section 38 of the EP Act on 5 August 2016. After deciding to assess the Proposal at a level of 'Public Environmental Review', the EPA prepared an ESD setting out the matters to be addressed in this ERD. This ERD responds to the ESD.

2.2 Justification

The proponent previously referred a proposal to the EPA for the construction and operation of a limestone and sand quarry at Lots 1001 and 1002 Preston Beach Road North, Preston Beach. This included a larger development footprint in closer proximity to wetlands of conservation significance.

In consideration of proximity to sensitive environmental features, this Proposal has undergone significant amendments which include:

- The quarry footprint has been reduced from approximately 16.0 hectares (ha) to 14.74 ha (refer to **Figure 2-1**). The proposed quarry lies 800 metres (m) south-west from Lake Pollard compared to 200 m west.
- Groundwater flows east to the south of Lake Pollard rather than directly to Lake Pollard.
- The limestone resource is lower in the landscape at a maximum of around 15 m Australian Height Datum (AHD) compared to 30 m AHD.
- The limestone resource lies west of the main 30 m limestone ridge that now separates the excavation from the Lake Pollard – Martin's Tank Lake chain.
- The vegetation within the quarry is regrowth vegetation with densely scattered *Xanthorrhoea preissii* or smaller scattered regrowth young tuart trees.
- The quarry is now 600 m from the Lake Pollard walk trail and 1 kilometre (km) from the lookout. The walk trail now lies on the other side of a large limestone ridge to 30 m AHD.
- The main limestone ridge will now remain intact and not be excavated.

The *Geological Survey of Western Australia* (Abeysinghe 1998) has identified a *Regionally Significant Basic Raw Material – Limestone* within Lot 1002 Preston Beach North Road, Preston Beach. The material is of high grade and is suitable for the supply of agricultural lime and road bases.

The Proposal seeks to provide a continued resource of strategically located limestone, suited to a variety of end products. The majority of the lime from this quarry will be used in the agricultural industry with lime being transported as far as Hyden in the east through Brookton to Wagin and Collie in the south. The northern limit of the limestone supply is north of Perth where the northern supplies of limesand have a transport cost advantage.

The limestone will be used to prevent soil acidification, which is a well-recognised major environmental issue, highlighted in the various State of Environment Reports in Western Australia (EPA 2007), where it is estimated that 55% of the agricultural land in Western Australia is susceptible to the problem.

The Western Australian Planning Commission (WAPC) in *WAPC 2012, Basic Raw Materials Demand and Supply Study for the Bunbury - Busselton Region*, determined that limestone is in short supply and that all the limestone available including that in the Lake Pollard area was just sufficient to satisfy the growth demands of the region for the next 30 years.

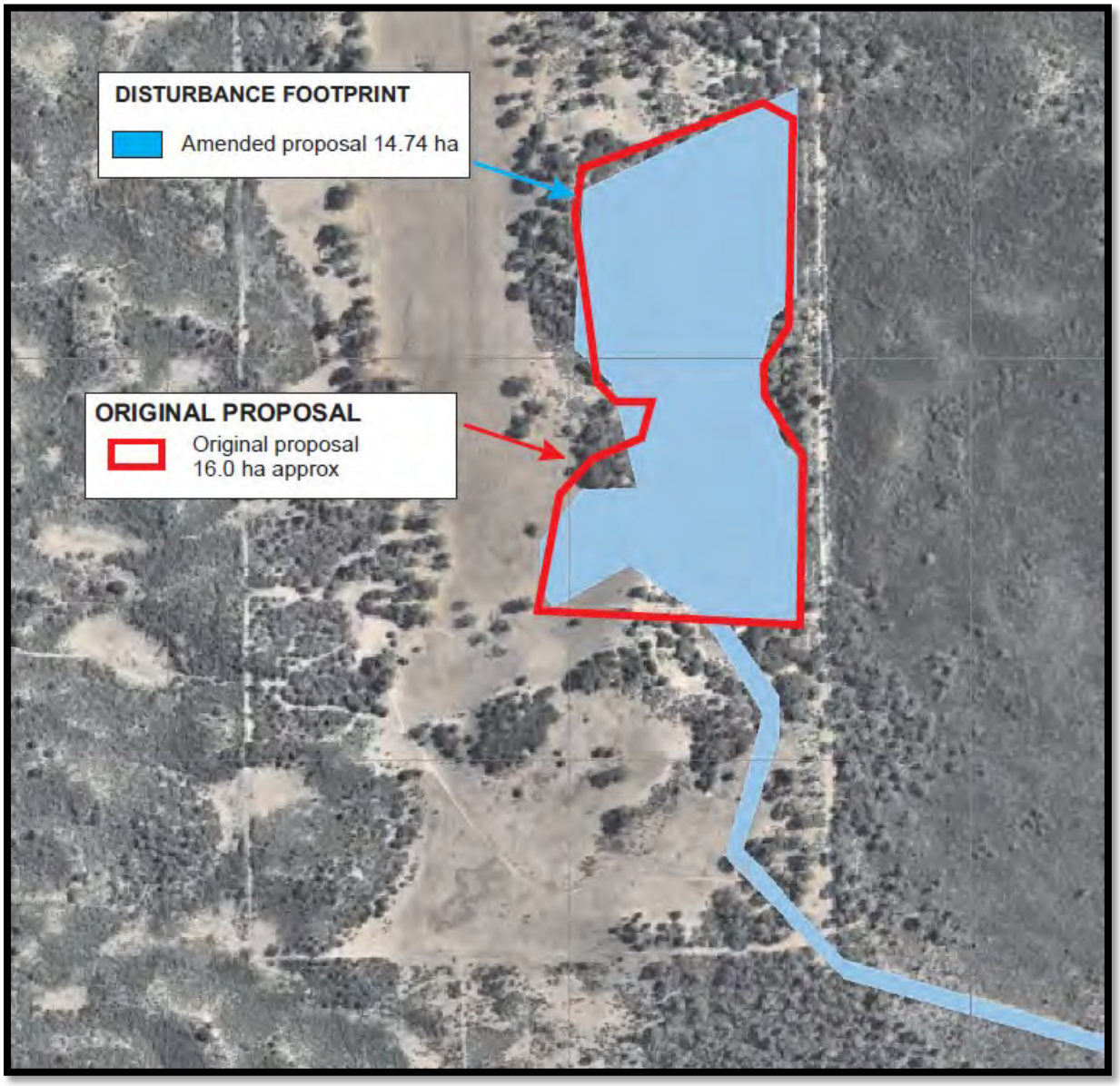


Figure 2-1. Amended disturbance footprint.

2.3 Proposal Description

2.3.1 Location

The property on which the Proposal will take place, Lot 1002 Preston Beach Road North, represents a privately-owned rural development bordered on three sides by the Yalgorup National Park, and to the north by Lot 1001, also rural land (refer to **Figure 2-3**). The property is located at the end of Preston Beach Road North, which terminates at the property's south-eastern boundary gate.

The location is relatively remote (refer to **Figure 2-2**) despite its proximity to Mandurah (30 km north) and Perth (150 km north) due to limited access through the Yalgorup National Park and the physical barrier posed by the coastal lakes system.

2.3.2 Proposal

The proponent is proposing to develop a limestone and sand extraction project (quarry) on Lot 1002, Preston Beach Rd North, Preston Beach, Western Australia. The limestone resource comprises high-grade lime located just south of a resource previously identified as a regionally significant Basic Raw Material (Resource 61) by the WAPC (2012). The lime will be used primarily for agricultural purposes and road-base.

The limestone and sand pit will cover an area of approximately 14.74 ha with a maximum natural elevation of about 15 m AHD. It will be excavated to 5 to 6 m AHD in eight stages, each about 2 ha, over 20 years. It is anticipated that approximately 50,000 tonnes of limestone and 10,000 tonnes of sand will be extracted each year, depending on supply and demand. Access to the property will be via the existing limestone road, Preston Beach Road North, and the sealed Preston Beach Road that exits onto National Route 1, Forrest Highway. The quarry will only be operational for about four months of the year, from December to April. This is because lime products are only required in late summer and autumn for agricultural purposes. A site Environmental Management Plan (EMP) has been developed which documents all environmental management measures relating to the Proposal (refer to **Appendix B**).

A summary of the Proposal characteristics is provided below in **Table 2-1**.

Table 2-1. Summary of Proposal characteristics.

Aspect	Proposal Characteristic
Excavation	
Area of excavation	The limestone resource is approximately 12.60 ha and the sand resource approximately 1.19 ha
Limestone extraction	50,000 tonnes per year
Sand extraction	10,000 tonnes per year
Life of project	20 years
Area cleared per year	Initially 2 ha and then 0.5 – 1.0 ha per year. Sand excavation can occur without the need to clear native vegetation.
Total area to be cleared	Quarry area – 13.9 ha Access road – 0.7 ha (parkland cleared vegetation)
Area mined per year	0.5 – 1.0 ha
Dewatering requirements	None
Processing	
Water requirements	Dust suppression on road
Water supply source	Potable water will be trucked to site
Infrastructure	
Total area of plant and stock	2 ha within excavation footprint or adjoining cleared land

Aspect	Proposal Characteristic
Required equipment/machinery	1 x loader 1 x small mobile screening plant 1 x small mobile crushing plant 1 x 10,000 L water truck 1 x portable toilet
Area of settling ponds	Not required
Fuel/chemical storage	Not required
Transport	
Truck movements	Variable but a maximum of 10 trucks per day from December to April
Access	Existing limestone Preston Beach North Road from the sealed Preston Beach Road
Workforce	
Construction/operation	Two people
Hours of operation	From December to April (excluding public holidays): Monday - Friday 7.00 am to 5.00 pm Saturday 7:00 am to 1 pm

2.3.3 Vegetation Impacts

A summary of the clearing activities is provided below:

- Limestone/sand quarry:
  - Staged clearing (initially about 2 ha and then 0.5 to 1.0 ha per year) of vegetation in Degraded to Good condition, with a total vegetation clearing area of 13.9 ha.
  - Progressive native rehabilitation following completion of each stage.
- Access road on Lot 1002:
  - Clearing of 0.7 ha of scattered parkland pasture vegetation in Completely Degraded to Degraded condition.
- Preston Beach Road North Road:
  - 0.6 ha of predominately pruning/trimming of tree/shrub branches.

The planned end use of the quarry is to restore a natural soil and return the ridge to native vegetation along the buffer to the access road along the eastern boundary of Lot 1002, with pasture in the west, so there is no net loss of native vegetation and the buffer to Lake Pollard will be enhanced. Lake Pollard and the surrounding vegetation are included as part of the Yalgorup National Park.

2.3.4 Quarrying Operations

2.3.4.1 Limestone Extraction

The limestone within the quarry is relatively soft and can be removed with a loader without the need for a bulldozer or blasting. It will then be screened to produce products of the correct size. A small mobile crusher is required to prepare the correct grainsize. A summary of the proposed limestone extraction activities is provided below:

- Prior to excavation commencing the quarry will be ground surveyed, the excavation footprint marked out and a 1 metre contour plan developed.
- Remove the vegetation cover by pushing it into windrows for use on the batters to minimise soil erosion and assist spreading on the final land surface as part of the final rehabilitation.
- Where practicable vegetation will be directly transferred to an area being rehabilitated. Smaller indigenous shrub material will be used in the rehabilitation process when available and suitable; for example on batter slopes of completed areas.
- All topsoil will be removed for spreading directly onto areas to be revegetated and screening or perimeter bunds. If direct spreading is not possible the topsoil will be stored in low dumps, for spreading at a later date.
- Soil and overburden, as yellow and brown sand and low grade limestone, will then be removed and either directly transferred to a rehabilitation area or stored in low dumps for later rehabilitation use. Where this is not used, overburden will be stored in dumps for future use in rehabilitation or the creation of bunds.
- Limestone interburden, if encountered, will be incorporated into the overburden dumps for later use in re-contouring the land surface at the conclusion of excavation.
- A front-end loader will be used to dig and push the limestone down the excavation face and track roll the limestone in the process.
- The preliminary crushed limestone will then be picked up by a loader and fed to the mobile crusher.
- All static and other equipment, such as crushers and screens (where used), will be located on the floor of the quarry to provide visual and acoustic screening.
- Excavation will commence on the western ridge and then move to the eastern ridge, working on the floor of the pit towards the edges to minimise the potential visual impact. The face and walls of the pit will act as noise barriers.
- Upon completion of each section of quarry the section will be reformed and back filled, where subgrade material is available, to achieve the proposed final contours.
- At the end of excavation, the floor of the quarry will be deep ripped, covered by overburden and topsoil, and rehabilitated to a constructed soil.

2.3.4.2 Sand Extraction

Sand will be sourced by pushing the topsoil into perimeter bunds for later rehabilitation. Sand will then be excavated with a loader, loading directly to a road truck.

2.3.4.3 Final Contours

The slope of the final contours of the quarry will be an undulating surface at around 5 m AHD which is consistent with the adjoining land. **Appendix C** provides the mine closure details.

Slopes of the batters at the end of excavation will be retained at 1:4 vertical to horizontal. Sand excavation will cut to an elevation of 4 m AHD because the resource is thin.

A separation of 4 m between the final contours and the maximum groundwater elevation will be maintained.

2.3.5 Access and Truck Movements

Access to the quarry will be along Preston Beach Road, which is sealed, and then to Preston Beach North Road which is limestone and will need grading and maintenance.

The Preston Beach Road provides access to the Preston Beach township. It is associated with regular residential traffic in addition to tourist traffic during holiday periods and weekends. Conversely, Preston Beach North Road does not provide any direct access to other residential dwellings. It provides access to the Martin Tank's campsite for a variety of vehicles (caravans, motorhomes etc.)

From December to April, a maximum of 10 trucks per day is anticipated (depending on demand) which will equate to one to two trucks per hour.

The access and internal roads will be limestone based and watered as needed to suppress dust.

The existing perimeter fences and gates will be maintained.

2.3.6 Transport Corridor

As previously discussed, access to the quarry will be via the existing limestone road, Preston Beach Road North, and the sealed Preston Beach Road that exits onto National Route 1, Forrest Highway.

In order to determine the suitability of the Preston Beach Road North as a transport corridor associated with the Proposal, Greenfield Technical Services was commissioned to undertake a road assessment in June 2014 (refer to **Appendix D**). The assessment determined that a road network upgrade is required for Preston Beach Road North to enable the necessary increase in truck traffic, including grading of the road, trimming of roadside vegetation to improve sight-lines, 50 m realignment of a public walking trail (within an existing track), and intersection and signage upgrades.

In 2015 the Shire of Waroona in consultation with the Department of Biodiversity, Conservation and Attractions (DBCA) undertook road maintenance works to Preston Beach Road North to accommodate caravans and motorhomes. This involved the use of heavy machinery and it is understood that vegetation pruning was undertaken. DBCA has also identified upgrades will be required for any further increased traffic. The Greenfield Technical Services report predates these road maintenance works and therefore they are not considered in the report.

The Greenfield Technical Services report notes that Preston Beach Road North is a public road and therefore there is no restriction on 19 metre semi-trailer trucks. However, the Shire has erected a sign on the road stating "Closed to all vehicles Class 3 and over". The proponent has consulted with the Shire of Waroona regarding this matter. The Shire have provided written advice that the required trucks could be used on Preston Beach Road North as an exemption to the local by-law, with conditions.

In consultation with the Shire of Waroona and the DBCA, the proponent is prepared to commit to Option 2B (refer to **Appendix D**, page 3 of the Greenfield Technical Services report) for the road upgrade and maintenance works along Preston Beach Road North. This will include but not be limited to:

- Trimming/pruning of road vegetation to increase sightlines.
- Grading of the road.
- Additional signage.

As a result of the works, the road will become safer for all users including caravans and visitor traffic to Martin's Tank campground.

2.4 Local and Regional Context

The quarry is located approximately 800 m south-west of Lake Pollard, 2 km west of Lake Clifton and 1.5 km north-west of Martin's Tank Lake, and lies immediately west of Yalgorup National Park.

The National Park is an internationally recognised, Class A Conservation Reserve and the lakes form part of the Peel-Yalgorup Ramsar-listed wetlands (Managed Recharge 2021). The closest dwelling is located approximately 1 km away to the south. The regional location of the Proposal is shown in **Figure 2-2.**

Figure 2-2. Regional location of the Proposal.

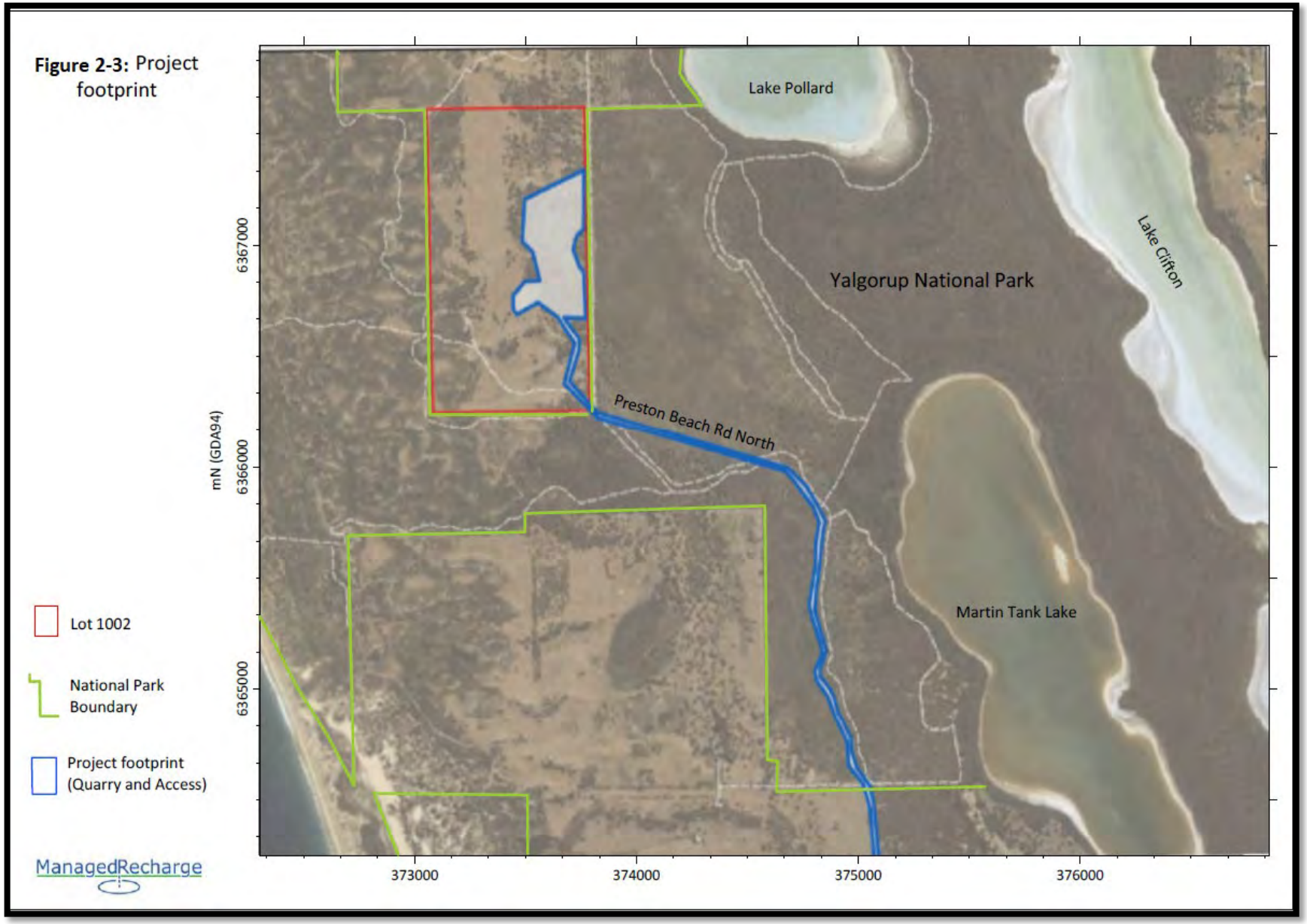


Figure 2-3: Project footprint
Lake Pollard
Yalgorup National Park
Lake Clifton
Preston Beach Rd North
Martin Tank Lake
mN (GDA94)
6367000
6366000
6365000
373000
374000
375000
376000
Lot 1002
National Park Boundary
Project footprint (Quarry and Access)
ManagedRecharge

3 STAKEHOLDER ENGAGEMENT

3.1 Key Stakeholders

The key stakeholders identified throughout the initial planning phase for the quarry are listed below in **Table 3-1.**

Table 3-1. Key stakeholders.

Stakeholder	Project role/Interest
Commonwealth Government	
Department of Agriculture, Water and the Environment (DAWE)	Matters of National Environmental Significance (Ramsar wetland, western ringtail possums, black cockatoos)
State Government	
Department of Water and Environmental Regulation	Prescribed premises pursuant to the EP Act
Environmental Protection Authority	Environmental approval under the EP Act
Department of Biodiversity Conservation and Attractions	Yalgorup National Park
Local Government	
Shire of Waroona	Planning approval and Extractive Industry Licence
Local Community	
FRAYGLE community group	Community group

3.2 Stakeholder Engagement Process

Consultation methods varied, with the most appropriate form of consultation adopted for each stakeholder. These involved the following:

- Identifying and resolving issues that affect stakeholders, residents, businesses and other community members, and managing their information needs.
- Issuing communication to stakeholders.
- Establishing and maintaining relationships with local community groups, residents, businesses, the Shire of Waroona and other stakeholders where relevant.
- Identifying and responding to local issues, including preparation of, and contribution to, communication strategies to address issues.
- Responding to email, telephone and general inquiries from stakeholders.

3.3 Stakeholder Consultation

The responses from stakeholders to date have been used to help guide development of the Proposal (refer to **Table 3-2**). Stakeholder consultation will continue as the project progresses.

Table 3-2. Stakeholder consultation.

Stakeholder	Issues	Response
DAWE	Requested additional information for decision to not refer Proposal pursuant to the EPBC Act.	Self-Assessment report provided to the DAWE. No further comments received.
EPA	Expressed concerns regarding the historical extraction footprint (not associated with this Proposal).	The extraction footprint has been significantly amended to reduce potential environmental impacts.
EPA	Expressed concerns regarding hydrological impacts to Ramsar wetland.	Site-specific monitoring undertaken. Detailed hydrological modelling undertaken which showed no impacts.
Shire of Waroona	None expressed to date.	Proponent consulted with the Shire regarding transport route along Preston Beach Road North. Shire advised that this route could be suitable.
EPA, DWER and community members	General environmental concerns.	Proponent conducted a site visit for all to view the proposed quarry footprint.

4 ENVIRONMENTAL PRINCIPLES AND FACTORS

4.1 Principles

The *Statement of Environmental Principles, Factors and Objectives* (EPA 2018c) was used as the basis for the environmental impact assessment presented in this ERD. **Table 4-1** presents an overview of how these principles have been considered in the context of the Proposal.

Table 4-1. Consideration given to environmental principles.

Principle	Consideration
1. The Precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by:* *a) Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* b) *An assessment of the risk-weighted consequences of various options.*	Detailed biological and hydrogeological surveys and modelling have been undertaken by specialist scientists to inform the assessment of the Proposal. A risk-based approach was undertaken for the design of the Proposal. The Proposal design was amended to avoid, where practicable, serious or irreversible impacts and appropriate management measures have been implemented to minimise residual impacts. This is demonstrated by adjustment of the quarry footprint to reduce impacts to mature trees and avoid potential impacts on Ramsar wetlands.
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*	The Proposal has been designed and will be implemented to ensure that cleared land will be rehabilitated to a condition better than that of the pre-disturbed land. Closure strategies to achieve this have been developed and are detailed in **Section 6.6**. A Rehabilitation and Closure Plan has been prepared which will be regularly updated. During the life of the project management measures will be implemented to ensure that the environment is protected against potential impacts
3. Principles relating to improved valuation, pricing and incentive mechanisms 1. *Environmental factors should be included in the valuation of assets and services.* 2. *The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* 3. *The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.*	The proponent endorses the need for improved valuation, pricing and incentive mechanisms. This has included: - Environmental factors have played a central role in the refinement of the proposal design. - By its nature, the proposal will generate very minor waste streams. - The cost of eventual closure and rehabilitation has been considered regarding total project costs.

Principle	Consideration
4. The principle of the conservation of biological diversity and ecological integrity. *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	Detailed biological surveys have been undertaken by specialists to inform the assessment of the Proposal. The data obtained from these assessments has been used in the refinement of the design of the Proposal. This has included design modifications to avoid direct impacts on vegetation of conservation significance.
5. The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	All reasonable and practicable measures to minimise the generation of waste and its discharge to the environment will be taken. The proponent will implement an 'avoid, reduce, re-use, reprocess, recycle, recovery and dispose' hierarchy of waste management approach across all components of the project.

5 INLAND WATERS

This section is based on extracted information from the *Preston Beach Road North – Hydrological Assessment* (Managed Recharge 2021), which is provided in **Appendix E**.

5.1 EPA Objective

The EPA's objective for inland waters is to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

5.2 Policy and Guidance

The following policies and guidance have been considered in the assessment of inland waters with respect to the above EPA objective:

- Environmental Factor Guideline – Inland waters (EPA 2018)
- Environmental Factor Guideline – Flora and vegetation (EPA 2016)
- Environmental Factor Guideline – Terrestrial fauna (EPA 2016)
- EPA Report 1359 – *Strategic Environmental Advice on the Dawesville to Binningup Area* (EPA 2010)

Other policies and guidance relevant to this factor are:

- Peel coastal groundwater allocation plan: *Groundwater-dependent ecosystems Environmental Water Report Series Report No. 27* (Department of Water 2015)
- Peel coastal groundwater allocation plan: *Water resource allocation and planning report series, Report No. 6* (Department of Water 2015)
- Water Quality Protection Note 15: *Extractive Industries near sensitive water resources* (Department of Water 2013)
- WA Environmental Offsets Policy (Government of Western Australia 2011)
- WA Environmental Offsets Guidelines (Government of Western Australia 2014)

5.3 Receiving Environment

5.3.1 Background

The quarry is approximately 800 m south-west of Lake Pollard, 2 km west of Lake Clifton and 1.5 km north-west of Martin's Tank Lake, and lies immediately west of Yalgorup National Park. The National Park is an internationally recognised, Class A Conservation Reserve and the lakes form part of the Peel-Yalgorup Ramsar-listed wetlands. The wetlands provide important habitat for water birds and Lake Clifton contains rare, living thrombolites that are found predominantly on the north-east side of the lake in a stretch that extends approximately 15 km (Managed Recharge 2021).

Lot 1002 covers an area of generally low-lying land (approximately 5-10 m AHD) that rises to a limestone ridge to the east (up to 35 m AHD in the Yalgorup National Park) and sand dunes to the west (up to 25 m AHD). While there are no surface water features located within the quarry, and most rainfall is infiltrated directly to the ground, in high rainfall events water may flow over-ground or as sub-surface flow into the north-south trending swale to the west of the quarry before infiltrating to the groundwater. It is possible, therefore, that the swale acts as a local groundwater recharge area (Managed Recharge 2021).

5.3.2 Geology

The quarry is located on the western margin of the Swan Coastal Plain, which comprises of sedimentary formations of the Perth Basin, extending to depths of up to 8000 m and bound to the east by the Darling Fault and to the west by the coast (Managed Recharge 2021).

The superficial formations comprise Cainozoic sediments, between 12 and 90 m thick, unconformable overlying Mesozoic sediments of the Osborne, Leederville or Cattamarra Coal Measures (formerly Cockleshell Gully Formation). The erosional surface dips gently and unevenly to the west, ranging in elevation from about 50 m AHD near the Darling Scarp to -28 m near the coast. The quarry is situated at the contact between the Quindalup Dunes (Safety Bay Sand) and Spearwood Dunes (Tamala Limestone and Sand). The lakes of concern (Lake Pollard, Lake Clifton and Martin Tank Lake) are represented by the Estuarine and Lagoonal deposits, east of the Tamala Limestone ridge, which overlie Tamala Limestone/Sand to the west and Bassendean and/or Guildford Sand to the east. The Tertiary-aged Ascot Formation Limestone may be present at depth. These Quaternary and Tertiary sediments unconformably overlie the Cretaceous Osborn and/or Leederville Formations (Managed Recharge 2021).

Shallow monitoring bores located in the swale to the west of the quarry (DLMB1, DLMB2 and DLMB4) are completed in Safety Bay Sand: Grey-brown to buff, very fine-to coarse-grained with a minor very-coarse fraction, sub-rounded to well-rounded with some spherical grains, generally moderately to poorly sorted, occasionally well sorted, calcareous quartz-sand (quartz is clear, frosted and orange) with some small shells, minor heavy minerals and possible traces of garnet and glauconite (Managed Recharge 2021).

5.3.3 Coastal Lakes

Lake Pollard, Martins Tank and Lake Clifton are part of the Yalgorup coastal lake system, which forms three parallel lines of lakes within 5 km of the coast. Martin Tank Lake lies east of Lake Preston separated by a limestone ridge, and Lake Clifton is separated from Martins Tank and Lake Pollard by a shallow sand ridge (Commander 1988).

The lakes receive virtually no runoff, and are maintained by direct rainfall accession and groundwater inflow. They act as groundwater sinks, with no outflow other than by evaporation. They are underlain by hypersaline groundwater, which, because it is denser than seawater, allows the lakes to periodically fall below sea level (Commander 1988). Monitoring conducted to the north of the quarry in 2008 showed water levels in Lake Pollard ranged from about -0.5 m AHD in February/March to about 0.45 m AHD in August/September (ENV Australia 2009).

5.3.4 Hydrogeology

The superficial formations, which consist predominantly of clay and sand to the east of the Swan Coastal Plain, and of sand and limestone to the west, form an unconfined aquifer extending westwards from the Darling Scarp to the coast (Deeney 1989).

At the quarry, the superficial aquifer is shallow and unconfined and occurs within the Safety Bay Sand and Tamala Limestone, Bassendean Sand, Guildford Sand and Ascot Formation, with hydraulic connection between the shallow sediments and the lagoonal and swamp deposits of the coastal lakes and wetlands. (Managed Recharge 2021).

5.3.4.1 Groundwater Recharge and Discharge

Groundwater recharge in the area is via direct rainfall infiltration, with infiltrated rainfall likely to reach the water table within days due to high vertical hydraulic conductivities (CyMod 2009). Discharge from the superficial aquifer in this region is predominantly from the coastal lake system via evaporation.

Groundwater west of the groundwater divide beneath the Quindalup Dunes will flow to the ocean. Minimal abstraction occurs in the area (Managed Recharge 2021).

5.3.4.2 Groundwater Levels and Flow

The water table elevation in the superficial aquifer generally falls from east to west, following the gently topographical gradient except within the Spearwood Dunes (limestone ridge) (Deeney 1989). The presence of watercourses, lakes and inlets has resulted in the formation of complex groundwater-flow regimes in the region, which includes a number of groundwater divides (Deeney 1989), or flow boundaries whose positions may be inferred from the water table configuration (Commander 1988).

Commander (1988) identified six groundwater flow systems between Harvey and Leschenault Inlets, one of which is "Martins Tank" an internal flow system covering a relatively small area of about 20 km^2 discharging to Martins Tank and other lakes including Lake Pollard. The quarry lies within this flow system. It is noted that the eastern divide of the Martin Tank flow system is inferred to lie between Lake Pollard-Martins Tank and Lake Clifton and so groundwater from the quarry will not reach Lake Clifton if/when this divide is present (Managed Recharge 2021).

Long-term water level monitoring conducted for DWER at monitoring bore B2, located approximately 200 m west of Martins Tank Lake, indicates a period of gradually declining groundwater levels between about 1979 and 1999, which appears to have stabilised over the last 20 years (refer to **Figure 5-1**). Groundwater levels in this bore generally range from about -0.2 m to 0.4 m AHD, with variations likely reflecting the amount of rainfall received in the area. It is noted that groundwater levels fall below sea level for two to three months each year in response to evaporation losses from the coastal lakes (Managed Recharge 2021).

A 2009 investigation undertaken just north of the quarry for Cape Bouvard Investments (ENV Australia 2009) indicated that the water table is close to sea level with a low hydraulic gradient falling to the east toward the lake, particularly in summer. These results are consistent with earlier studies. Groundwater levels fluctuate seasonally by about 0.5 m in direct response to infiltration of winter rainfall (Managed Recharge 2021).

A site-specific drilling program was undertaken in March and May 2018, primarily to define the water table contours at the quarry and determine groundwater flow characteristics in relation to potential flow towards the coastal lakes, in particular Lake Pollard, Martins Tank Lake and Lake Clifton (Managed Recharge 2021). This involved the installation of seven monitoring bores, with six of the monitoring bores (DLMB1 to DLMB6) drilled to about 2 m below the water table and one monitoring bore, DLMB7, was drilled to a depth of 21 m (refer to **Figure 5-1**).

Groundwater levels were measured between 3.27 m btc (below top of PVC casing) (DLMB2) and 10.47 m btc (DLMB3) on 24 May 2018, with the deeper groundwater levels occurring at sites with higher topographical elevation. The water table occurs at an elevation of between -0.09 m AHD (DLMB6) and 0.19 m AHD (DLMB4). **Figure 5-2** shows groundwater level contours across the quarry in May 2018. The plot shows that groundwater flow beneath the quarry is to the east-north-east and east toward the coastal lakes, and that a low groundwater ridge is located to the west of the quarry. It is noted that the groundwater elevation is in no way related to the topography in this area, and no groundwater mounding was evident beneath the limestone ridge (DLMB3 and DLMB7) (Managed Recharge 2021).

Seasonal groundwater levels were measured at the quarry and in DWER monitoring bore B2 between May 2018 and June 2019, the results are plotted with salinity and rainfall in **Figure 5-3**. The results show seasonal fluctuations in the groundwater table elevation of between 0.18 and 0.32 m, with the largest changes

observed in the bores closest to the lakes (B2 and DLMB6). The average seasonal variation is 0.24 m, which is relatively low and consistent with regional groundwater level changes commonly observed in the high-permeability Tamala Limestone.

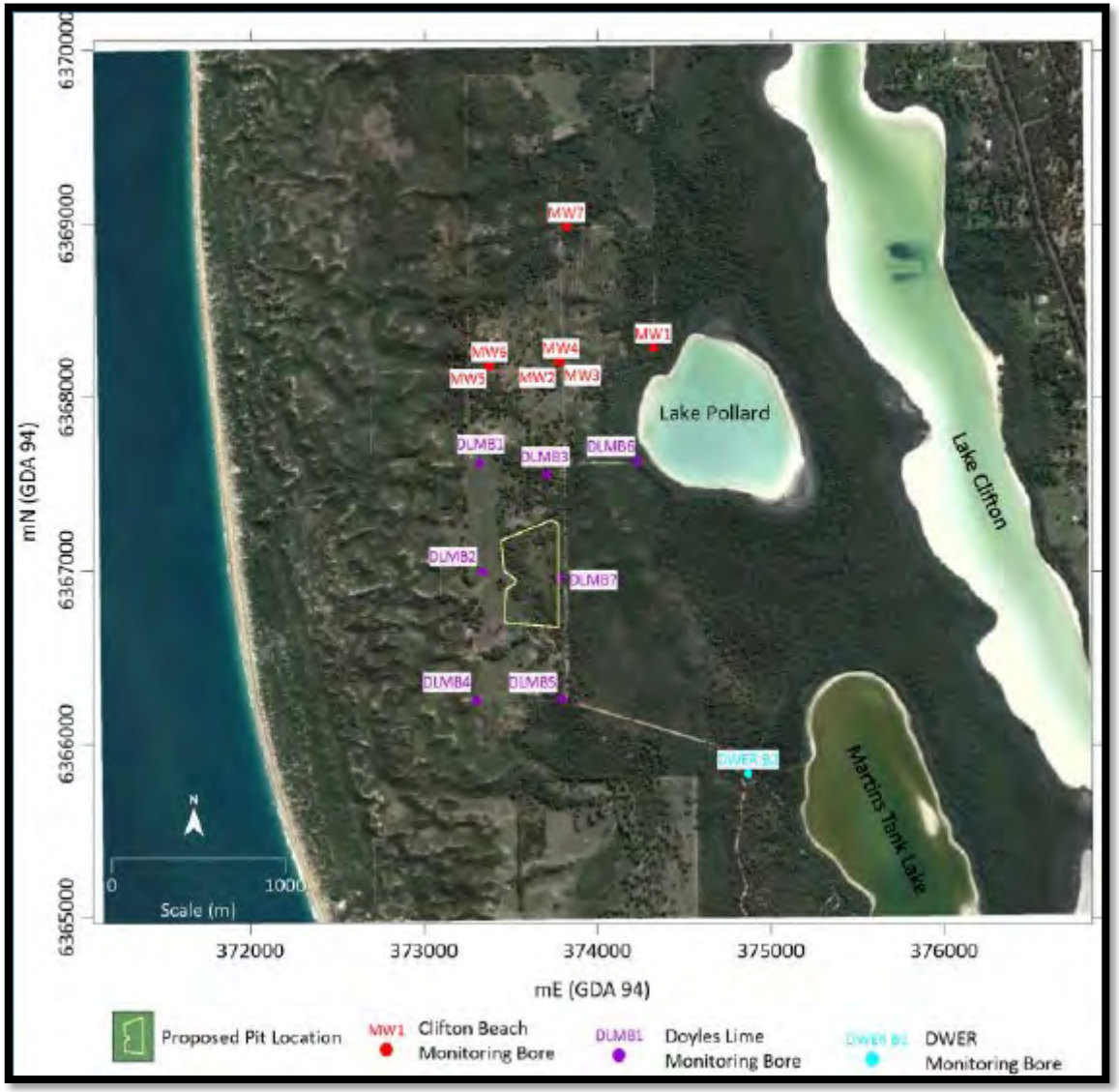


Figure 5-1. Monitoring bore locations (Managed Recharge 2021).

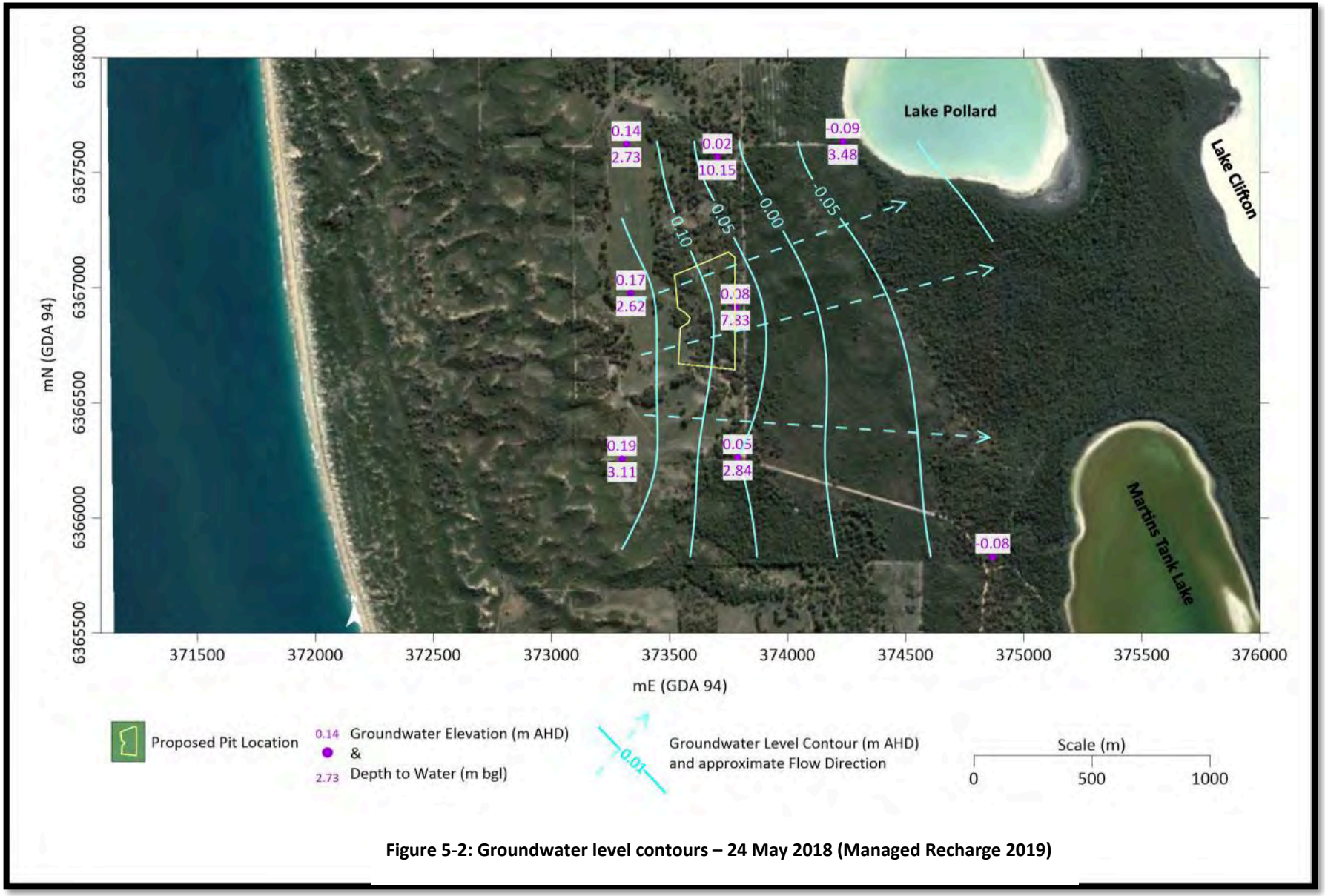
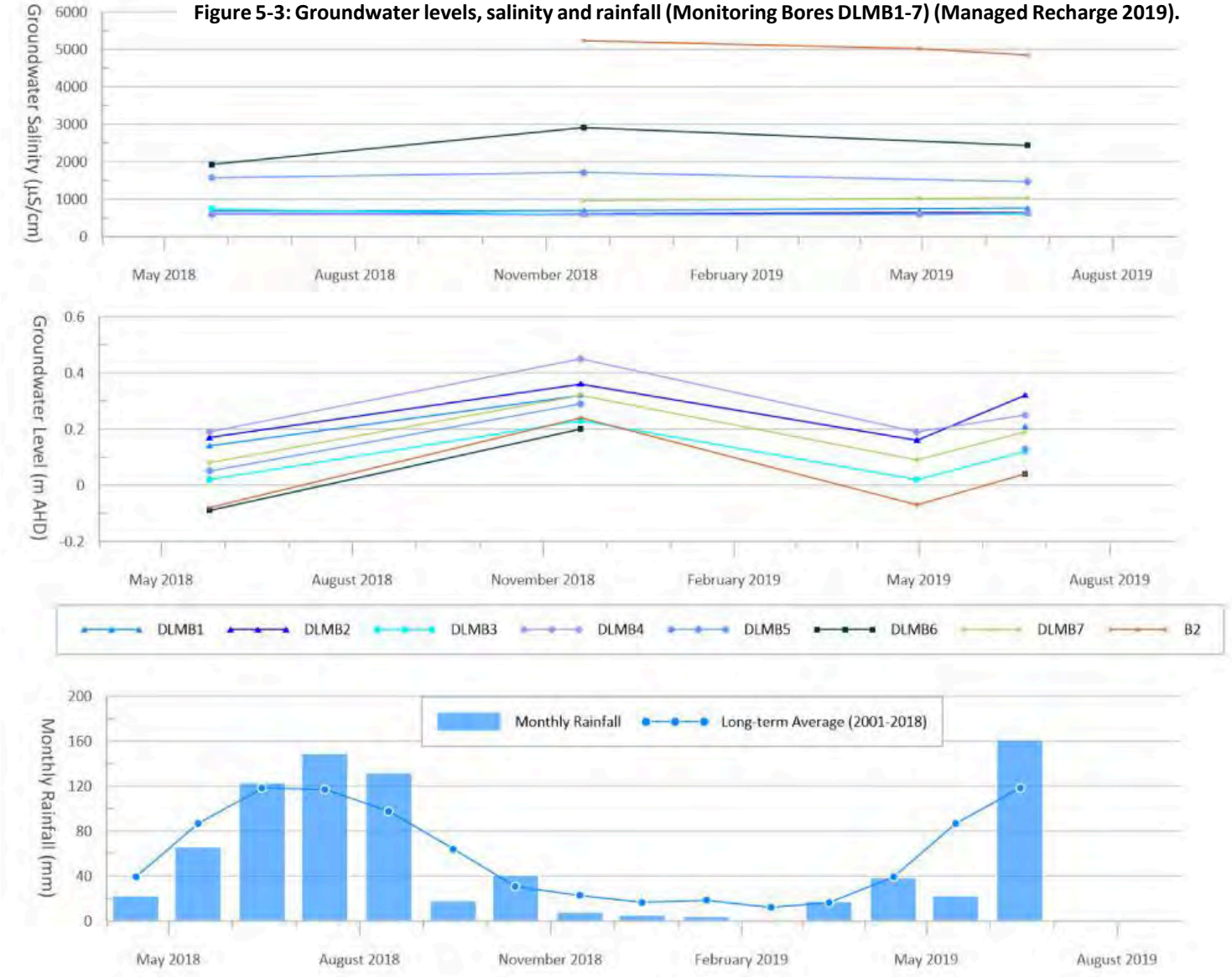


Figure 5-2: Groundwater level contours – 24 May 2018 (Managed Recharge 2019)

Figure 5-3: Groundwater levels, salinity and rainfall (Monitoring Bores DLMB1-7) (Managed Recharge 2019).



When groundwater levels are at a minimum (May 2018), there is a very low groundwater gradient of 0.00024 toward Lake Pollard from the northern half of the quarry, and 0.00019 toward Lake Clifton from the southern half of the quarry. There is no flow from the proposed quarry towards Martins Tank Lake. The values represent maximum flow gradients towards the lakes which are greatest at the end of autumn, when groundwater levels near the lake are at a minimum (refer to **Figure 5-3**).

Using Darcy's velocity equation, with K=20 to 200m/d, the groundwater flow rate towards Lake Pollard is estimated to be between about 9 and 90 m/year, and between about 7 and 70 m/year toward Lake Clifton, giving travel times of between 9 and 90 years to Lake Pollard and from 30 to 300 years to Lake Clifton. If it is assumed a K value of 60 m/d best represents regional conditions, the groundwater flow rate is likely to be in the order of 26 m/year towards Lake Pollard and 21 m/year toward Lake Clifton, giving representative travel times of about 30 years to Lake Pollard and 95 years to Lake Clifton. It is noted that these estimated flow rates do not allow for the inferred groundwater divide between the quarry and Lake Clifton, which is likely to prevent or obstruct water travelling the full distance to that lake (Managed Recharge 2021).

5.3.4.3 Groundwater Salinity

In the Martins Tank flow system, rainfall maintains a lens of fresh or brackish groundwater surrounding the coastal lakes (Commander 1988). Hydraulic boundaries occur between groundwater bodies with strongly contrasting salinities, with less-dense fresh water generally forced upward over more saline groundwater.

When drilled, the brackish lens in DWER monitoring bore B2 extended to a depth of about 14 m, overlying hypersaline groundwater with a well-defined interface and thin mixed zone. In 1988, the salinity of the brackish zone in B2 ranged from 1000 to 4000 mg/L total dissolved solids (TDS), increasing with depth, and the salinity of the underlying hypersaline water was in the order of 44000 mg/L TDS.

To the north of the quarry the freshwater lens in 2008 was apparently thinner, extending about seven metres below the water table (ENV Australia 2009). In the westernmost bores, MW5 and MW6, the freshwater lens overlies groundwater with salinity between about 18000 and 30000 mg/L TDS, suggesting the bores are completely within the coastal saltwater wedge. At MW1, near Lake Pollard, brackish water overlies more saline (up to ~1000 mg/L TDS) water at depth. The depth of the saline-water interface varied by up to ~1 m throughout the year, being deeper following winter rainfall.

Groundwater salinity readings have been measured in-situ to sample 1 m below the water table from monitoring bores DLMB1 to DLMB7 and DWER monitoring bore B2. A total of four monitoring rounds have been completed to-date with the results plotted with groundwater levels and rainfall in **Figure 5-3**.

The results show that groundwater is freshest to the west of the quarry, with salinity increasing to the east and south-east. The low salinity groundwater beneath the swale (DLMB1, DLMB2 and DLMB4), where the water table elevation is highest, indicates that this area is a local groundwater recharge zone. Similarly, the low salinity measured in DLMB3 to the north indicates groundwater recharge likely occurs on the flanks of the limestone ridge in the areas where rainfall runoff might be channelled. It is possible that the salinity results from monitoring bore DLMB7 are influenced by more saline groundwater from below as the bore is slotted over a much deeper interval that the other DLMB series bores; this may also be true for results from B2.

Groundwater salinity profiles were measured in monitoring bores DLMB7 and DWER bore B2 at 1 m intervals to the bottom of the casing. Salinity profile data were collected in November 2018, April 2019 and June 2019, the data is plotted in **Figures 5-4** and **5-5.** A salinity profile was also measured in DLMB7 in May 2018, at the time the bore was constructed, however the results are influenced by the presence of drilling fluids and are therefore not representative of aquifer conditions (Managed Recharge 2021).

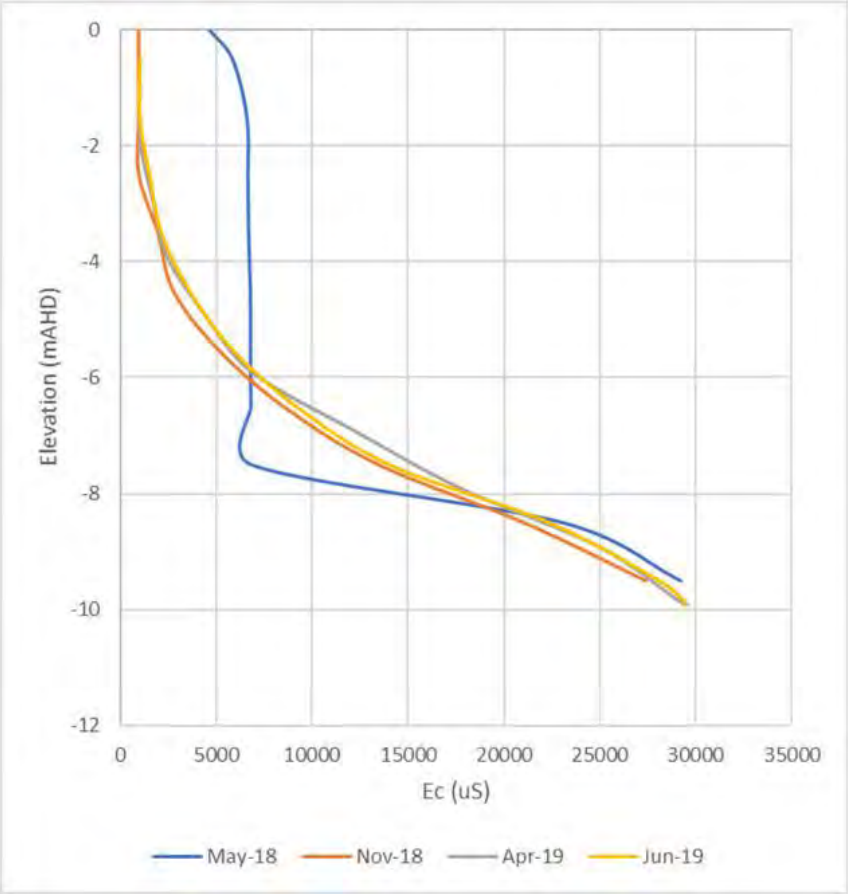


Figure 5-4. Groundwater salinity profile from DLMB7 (Managed Recharge 2021).

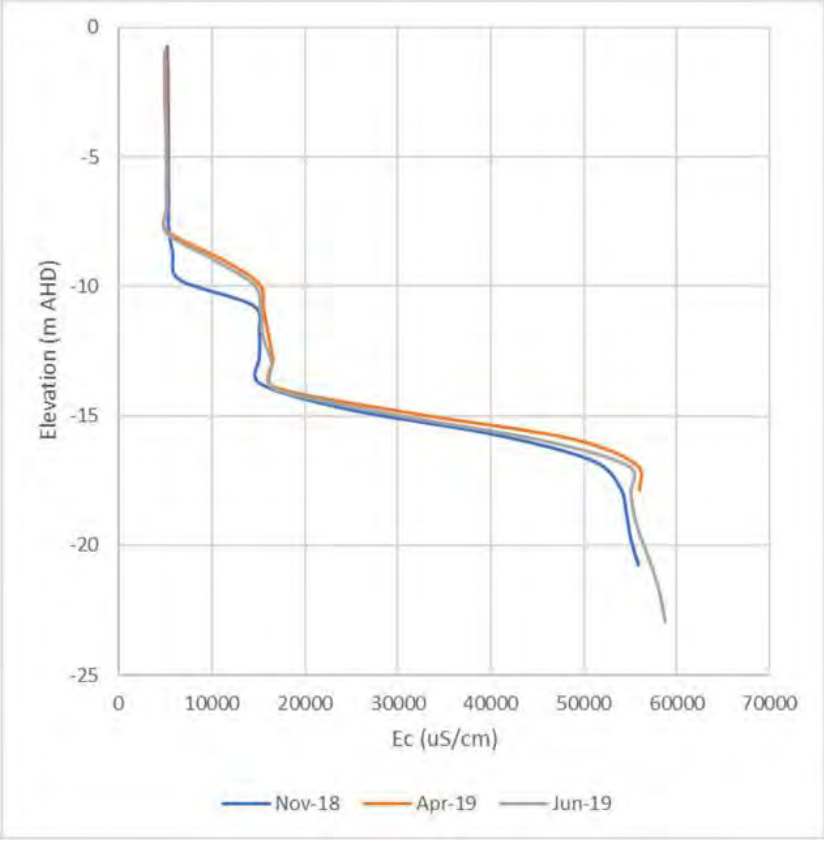


Figure 5-5. Groundwater salinity profile from DWER bore B2 (Managed Recharge 2021).

The salinity profile for monitoring bore DLMB7 shows fresh water (<1670 µS/cm) extends from the water table at about 0.1 to 0.3 m AHD to between about -2.5 (May and June 2019) and -2.9 (November 2018) m AHD, giving a freshwater lens of between 2.6 and 3.2 m thickness for the end of autumn and spring, respectively. The results suggest seasonal thinning of the freshwater lens by approximately 0.6 m at this location. There is a gradual increase in salinity below the freshwater, with brackish groundwater (>1670 and <3340 µS/cm) to about -4.0 to -4.5 m AHD, saline groundwater (>3340 and <16670 µS/cm) to about -7.5 m AHD, and highly saline groundwater (>16670 and <58330 µS/cm) to about -9.5 to -10 m AHD. These results vary from historical records for nearby monitoring bores, where a thicker freshwater lens (5 to 6 m thickness) has typically overlain a sharp and well-defined saline water interface. It is unclear whether the difference relates to changes in the aquifer over the last decade or the location of the bores; an attempt was made to run salinity profiles in the northern bores (MW1, MW5 and MW6) in November 2018, however they were found to be inaccessible due to bore deterioration (Managed Recharge 2021).

Comparison of the salinity profile for DWER monitoring bore B2, using data collected between November 2018 and June 2019, and historical data suggests salinity in the superficial aquifer has increased in this region since the late 1980's, with brackish water of about 5000 µS/cm (approximately 3000 mg/L TDS) (cf. 1000 to 3000 mg/L in 1988) overlying a stepped saline interface that lies between about -8 and -9.5 m AHD. The saline interface also appears to have risen by several meters with salinities in excess of 5000 mg/L (>8330 µS/cm) occurring at 9 to 11 m below the water table in 2018/2019, compared with about 15 m below the water table in 1988. Salinity monitoring results for B2 show an approximate rise of 2 m in the saline water interface between the end of spring (November 2018) and end of autumn (Managed Recharge 2021).

5.3.4.4 Groundwater Chemistry

In November 2018, six groundwater samples and one surface water sample were collected for laboratory analysis, and tested for a suite of major ions, metals, nutrients and physical parameters. The results returned no anomalous values nor any elevated metals or nutrients values (Managed Recharge 2021).

The results for major ions were analysed whereby it was demonstrated that groundwater samples from the western and northern bores, DLMB1, DLMB2, DLMB3 and DLMB4 are a Ca-HCO_3 type, typical of freshwater recharged through a carbonate soil profile, the water from Lake Pollard has a strong Na-Cl signature, typical of seawater, and the samples from DLMB5 and DLMB6 fall on a mixing line between these two end-members indicating the groundwater is a mixture of the two types (Appelo 1994). The results support the conceptual hydrogeological model (discussed below), confirming groundwater recharge via rainfall infiltration occurs to the west and north of the quarry, and indicating mixing of freshwater with saline water in bores DLMB5 and DLMB6 (Managed Recharge 2021).

Further statistical analysis of the general hydro-chemical trends was undertaken (refer to **Appendix E**) whereby the following spatial distribution characteristics were noted (Managed Recharge 2021):

- Ca-HCO_3 type waters beneath most of the quarry (DLMB1-4);
- Strong Na-Cl signature for water in Lake Pollard with depleted levels of Ca-HCO_3 indicative of likely calcite precipitation, and relatively enriched in Mg2+ and to a lesser extent SO_4-.
- Groundwater next to the lake (DLMB6) has a strong Na-Cl signature showing lake water moves into the aquifer to the west of Lake Pollard, probably following heavy rainfall events and winter recharge. The groundwater is also relatively enriched with Ca-HCO_3, consistent with continued dissolution of calcite as the groundwater moves through the limestone aquifer towards the lake. Mg^2+ and, to a lesser extent, SO_4, are also relatively enriched compared to most of the groundwater beneath the quarry.

- The groundwater composition to the south-east of the quarry (DLMB5) is clearly impacted by a source of saline water, with a higher proportion of Na-Cl than across most of Lot 1002. The groundwater is also relatively enriched with HCO_3^{2}-, Mg^{2}+ and SO_4-. Originally it was believed that this could be indicative of mixing of groundwater from Martins Tank Lake (Managed Recharge 2021), however further investigation shows a small sumpland exists <150 m south-east of the monitoring bore, and this is a more likely source of mixing at this location.

5.3.5 Conceptual Site Hydrogeological Model

Based on the results of the site-specific investigations and earlier groundwater investigations in the area, a conceptual site hydrogeological model has been developed (refer to Figure 11 of **Appendix E** for further detail), that is, the superficial aquifer beneath the quarry occurs along a narrow coastal strip within the highly permeable Safety Bay Sands and/or Tamala Limestone. It is recharged by direct rainfall infiltration, which creates a freshwater lens overlying the coastal saltwater interface, and further east overlying hypersaline groundwater derived from the coastal lakes. A low-lying groundwater divide lies to the west of the quarry and groundwater flows under a very low hydraulic gradient towards the coastal lakes, which act as regional, evaporative groundwater discharge areas (Managed Recharge 2021).

Seasonal fluctuations in the water table are in the order of 0.24 m to 0.5 m, consistent with variations seen elsewhere in the high-permeability Tamala limestone formation (Deeney 1989), with the largest variations occurring near the lakes, apparently in response to summer evaporation.

There is no evidence of groundwater levels being influenced by local topography, nor any significant groundwater mounding beneath the limestone ridge that could meaningfully be described as “winter rainfall storage” (Managed Recharge 2021).

5.4 Potential Impacts

The Proposal has the potential to directly and indirectly impact on inland waters during construction and operation phases.

Potential impacts from the Proposal to inland waters are:

- Change to groundwater quality and quantity within the Yalgorup Lake System;
- Reduction of freshwater flow towards the lakes due to groundwater extraction; and
- Further decline of the Lake Clifton living microbialites due to decrease in water flow.

5.5 Assessment of Impacts

5.5.1 Groundwater Abstraction

The Proposal will not require the abstraction of any groundwater from the subject site. All water required for dust suppression will be carted to site from the nearest standpipe.

5.5.2 Groundwater Recharge Estimations and Contribution to Lake Water Budget

The coastal lakes act as a groundwater sink, accordingly it is necessary to undertake a water budget analysis to assess the potential risk of impact to Lake Pollard, Lake Clifton and Martins Tank Lake from the quarry.

It is noted that there is no evidence to support the presence of additional winter rainfall storage capacity within the aquifer at this location. On this basis there is no risk relating to impacts on winter rainfall storage capacity at the quarry. Similarly, the current investigation shows there is no groundwater flow from the

quarry to Martins Tank Lake, and that any flow from the quarry to Lake Clifton is negligible; the analytical modelling therefore focuses on potential impact to Lake Pollard (Managed Recharge 2021).

5.5.2.1 Quarry Contribution to Groundwater Discharge along the Western Side of Lake Pollard

The area of recharge over the quarry has been compared with the total estimated recharge area from a "western discharge envelope" (refer to **Figure 5-6**). This "discharge envelope" marks out an area, to the east of the inferred groundwater divide beneath the Quindalup dunes, that can reasonably be assumed to contribute groundwater discharge to the western side of Lake Pollard providing an indication of the proportion of groundwater discharge contributed from the quarry (Managed Recharge 2021).

The total estimated area for the "western discharge envelope" is ~2,959,000 m^2, and the total area for the quarry is ~230,000 m^2, i.e. less than 10% of the "western discharge envelope". Hence, any change to rainfall recharge volumes or groundwater quality resulting from the quarry will impact and area <10% of the total area contributing to groundwater discharge to Lake Pollard from the western dunes, and subsequently the risk of a significant adverse impact on the lake is considered to be low (Managed Recharge 2021).

5.5.2.2 Pre and Post Development Water Balance

As an internal draining surface catchment, with the undisturbed profile remaining >3m above the groundwater table and revegetation of a previously revegetated area planned, no net volumetric change to the water balance is anticipated.

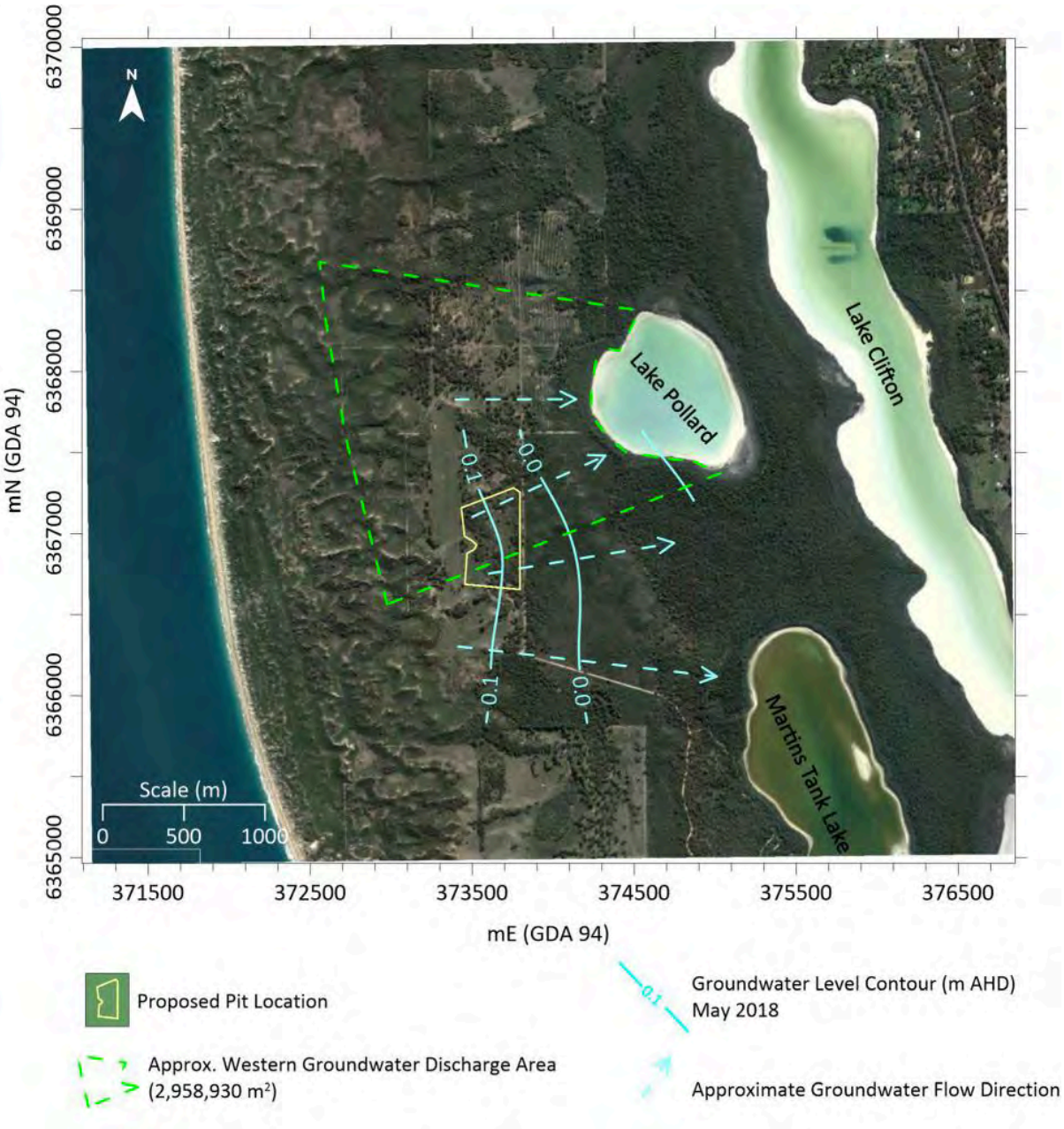


Figure 5-6. Approximate area providing groundwater discharge to Lake Pollard.

5.5.2.3 Rainfall Recharge Volumes

Rainfall recharge via direct infiltration to the aquifer is the primary method of groundwater recharge in the region and maintains the freshwater lens that feeds into the coastal lakes, supporting their unique ecological systems. Two methods to estimate the volume of rainfall recharge over the quarry and total "western discharge envelope" were completed and compared (Managed Recharge 2021).

The recharge estimates for the two calculations returned similar results. Within the quarry, recharge as a percentage of rainfall returned an estimated volume of 11,463 m^3/yr and 11,040 m^3/yr. Within the "western discharge envelope", recharge as a percentage of rainfall returned an estimated volume of 147,473 m^3/yr and 142,029 m^3/yr (Managed Recharge 2021).

In consideration of these results, assuming all recharge from the quarry discharges into Lake Pollard, which is conservative, the volume of estimated groundwater recharge contributed to Lake Pollard from the quarry makes up approximately 2% of the total groundwater discharged via evapotranspiration. Therefore,

any impact on the volume or quality of recharge water discharging to the lake from the quarry poses minimal risk of impact on the lake's hydrogeological regime as a whole (Managed Recharge 2021).

5.5.3 Surface Water

Most rainfall occurring on site is likely to infiltrate directly to the underlying dunes, however following extreme rainfall events, or after periods of intense rainfall, there may be some transient surface water flow. The topographic contours and cross-sections show that any surface flow that occurs at Lot 1002 is predominantly directed to the low-lying swale to the west of the proposed pit, and is essentially internal. Any surface flow that occurs on the eastern side of the ridge will flow east toward to lake systems i.e. following topography. It is noted that no excavation is planned to the south of the site, where some minor surface flow to the south and east may occur (Managed Recharge 2021).

Any ground disturbance activities undertaken at the proposed pit location will have no impact on existing surface flow conditions with respect to any flow towards Lake Pollard, Lake Clifton, Martins Tank Lake or the Yalgorup National Park, where the coastal lakes and associated Ramsar-listed wetlands are located.

5.5.4 Groundwater Recharge and Discharge

Recharge to the aquifer via rainfall infiltration is unlikely to be significantly impacted at the quarry, which has been shown to be a local groundwater recharge area with rainfall infiltration occurring predominantly via the swale to the west, and the limestone ridge to the north. Any additional recharge that might occur over the quarry as a result of clearing and leveling of the land is unlikely to represent a net increase in recharge in the long-term, as previously discussed. There may be a temporary increase in groundwater recharge in the quarry as vegetation is cleared, however this will be mitigated once the land is rehabilitated and revegetated (Managed Recharge 2021), which will occur on a progressive basis.

The proposed depth of undisturbed profile is 4 m, which would prevent any significant increase in evaporative discharge from the quarry. This is supported by the low salinity values measured in the groundwater beneath the swale (<500 mg/L TDS) indicating minimal evaporation of groundwater from the water table ~3.5 m below ground surface (Managed Recharge 2021).

5.5.5 Groundwater Abstraction

As previously indicated, groundwater abstraction will not occur at the subject site.

5.5.6 Groundwater Salinity

With minimal changes to groundwater recharge and/or evapotranspiration, there is unlikely to be any adverse impact to groundwater salinity at the quarry. If there is a shift in the location of rainfall infiltration slightly to the east with the leveling of land on the western flank of the limestone ridge, this may decrease the groundwater salinity in that area and potentially thicken the freshwater lens closer to the lakes, but this is unlikely to have a detrimental impact on the hydrogeological system overall, and may even be beneficial. The small volume of groundwater required for the water supply should be available from the fresh-water lens, which has provided domestic and stock supplies in the past, without causing saline water up-coning (Managed Recharge 2021).

5.5.7 Groundwater Dependent Ecosystems

The only known conservation significant groundwater dependent ecosystems in proximity to the subject site are Lake Clifton, Lake Pollard and Martin's Tank Lake (refer to **Figure 5-7**). A low-lying groundwater divide lies to the west of the quarry and groundwater flows under a very low hydraulic gradient towards the coastal lakes, which act as regional, evaporative groundwater discharge areas (Managed Recharge

2021). Accordingly, the only habitats, flora and fauna vulnerable to changes in hydrology that have the potential to be impacted by the Proposal are located to the east of the subject site (being Lake Clifton, Lake Pollard and Martin's Tank Lake).

A Multiple Use wetland (UFI 3103) is located approximately 470 m the south of the Proposal. Multiple Use wetlands are assessed as possessing few remaining ecological attributes and functions. While such wetlands can still contribute to regional or landscape ecosystem management, including hydrological function, they are considered to have low intrinsic ecological value. In addition, unsurveyed interdunal wetlands in the coastal dunes are located to the west of the Proposal which may potentially contain the Threatened Ecological Community Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (Floristic Community Type SCP19) (Managed Recharge 2021).There is an adequate buffer between the quarry and the western dune system, namely the north-south trending swale where any interdunal flow would naturally discharge before recharging to the aquifer; as disused pastural land, there are no notable environmental values that will be impacted by the modifications to surface flow, and any impact will be contained within the property boundary (Managed Recharge 2021).

As discussed above, the risk that the environmental values of these groundwater dependent ecosystems might be adversely impacted by changes in the hydrological regime are negligible. Any potential impacts to hydrology will be contained within the property boundary and would be minimal (Managed Recharge 2021).

Figure 5-7. Mapped groundwater dependent ecosystems in proximity to the quarry.

5.5.8 Groundwater Contamination

The Proposal will not involve servicing of machinery or storage of any chemicals or fuels onsite (Landform 2016). Portable toilets will be provided, and all waste will be removed from site for disposal at an approved facility (Landform 2016). The current investigation has shown the minimum depth to groundwater is > 4 m bgl, which is the minimum requirement for water quality protection from extractive industry operations in a Priority 1 drinking water area. The risk for groundwater contamination is therefore considered to be low (Managed Recharge 2021).

5.5.9 Hydrological Processes and Inland Water Quality

A conceptual model of the hydrogeological system has been developed including recharge and discharge mechanisms at the quarry, and in relation to the environmentally sensitive conservation wetlands in the Yalgorup National Park. It has been shown that the quarry is an internal surface water catchment that acts as a groundwater recharge zone. Fresh, shallow groundwater flows under a very low hydraulic gradient

towards the Yalgorup National Park and coastal lakes, which act as a regional groundwater discharge zone. Groundwater from the northern half of the quarry flows toward the south-western shore of Lake Pollard at an estimated rate of about 26 m/year. Groundwater from the southern half of the quarry flows towards Lake Clifton at an estimated rate of about 21 m/year, although another groundwater divide is inferred to lie between Lake Clifton and the western lakes, and this is likely to prevent the groundwater reaching Lake Clifton itself (Managed Recharge 2021).

The results of this hydrogeological investigation indicate that the risk of loss of winter-rain storage capacity as a result of the Proposal is negligible. The proposal is to excavate limestone and/or sand to about 4 m above the water table. The results from on-site drilling show that the superficial aquifer occurs within the saturated sediments of the Safety Bay Sand and/or Tamala Limestone, both of which have relatively high vertical hydraulic conductivities and allow rapid infiltration of rainfall to the water table. Groundwater levels measured on Lot 1002 over the past 12 months (refer to **Figure 5-3**) and to the south-east in monitoring bore B2 indicate groundwater level rise in response to winter rainfall is generally ≤ 0.5 m, which is well within the proposed undisturbed-ground buffer between the pit-floor and water table. There is no evidence of perched water at the quarry, and measured aquifer response to rainfall confirms infiltration to the aquifer occurs without notable delay (Managed Recharge 2021).

It is also noted that groundwater level changes are affected more by evaporative discharge from the lakes than rainfall recharge (as evidenced by larger seasonal fluctuations and lower minima in monitoring bores DLMB6 and B2, located near the lakes), and that groundwater levels are highest to the west of the quarry (DLMB2 and DLMB4), further supporting the conclusion that groundwater mounding beneath the limestone ridge during winter is not a significant hydrogeological process in this system. This is consistent with the recharge/discharge calculations in **Section 5.5.4**, which show the volume of groundwater discharged from the lakes far exceeds groundwater recharge (Managed Recharge 2021).

Any change to the site water balance will be minimal, since the proposed operations are unlikely to significantly affect net recharge or discharge. Therefore, the risk of adversely impacting groundwater quality, levels or flow at the quarry is considered too low, and hence the risk relating to hydraulically connected ecosystems is also considered low. This is developed further in relation to potential post-development impacts below.

5.5.10 Geochemical Modelling

Geochemical modelling was performed to assess current groundwater chemistry and saturation indices with respect to carbonate minerals (calcite, aragonite and siderite) and to determine the potential for increased discharge of calcium-bicarbonate to Lake Pollard due to increased limestone dissolution in the quarry, resulting from the exposure of fresh and crushed limestone to the atmosphere and rainfall.

The values for major ion concentrations as discussed in **Section 5.3.4.4** were analysed (using the USGS geochemical modelling software, PHREEQC) and the results were reviewed to determine the potential for dissolution and/or precipitation of carbonate minerals in the groundwater system and Lake Pollard under existing conditions.

The technical results are provided within **Appendix E** and demonstrate that under current conditions calcite and aragonite are near equilibrium or slightly supersaturated (SI between 0.06 and 0.28) in the groundwater system and that these minerals, particularly calcite, are likely to precipitate from solution under favourable conditions; the results are consistent with groundwater present in a limestone matrix (Managed Recharge 2021).

In general, groundwater present beneath the swale, in the Safety Bay Sand is less saturated regarding $CaCO_3$ than the groundwater present in the Tamala Limestone, but the trend does not hold perfectly, with groundwater from monitoring bores DLMB4 and DLMB5 showing contrary results. It is noted that there is no significant increase in the saturation index between the monitoring bores on-site and monitoring bore DLMB6, located next to Lake Pollard indicating the groundwater is in equilibrium with the limestone matrix and minimal, if any, additional carbonate dissolution occurs along the groundwater flow path (Managed Recharge 2021).

At Lake Pollard, the water is more highly supersaturated with regard to calcite and aragonite (SI = 0.64 and 0.49, respectively) probably as a result of mixing and evaporation, and these minerals will have a greater tendency to precipitate in the lake system, which is consistent with the assessment of geochemical characteristics in **Section 5.3.4.4** (Managed Recharge 2021).

All samples are sub-saturated regarding Siderite, indicating this mineral is likely to be dissolved in the groundwater and lake system. It is possible that the rate of limestone dissolution will increase upon excavation, when fresh and crushed rock is directly exposed to the atmosphere and rainfall. Geochemical modelling, however, shows the native groundwater at this location is already in equilibrium or slightly supersaturated with respect to calcium carbonate minerals, and so the geochemical reaction is unlikely to proceed further (that is the reaction reaches a point where the rate of dissolution and precipitation equilibrate), and relative concentrations of Ca^{2}+ and HCO_3- would not increase significantly over and above existing conditions (Managed Recharge 2021).

On this basis, the risk of impact to Lake Pollard, or other wetland features, due to changed geochemical conditions in the discharging groundwater as a result of the Proposal is low. In addition, it is anticipated that the rate of limestone dissolution will decrease over time as weathered surfaces develop on the exposed limestone. Any fines reaching the aquifer via solution channels in the limestone would settle long before the groundwater reaches the lake, given the estimated transport time of 26 years.

5.6 Mitigation and Management

5.6.1 Mitigation Hierarchy

As previously discussed, any potential impacts to inland waters as a result of the Proposal are low. The application of the mitigation hierarchy for inland waters is outlined in **Table 5-1**.

The risk of groundwater contamination is low and will be mitigated through the implementation of the management measures (as provided below) which are also included in the EMP.

Table 5-1. Mitigation hierarchy and residual impacts for inland waters.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
Reduction of rainfall recharge	The quarry size has been reduced. The maximum volume of estimated groundwater recharge contributed to Lake Pollard from the quarry makes up approximately 2% of the total groundwater discharged via evapotranspiration. Therefore, any impact on the volume or quality of recharge water discharging to the lake from the quarry poses minimal risk of impact on the lake's hydrogeological regime as a whole.	• Maintain a 4 m separation distance between pit floor and groundwater level.	Progressive rehabilitation of each completed cell with native species.	No significant residual impacts as the Proposal will not result in a reduction of rainfall recharge.
Reduction to winter rainfall storage capacity	Ground disturbance activities undertaken at the quarry will have no impact on existing flow conditions with respect to any possible interflow towards Lake Pollard, Lake Clifton, Martins Tank Lake or the Yalgorup National Park. Similarly, there is an adequate buffer between the quarry and the western dune system, namely the north-south trending swale where any interdunal flow would naturally discharge before recharging to the aquifer; as disused pastural land, there are no notable environmental values that will be impacted by the modifications to surface flow, and any impact will be contained within the property boundary.	• Maintain a 4 m separation distance between pit floor and groundwater level.	Progressive rehabilitation of each completed cell with native species.	No residual impacts as the Proposal will not result in any impacts to winter rainfall storage capacity.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
Alteration to surface water flows and quality	No impact to surface water drainage features (none located in the quarry) and no net increase in groundwater recharge as a result of overland flow. The quarry is an internal catchment and therefore there will be no change to surface flow characteristics in the neighbouring Yalgorup National Park.	• No chemicals or fuels will be stored onsite. • Allow clean stormwater from non-process areas and access roads to infiltrate into the surrounding soil by constructing diversion banks upslope of areas to be disturbed. • Construct catch drains to capture runoff from disturbed areas and direct into the pit area to enable infiltration. • Implement erosion/sedimentation control measures as specified within the EMP.	Undertake rehabilitation as per Mine Closure Plan to create a safe and stable landform.	No significant residual impacts as the Proposal will not result in any impacts to surface water flows.
Alteration to groundwater recharge and discharge	Recharge to the aquifer via rainfall infiltration is unlikely to be significantly impacted at the quarry, which has been shown to be a local groundwater recharge area with rainfall infiltration occurring predominantly via the swale to the west, and the limestone ridge to the north. Any additional recharge that might occur over the quarry as a result of clearing and leveling of the land is unlikely to represent a net increase in recharge in the long-term, as previously discussed. There may be a temporary increase in	• Progressive rehabilitation to mitigate any potential increase in groundwater recharge in the quarry as vegetation is cleared (although considered a very low risk). • Maintain 4m undisturbed profile to avoid any potential risk associated with evaporative discharge.	Progressive rehabilitation of each completed cell with native species.	No significant residual impacts, while the Proposal is not anticipated to result in any notable changes to groundwater recharge, mitigation measures have been applied to further ensure the maintenance of the existing groundwater recharge system.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
	groundwater recharge in the quarry as vegetation is cleared, however this will be mitigated once the land is rehabilitated and revegetated.			
Alteration to groundwater salinity	With minimal changes to groundwater recharge and/or evapotranspiration, there is unlikely to be any adverse impact to groundwater salinity at the quarry. If there is a shift in the location of rainfall infiltration slightly to the east with the leveling of land on the western flank of the limestone ridge, this may decrease the groundwater salinity in that area and potentially thicken the freshwater lens closer to the lakes, but this is unlikely to have a detrimental impact on the hydrogeological system overall, and may even be beneficial.	• No water abstraction will be undertaken.	Progressive rehabilitation of each completed cell with native species.	No residual impacts as the Proposal will not result in any alterations to groundwater salinity.
Groundwater dependent ecosystems	• The risk that the environmental values of these groundwater dependent ecosystems might be adversely impacted by changes in the hydrological regime are negligible. Any potential impacts to hydrology will be contained within the property boundary and would be minimal.	• No water abstraction will be undertaken.	Progressive rehabilitation of each completed cell with native species.	No significant residual impacts as the Proposal will not result in any impacts to groundwater dependent ecosystems.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
Groundwater contamination	• No servicing of vehicles/machines onsite. • No storage of chemicals or fuel.	Maintain a 4 m separation distance between pit floor and groundwater level. Include spill response procedures within the EMP.	Progressive rehabilitation of each completed cell with native species.	Minor contamination risk is managed with no significant residual impact to inland water quality.
Alteration to geochemical conditions	The risk of impact to Lake Pollard, or other wetland features, due to changed geochemical conditions in the discharging groundwater as a result of the Proposal is low. In addition, it is anticipated that the rate of limestone dissolution will decrease over time as weathered surfaces develop on the exposed limestone. Any fines reaching the aquifer via solution channels in the limestone would settle long before the groundwater reaches the lake, given the estimated transport time of 26 years.	Maintain a 4 m separation distance between pit floor and groundwater level.	Progressive rehabilitation of each completed cell with native species.	No significant residual impacts as the Proposal will not result in alterations to geochemical conditions.

5.6.2 Groundwater Monitoring Program

As a component of this impact assessment, a detailed groundwater monitoring program has been undertaken by Managed Recharge (2019) to determine potential impacts to the receiving environment from the Proposal (refer to *Table 5 - Groundwater Level and Salinity Monitoring Results* (page 17) of the Managed Recharge (2019) report). A detailed assessment of this data has concluded that there will be no impacts to groundwater or groundwater dependent ecosystems.

To ensure the hydrological regimes and quality of groundwater and surface water is maintained so that environmental values are protected, ongoing groundwater monitoring is proposed for the life of the mine. This will entail quarterly groundwater level, pH and salinity monitoring at bores DLMB1 to DLMB7 and DWER bore B2, as detailed within the EMP.

5.7 Predicted Outcome

As discussed above, the Proposal has a very low potential to impact on groundwater and surface water values. The Proposal does not intersect any surface water or groundwater features.

There are no predicted residual impacts on inland waters as a result of the Proposal, based on the following:

- No change to surface water features or rainfall runoff and recharge patterns within the quarry.
- No change to groundwater flow, chemistry or recharge/discharge rates.
- No impacts to the lake systems located within the Yalgorup National Park.
- Minor contamination risk that can be appropriately managed, with no significant residual impact to inland water quality.

Through the implementation of the mitigation hierarchy, there are no residual impacts from the Proposal to inland waters at a local or regional scale. Accordingly, it is considered that hydrological regimes and quality will be maintained such that the environmental values they support will not be affected and the EPA's objective for inland waters will be met.

6 FLORA AND VEGETATION

6.1 EPA Objective

The EPA's objective for flora and vegetation is to protect flora and vegetation so that biological diversity and ecological integrity are maintained.

6.2 Policy and Guidance

The following policies and guidance have been considered in the assessment of flora and vegetation with respect to the abovementioned EPA objective.

6.2.1 EPA Policies and Guidance

- *Environmental Factor Guideline – Flora and vegetation* (EPA 2016)
- *Environmental Factor Guideline – Terrestrial fauna* (EPA 2016)
- Technical Guide – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and Department of Parks and Wildlife 2015)
- EPA Report 1359 – *Strategic Environmental Advice on the Dawesville to Binningup Area* (EPA 2010)
- Environmental Protection Bulletin No. 12 – *Swan Bioplan – Peel Regionally Significant Natural Areas* (EPA 2013)
- *Guidelines for Preparing Mine Closure Plans* (DMP & EPA 2015)
- Guidance Statement No. 6 – *Rehabilitation of Terrestrial Ecosystems* (EPA 2006)

6.2.2 Other Policies and Guidance

- WA Environmental Offsets Policy (Government of Western Australia 2011)
- WA Environmental Offsets Guidelines (Government of Western Australia 2014)
- Western Australian Planning Commission – *South Metropolitan Peel – Sub-Regional Planning Framework.*

6.3 Receiving Environment

6.3.1 Desktop Review

6.3.1.1 Regional Context

According to Interim Biogeographical Regionalisation of Australia (IBRA) descriptions, Perth is located within the Swan Coastal Plain region. The Swan Coastal Plain comprises two major divisions, the Swan Coastal Plain 1 – Dandaragan Plateau and Swan Coastal Plain 2 – Perth Coastal Plain (Mitchell, Williams and Desmond 2002), with the project footprint situated in the latter. This subregion is broadly characterised as including areas of jarrah and banksia woodlands on sandy soils in a series of sand dunes, along with wetlands areas, often within the interdunal swales (Mitchell, Williams and Desmond 2002).

6.3.1.2 Soil Type

According to the NRInfo (natural resource information) database maintained by the Department of Primary Industries and Regional Development WA (2018), nine soil types are associated with the project footprint. The soil types are a reflection of the transition between the Quindalup dune system to the west and the Spearwood dune system to the east, with the Vasse soil system present in proximity to wetlands (refer to **Table 6-1**) (Natural Area 2019).

Table 6-1. Soil types within the project footprint.

Map unit	Name	Description	Lot 1002	Preston Beach Road
211Qu_Qd	Quindalup South Qd Phase	Small gently undulating plains (deflation basins) enclosed by discrete parabolic dunes with moderately deep to very deep calcareous sands over limestone	X	
211Qu_Qp2	Quindalup South Qp2 Phase	Long walled discrete parabolic dunes with moderate to steep slopes and uniform calcareous sands showing variable depths of surface darkening.	X	
211Sp_S1a	Spearwood S1a Phase	Dune ridges with shallow to moderately deep siliceous yellow-brown sands, very common limestone outcrop and slopes up to 15%.	X	X
211Sp_S1c	Spearwood S1c Phase	Dune ridges with deep bleached grey sands with yellow-brown subsoils and slope up to 15%.		X
211Sp_S2b	Spearwood S2b Phase	Lower slopes (1-5%) of dune ridge with shallow to deep siliceous yellow-brown sands and common limestone outcrop.	X	X
211Sp_S4a	Spearwood S4a Phase	Flat to gently undulating sandplain with deep, pale and sometimes bleached, sands with yellow-brown subsoils.	X	
211Sp_S4b	Spearwood S4b Phase	Flat to gently undulating sandplain with shallow to moderately deep siliceous yellow-brown and grey-brown sands with minor limestone outcrops.	X	X
211Va_V4	Vasse V4 Phase	Low level storm beach ridges and terraces with shallow to moderately deep uniform, alkaline black sandy loams to loams overlaying unconsolidated shell beds or clayey marl.		X
211Va_V6	Vasse V6 Phase	Upper level sandy terrace and gently undulating beach ridges with deep grey or bleached pale brown siliceous sands overlaying soft shelly limestone.		X

The quarry consists predominantly of two of the above soil types, the Spearwood S4b Phase and the Quindalup Qd Phase. The Tamala limestone is covered by shallow, yellow-brown calcareous loamy sands that have originated as a result of weathering of the limestone on the central ridge. Deeper sand occurs in the swale in the west and to the east (Landform Research 2016).

6.3.1.3 Vegetation Complex

A review of the WALGA Environmental Planning Tool (2019) indicated that two vegetation complexes occur within the project footprint. These are provided below within **Table 6-2.**

Table 6-2. Summary of vegetation complexes mapped within the project footprint.

System	Description	Pre-European Extent (ha)	Current Extent (ha)	Percentage Remaining (%)
Yonngarillup Complex	Dominated by tuart woodlands with *Agonis flexuosa* in the second storey. This tuart woodland can be replaced by an open-forest of tuart-jarrah-marri on more restricted patches. Understorey species include *Banksia attenuata*, *Macrozamia riedlei* and *Hibbertia hypericoides*.	27,977.93	10,018.14	35.81
Vasse Complex	This complex supports mixed vegetation of Melaleuca spp. Closed-scrub, fringing woodland of *Eucalyptus rudis* and *Melaleuca spp.*, and open-forest of tuart-jarrah-marri. The actual location of vegetation types appears to be determined by periods of flooding, drainage and depth of the sand. Other species include *Melaleuca rhaphiophylla, M. preissiana* and *Acacia saligna*.	15,691.63	4,926.97	31.40

6.3.1.4 Flora Species

A review of the DBCA online database NatureMap, indicated 13 priority and three threated flora species listed under the BC Act as potentially occurring within 10 km of the project footprint.

A review of the DAWE Protected Matters Search Tool (PMST) indicated three vulnerable, five endangered and two critically endangered flora species listed as matters of national environmental significance (MNES) under the EPBC Act, as potentially occurring or have habitat occurring within 10 km of the project footprint (refer to **Table 6-3**).

A search of the DBCA threated and priority flora database indicated 11 priority species have been previously recorded in the area including two species, *Hakea oligoneura* and *Hibbertia spicata* sp. *Leptotheca*, which have been recorded 25 m east from Lot 1002, and *Pimelea calciola* and *Stylidium maritimum* which have been recorded 600 m to the east on Lake Pollard shoreline. Of the 21 conservation significant species listed, 13 were identified as having the potential to occur within the project footprint due to soil condition and species distribution, as highlighted in **Table 6-3** (Natural Area 2019).

Table 6-3. Significant flora listed on database search.

Scientific Name	Common Name	Cons Code	NatureMap	PMST	DBCA
Angianthus drummondii		P3	X		
Andersonia gracilis	Slender Andersonia	EN		X	
Banksia nivea subsp. *Uliginosa*	Swamp Honeypot	EN		X	
Caladenia huegelii	King Spider-Orchid	EN	X	X	
Caladenia swartsiorum	Island Point Spider-Orchid	P2	X		

Carex tereticaulis		P3	X		
Conostylis pauciflora subsp. *pauciflira*		P4	X		X
Diuris drummondii		VU		X	
Diuris micrantha	Dwarf Bee-orchid	VU		X	
Diuris purdiei	Purdie's Donkey-orchid	EN	X	X	
Drakaea elastica	Gloss-leafed Hammer-Orchid	EN		X	
Drakaea micrantha	Dwarf Hammer-Orchid	VU		X	
Eucalyptus argutifolia	Wabling Hill Mallee	VU	X	X	X
Galium leptogonium		P3			X
Hakea oligoneura		P2	X		X
Haloragis scoparia		P1	X		X
Hibbertia spicate sp. *Leptotheca*		P3	X		X
Hydrocotyle sp. *Hamelinensis*		P2	X		X
Lasiopetalum membranaceum		P3	X		X
Pimelea calcicole		P3	X		X
Platysace ramosissima		P3	X		
Sphaerolobium calciola		P3	X		X
Stylidium martimum		P3	X		X
Synaphea sp. *Fairbridge Farm*	Selene's Synaphea	CR		X	
Synaphea sp. *Serpentine*		CR		X	
Synaphea stenoloba	Dwellingup Synaphea	EN		X	

6.3.2 Flora and Vegetation Survey

6.3.2.1 Flora Species

Natural Area undertook a detailed flora and vegetation survey over two days between 20 – 21 November 2017 of a broad area, including the project footprint. The survey was undertaken in accordance with Technical Guide – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and Department of Parks and Wildlife 2015) (refer to **Appendix F**). The detailed methodology and limitations associated with the survey are provided in Appendix F. Despite potential limitations, it was estimated that approximately 80-90% of flora species were identified (Natural Area 2019).

During the survey a total of 109 flora species were recorded from 45 families, including 82 native and 27 introduced (weed) species. Of the flora species recorded, there was one Cyad (Cyadopsida), 27 Monocotyledons (Lillopsida) and 81 Dicotyledons (Magnoliopsida) (Natural Area 2019).

No evidence of significant flora was found during the survey (Natural Area 2019).

6.3.2.2 Weeds

Due to the history of anthropogenic disturbances, a significant number of exotic understorey species were recorded within the survey area, as provided within **Table 6-4** below (Natural Area 2019). Weeds were

identified at all survey quadrants with a variety of species present. Locations of the survey quadrants and weeds are provided in **Figure 6-1**.

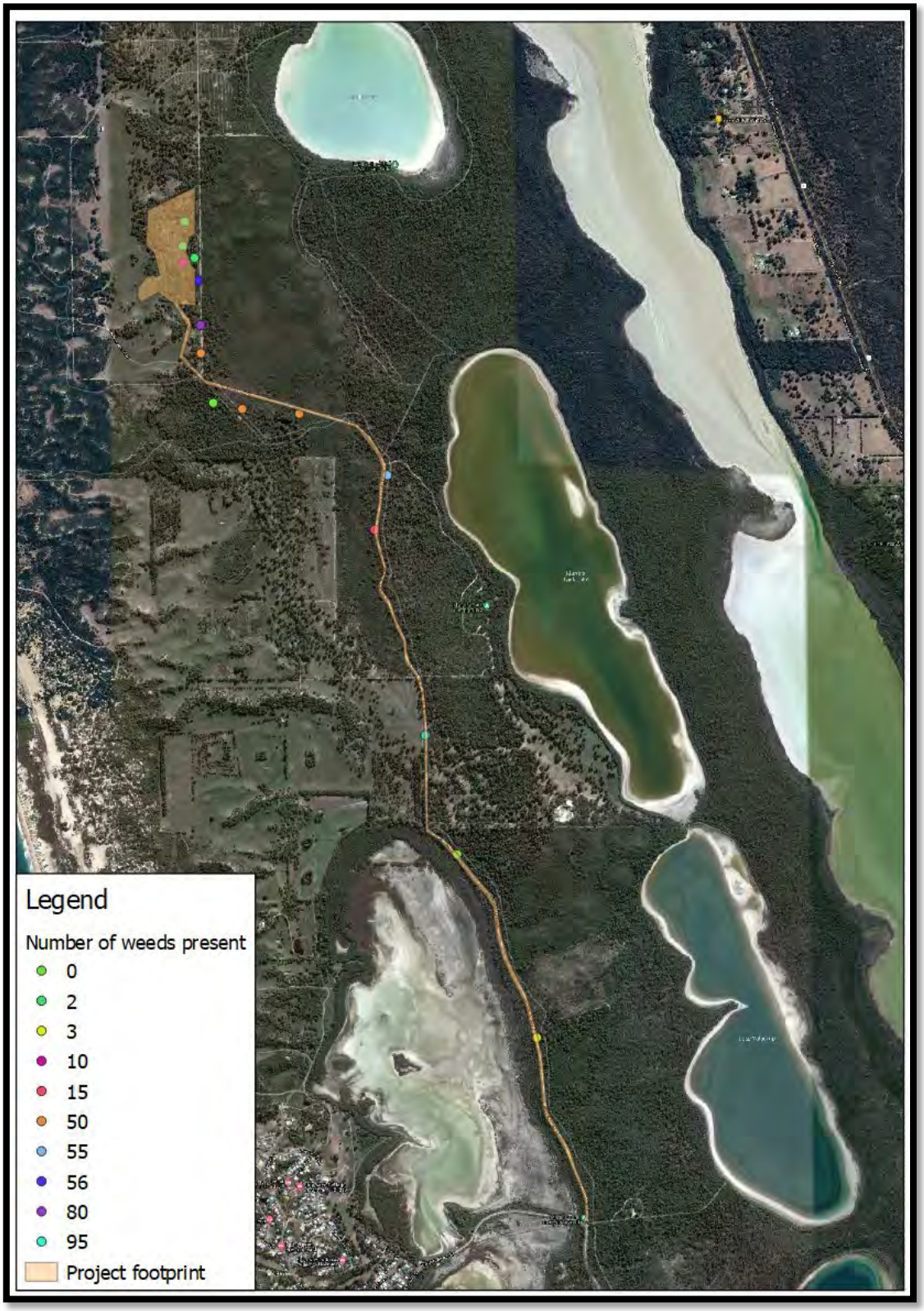


Figure 6-1: Location of survey quadrants and number of weeds present

Gomphocarpus fruticosus (Narrowleaf cotton bush) and *Moraea flaccida* (One-leaf Cape Tulip) are classified as Declared Pests under the *Biosecurity and Agriculture Management Act 2007*.

Table 6-4. Weed species and percentage (%) coverage by vegetation type (Natural Area 2019).

Vegetation Type	Invasive Species Name	%
Banksia Jarrah Woodland	*Centaurea melitensis*	0.1
	Euphorbia peplus	0.1
	Lysimachia arvensis	0.1
	Trachyandra divaricata	15
Eucalyptus decipiens Woodland	*Briza maxima*	0.1
	Trachyandra divaricata	3
Tuart and Peppermint Woodland	*Ehrharta longiflora*	0-0.1
	Euphorbia peplus	0-0.5
	Lysimachia arvensis	0-0.1
	Petrorhagia dubia	0-0.1
	Trachyandra divaricata	0-2.0
	Sonchus aleraceus	0-0.1
	Trifolium campestre	0-1.0
	Solanum nigrum	0-0.1
	Briza maxima	0-0.1
	Centaurium erythraea	0-0.1
	Hypochaeris radicata	0-0.1
	Crassula glomerata	0-0.1
	Cuscuta epithymum	0-0.1
	Dischisma arenarium	0-0.1
Coastal Shrubland	*Cuscuta epithymum*	0.1
	Euphorbia peplus	0.1
	Lysimachia arvensis	0-0.1
	Moraea flaccida	0-0.5
	Trachyandra divaricata	50
	Parentucellia latifolia	0-0.1
Grasstree Shrubland	*Bromus diandrus*	0-0.1
	Lolium rigidum	0-0.1
	Lotus subbiflorus	0-0.1
	Lysimachia arvensis	0-0.1
	Trachyandra divaricata	0.5-1.0
	Trifolium campestre	0.1
	Briza minor	0-0.1
	Crassula glomerata	0-0.1
	Lagurus ovatus	0-0.1
	Petrorhagia dubia	0-0.1

Vegetation Type	Invasive Species Name	%
	Centaurium tenuiflorum	0-0.1
	Lupinus cosentinii	0-0.1
Trachyandra Herbland	*Crassula glomerata*	0-10.0
	Euphorbia peplus	0.1-1.0
	Lotus subbiflorus	0-0.1
	Lysimachia arvensis	0-0.1
	Trachyandra divaricata	25-95
	Bromus diandrus	0-0.1

6.3.2.3 Vegetation Types

Six vegetation types were determined during the field survey. The Tuart and Peppermint Woodlands comprised 44.9%, or 16.8 ha of the area surveyed (Natural Area 2019). As provided within **Table 6-5** all other vegetation types occurred in small patches, with the total area of these vegetation types between 1.8 and 7.9 ha (Natural Area 2019). The location of the six vegetation types within the survey area are depicted in **Figures 6-2** and **6-3** (sourced from Natural Area 2019). It is noted that there are no groundwater dependent ecosystems located within the proposed clearing footprint.

Table 6-5. Summary of vegetation types determined during the field survey.

Vegetation Type	Description	Size (ha)	Quarry Area	Access Road	Preston Beach Rd North
Banksia Jarrah Woodland	Banksia attenuate and *Eucalyptus marginata* Woodland over *Xanthorrhoea preissi* shrubland and a weedy understorey of *Trachyandra divaricata*.	1.8			x
Eucalyptus decipiens Woodland	*Eucalyptus decipiens* Woodland over *Xanthorrhoea preissii* shrubland.	6	x		x
Tuart and Peppermint Woodland	*Eucalyptus gomphocephala* and *Agonis flexuosa* Woodland over *Spyridium globulosum* or *Xanthorrhoea preissii* shrubland.	16.8	x	x	x
Coastal Shrubland	Shrubland of *Acacia cyclops*, *Melaleuca systena*, *Hibbertia racemosa* and *Spyridium globulosum* over a weedy understorey of *Trachyandra divaricarta*.	2.5			x
Grasstree Shrubland	Shrubland of *Xanthorhoea preissii*, *Melalueca systena* and *Banksia dallanneyi* over *Lepidosperma gladiatum* in the herb layer.	7.6	x		
Trachyandra Herbland	Herb layer of *Trachyandra divaricata*, *Euphorbia peplus*, *Crassula glomerata* and *Lysimachia arvensis*; *Eucalyptus gomphocephala* and *Agonis*	2.7	x	x	x

Vegetation Type	Description	Size (ha)	Quarry Area	Access Road	Preston Beach Rd North
	flexuosa are associated with this vegetation type by comprise less than 2% of the canopy.				

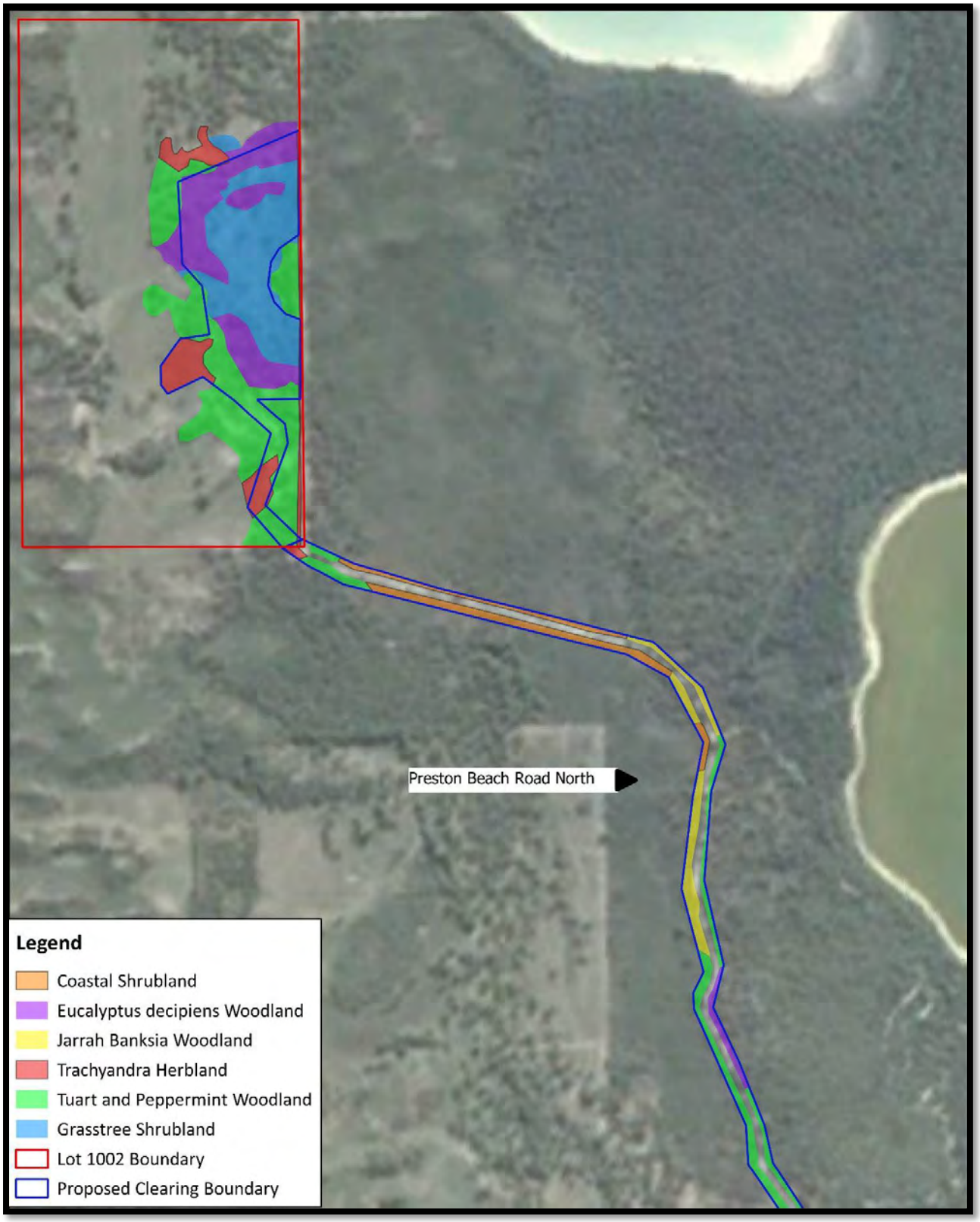


Figure 6-2. Vegetation types within the survey area (Natural Area 2019).

Figure 6-3. Vegetation types within the survey area (Natural Area 2019).

6.3.2.4 Vegetation Condition

The vegetation condition within the survey area was assessed utilising the rating scale attributed to Keighery in *Bush Forever Volume 2* (Government of Western Australia 2000) (refer to **Table 6-6**). Accordingly, the vegetation condition ranged from Completely Degraded to Very Good. The majority of the survey area was classified as Degraded or Completely Degraded (79%) with small areas along Preston Beach Road North classified as Very Good (refer to **Figure 6-4** (sourced from Natural Area 2019)).

Table 6-6. Vegetation condition rating (Keighery 2000).

Category	Description
1 Pristine	Pristine or nearly so, no obvious signs of disturbance.
2 Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3 Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4 Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
5 Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetations structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6 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 crop species with isolated native trees or shrubs.

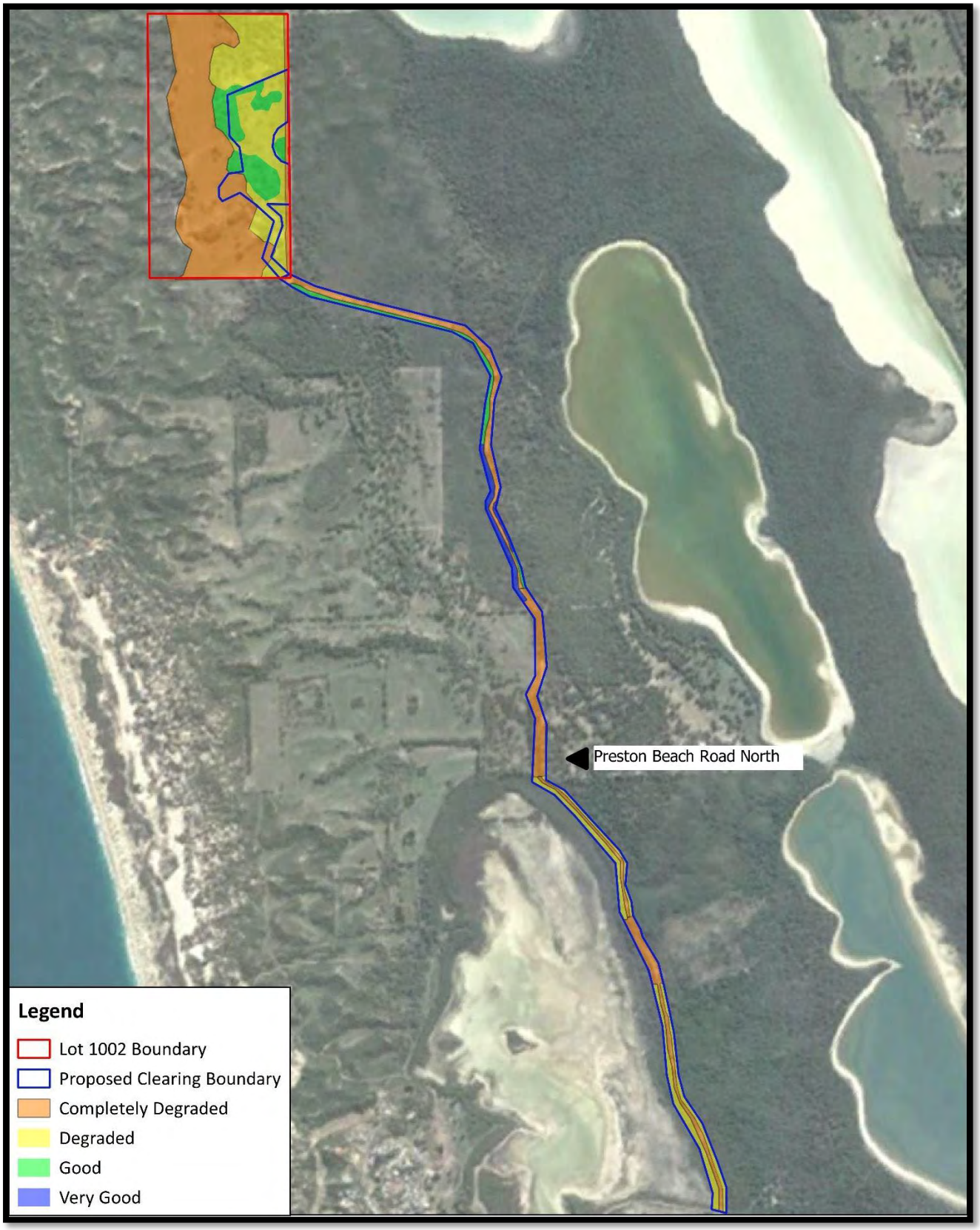


Figure 6-4. Vegetation condition classification within survey area (Natural Area 2019).

6.3.2.5 Threatened Ecological Communities

During the flora and vegetation survey, a single quadrat was classified as Banksia Jarrah Woodland, and the comparison to the Gibson *et al.* dataset confirmed that the most similar community is SCP28 - Spearwood *Banksia attenuata* or *Banksia attenuata* – Eucalyptus woodlands. SCP28 community type falls into the Banksia Woodland of the Swan Coastal Plain, a community type classified as Priority 3 at a State level (Natural Area 2019) and Endangered under the Commonwealth EPBC Act. However, no vegetation clearing is proposed in this area, with works limited to pruning overhanging tree branches.

Tuart Woodlands of the Swan Coastal Plain is classified as a Priority 3 ecological community at a state level and Critically Endangered under the EPBC Act. All patches of the Tuart Woodland within the proposed quarry are less than 0.5 ha and do not comply with the condition classes or patch size criteria associated with the Critically Endangered TEC as provided within *Tuart Woodlands and Forests of the Swan Coastal Plain: A Nationally Significant Ecological Communit*y (DotEE 2019).

A patch of Tuart and Peppermint Woodland on Preston Beach Road North does exceed the 1 ha size limit and is in Very Good condition, however this area is only subject to pruning and trimming of trees and shrub branches (i.e. no trees will be removed). Accordingly, there will be no direct impacts to the Commonwealth listed TEC.

6.4 Potential Impacts

Activities or aspects of the Proposal that have the potential to affect flora and vegetation, not considering mitigation measures, include:

Direct Impacts:

- Clearing of vegetation will directly reduce the extent of vegetation communities, and may disturb conservation significant flora species or ecological communities.

Indirect Impacts:

- Spread of weeds and dieback from vehicle movements, introduced/imported material, earthworks or surface and/or subsurface water flow have the potential to introduce and spread weed species and dieback.
- Dust generation due to earthworks and vehicle movements has the potential to smother vegetation.

6.5 Assessment of Impacts

6.5.1 Vegetation Clearing

The Proposal will result in an initial loss of flora and vegetation, most of which, due to historical clearing, limestone mining and grazing within Lot 1002, is in a Degraded or Completely Degraded condition (Natural Area 2019). A summary of the clearing activities is provided below:

- Limestone/sand quarry:
    - Staged clearing (initially about 2 ha and then 0.5 to 1.0 ha per year) of vegetation in Degraded to Good condition, with a total vegetation clearing area of 13.9 ha.
    - Progressive native rehabilitation following completion of each stage.
- Access road on Lot 1002:
    - Clearing of 0.7 ha of scattered parkland pasture vegetation in Completely Degraded to Degraded condition.

- Preston Beach Road North Road:
    - 0.6 ha of predominately pruning/trimming of tree/shrub branches.

The area and condition of vegetation types that are located within the project footprint are provided below in **Table 6-7**.

Table 6-7: Area of vegetation types and condition subject to clearing/pruning.

Vegetation Type	Vegetation Condition	Area (ha)
Quarry		
Trachyandra Herbland	Completely Degraded	0.6
	Good	0.2
Tuart and Peppermint Woodland	Degraded	0.5
	Good	1.2
Eucalyptus decipiens Woodland	Degraded	1.6
	Good	3.3
Xanthorrhoea preissi Shrubland	Degraded	5.4
	Good	1.1
Access Road		
Tuart and Peppermint Woodland	Degraded	0.5
Trachyandra Herbland	Degraded	0.2
Preston Beach Road North		
Tuart and Peppermint Woodlands	Degraded	0.4
	Very Good	0.05
Jarrah banksia woodland	Good	0.04
	Very Good	0.02
Coastal Shrubland	Good	0.09

6.5.2 Vegetation Complexes

Direct impacts (i.e. vegetation clearing) will be limited to the Yonngarillup Complex which is mapped as occurring within the proposed quarry.

A small area of the proposed access road (0.5 ha) is mapped as the Vasse Complex. Given that this area is already parkland cleared and the access road will be delineated to avoid direct impacts to remnant vegetation as far as practicable, there are not expected to be any significant impacts or reductions to this vegetation complex. Accordingly, impacts to the Vasse Complex are not discussed further.

The Government of Western Australia (DBCA 2019) assessed vegetation complexes mapped against presumed pre-European extents within the Swan Coastal Plain IBRA bioregion (refer to **Table 6-8**) and Local Government Association (LGA) levels (refer to **Table 6-9**) (Webb, Kinloch, Keighery & Pitt 2016).

The current extent of the Yonngarillup Complex is in excess of 30% of its pre-European extent within the Swan IBRA bioregion and within the Shire of Waroona.

At the Swan Coastal Plain IBRA bioregion scale and the LGA scale, clearing required for the Proposal will not change the status of the vegetation complex. The extent of the complex will remain above 30% of its pre- European extent.

The reduction in pre-European extent of the Yonngarillup Complex is less than 1% on the basis of its extent on the Swan Coastal Plain and at the LGA scale. The vegetation complex relevant to the Proposal are well represented based on the percentage of vegetation remaining as provided in **Table 6-2**. As a result, impacts from clearing are not of sufficient magnitude to significantly impact the representation of this vegetation complex.

Table 6-8. Extent of vegetation complex on the Swan Coastal Plain within the subject site.

Complex	Pre-European Extent (ha)	Current Extent (ha)	Percentage Remaining (%)	% Remaining in DBCA Managed Land	Amount within Subject Site (ha)	% of Current Extent within Subject Site	% Remaining After Proposal
Yonngarillup Complex	27,977.93	10,018.14	35.81	13.14	13.9	0.13	35.68

Table 6-9. Extent of vegetation complex within Shire of Waroona and the subject site.

Complex	Pre-European Extent (ha)	Current Extent (ha)	Percentage Remaining (%)	% of Complex Mapping within each LGA	Amount within Subject Site (ha)	% of Current Extent within Subject Site	% Remaining After Proposal
Yonngarillup Complex	3,886.36	2,335.24	60.09	13.89	13.9	0.59	59.5

Assessment of the local scale impacts has been determined through using DPIRD Native Vegetation Extent data (DPIRD 2020) for a 5 km buffer surrounding the subject site. This shows that the 5 km buffer contains 4,999 ha of native vegetation. The clearing footprint contains 14.6 ha of native vegetation and therefore the clearing would result in a 0.2 % reduction in the extent of native vegetation within the 5 km buffer.

6.5.3 Conservation Significant Flora and Vegetation

No conservation significant flora species will be impacted as a result of the Proposal.

The proposal will not result in any direct impacts to the Commonwealth listed Tuart woodland TEC or Banksia Woodland of the Swan Coastal Plain TEC.

The Proposal will result in clearing 1.2 ha of fragmented Tuart (*Eucalyptus gomphocephala*) woodlands PEC in a Good condition and less than 1 ha in a Degraded to Completely Degraded condition. This represents a

loss of less than 0.1% of the remaining extent of the PEC. This PEC is also present and dominant in the adjacent Yalgorup National Park (Natural Area 2019).

The impact from the Proposal is considered small and incremental. No rare or endangered plants have been recorded in the mapped occurrences of the PEC within the project footprint, and the Proposal is not considered to cause the PEC or flora or fauna taxa to become rare or endangered. Therefore, in accordance with the considerations of significance set out in the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014), the residual impact to the PEC from the Proposal is not significant. Furthermore, complete rehabilitation of the cleared areas is proposed.

6.5.4 Indirect Impacts to Vegetation

The Proposal has the potential to cause degradation of the adjacent native vegetation within the Yalgorup National Park.

The primary threatening processes that have the potential to indirectly impact surrounding native vegetation are the introduction and/or spread of weed species. *Phytophthora* dieback is not considered a significant risk as discussed below.

There is also the potential for contamination of groundwater or surface water runoff during excavation activities, with potential sources including uncontained spills and impacts on adjacent vegetation from altered hydrological regimes.

These potential indirect impacts of the Proposal are discussed further below.

6.5.4.1 Weeds

The Proposal has the potential to introduce new weed species to the project footprint and adjacent vegetation or cause the spread of existing weed species. Weeds can cause the degradation of native vegetation by competing with native flora for resources such as space, sunlight, water and nutrients.

The introduction or spread of existing weeds may result in impacts that, while not significant, would be detrimental to the condition of remnant vegetation.

6.5.4.2 Dust

Dust generation due to vehicle movement and earthworks has the potential to indirectly impact vegetation within the project footprint, roadside and any adjacent vegetation. Dust has the potential to smother the vegetation, which, may be detrimental to the condition of remnant vegetation.

Notwithstanding, as discussed within Section 8.4 of **Appendix J**, the incremental annual average dust deposition rate for vegetation adjacent to the project footprint ranges from 0.1-0.5 g/m^2/month. This is significantly below the dust deposition criteria of 4 g/m2/month, provided within the New South Wales (NWS) EPA '*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*' (NSW EPA 2017). Accordingly, impacts to vegetation from dust deposition are considered unlikely.

6.5.4.3 *Phytophthora* Dieback

Phytophthora dieback is caused by the plant pathogen, *Phytophthora cinnamomi*, which kills susceptible plants by attacking their root systems. There are a number of *Phytophthora* species currently known to occur in south-west Western Australia, some of which are thought to be indigenous and others introduced (DPaW 2015). All currently recorded *Phytophthora* species are soil-borne and potentially plant pathogens and hence the management measures provided within the EMP references in **Table 6-1** are for the management of all currently known *Phytophthora* species. The focus of these measures is on *Phytophthora*

cinnamomi as it currently remains the major disease threat to the State's unique native flora and ecosystem health (DPaW 2015).

As provided within **Table 6-1**, the proposed quarry is located on the Spearwood and Quindalup dune system. In the context of *Phytophthora* dieback, this is significant because typically, *Phytophthora cinnamomi* does not 'express' on these alkaline soils associated with this dune system (CALM 2003).

This inability to establish an actual disease syndrome is a direct result of the unfavourable pH levels associated with these soil types. The *Phytophthora cinnamomi* management manual states that a "*No apparent disease at all*" syndrome will occur on Spearwood and Quindalup dune systems of the Swan Coastal Plain (CALM 2003).

Accordingly, the pathogen has no capacity to impact upon the vegetation. In addition, those plant species that most reliably indicate the presence of *P. cinnamom*i are generally in much lower abundance, or absent on these dunes, further increasing the difficulty associated with disease detection (CALM 2003).Without adequate management in place, it is possible that *Phythophthora* dieback could lead to the death of susceptible species in affected areas. However, given the very low likelihood of the disease being present in Lot 1002, it is not anticipated the Proposal will have a significant residual impact on the surrounding native vegetation due to *Phytophthora* dieback.

6.5.4.4 Altered Hydrological Regime

Potential impacts to inland waters and nearby groundwater dependent ecosystems are detailed in **Section 5**. The predicted residual impacts of the Proposal on inland waters relevant to adjacent vegetation are:

- No change to groundwater levels is predicted.
- No change to surface water features (all located outside the project footprint).
- Minor contamination risk that can be appropriately managed, with no significant residual impact to inland water quality.

Based on the conclusions above, impacts to flora and vegetation as a result of changes to hydrological regimes are not expected. Furthermore, there are no groundwater dependent ecosystems or riparian vegetation located within the impact area (refer to Natural Area 2019).

6.5.4.5 Strategic Environmental Advice on the Dawesville to Binningup Area

The EPA prepared the report *Strategic Environmental Advice on the Dawesville to Binningup Area* (2010) which provides advice to the Minister for Environment under section 16(e) of the *Environmental Protection Act 1986* on the significant environmental values of the Dawesville to Binningup area. Specifically, this report provides a series of recommendations for the management of this area. The recommendation relevant to the proposal is (EPA 2010):

The existing road, servicing properties west of Lake Preston, should remain a low standard road, and be realigned well away from the lake and its fringing vegetation.

The Shire of Waroona in consultation with the DBCA have undertaken road upgrade works to Preston Beach Road North. Accordingly, the only proposed works required for the Proposal are:

- Minor intersection work and signage.
- Trimming of road vegetation to increase sightlines.
- Grading of the road.
- Additional signage.

Based on the above, there are no deviations from the recommendations provided in the EPA's strategic advice for this area.

6.6 Management and Mitigation Measures

The planned management and mitigation measures are designed in accordance with the mitigation hierarchy of avoid, minimise and rehabilitate to ensure impacts arising from the Proposal on flora and vegetation are as low as reasonably practicable and meet the EPA's objective for this factor. **Table 6-10** demonstrates how the EPA's mitigation hierarchy has been applied to flora and vegetation to address key potential impacts. The management measures relating to flora and vegetation are provided in the EMP (Accendo 2021).

Table 6-10. Mitigation hierarchy and residual impacts for terrestrial flora and vegetation.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
Temporary loss of vegetation	• Excavation footprint has been modified to retain mature tuarts. • Access road will be designed to avoid mature tuarts. • Impacts along Preston Beach Road North have been reduced as far as practicable and are now limited to pruning. • The battle-axe road between the property and the Yalgorup National Park will not be used as an access road.	Prepare and implement EMP which will include the following management measures: • ensure clearing does not exceed the authorised extent and is minimised where possible; • where possible, adjusting clearing areas to incorporate lower conservation significance areas; • land clearing will be undertaking progressively with the amount of active disturbance minimised; • hygiene management measures; and • dust control.	All cleared areas within the quarry will be progressively rehabilitated. Revegetation will occur with locally endemic species including species associated with the PEC.	No residual impacts to flora and vegetation as all cleared areas will be rehabilitated to vegetation of improved condition (comparative to the current state). The rehabilitation works will result in a net environmental benefit.
Degradation of adjacent flora and vegetation	• The battle-axe road between the property and the Yalgorup National Park will not be used as an access road.	A 20-60m vegetative buffer to the battleaxe road and the excavation area will be provided. Implementation of the EMP which will include: • Suitable surface water controls to ensure that it is contained within the excavation area;	Not applicable	No residual impacts to flora and vegetation as result of degradation to adjacent areas are anticipated with the implementation of the proposed management measures.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
		• No storage of chemicals or fuel will occur onsite; • Restrict clearing to the approved project footprint to avoid over clearing and to minimise indirect impacts to adjacent remnant vegetation • Hygiene management measures • Dust control.		
Weeds and disease	• The battle-axe road between the property and the Yalgorup National Park will not be used as an access road.	An EMP will be implemented which will include weed and dieback hygiene management measures. Weed control will target *Gomphocarpus fruticosus* (Narrowleaf Cotton bush) and *Moraea flaccida* (One-leaf Cape Tulip).	Not applicable	No residual impacts to flora and vegetation as result of weeds and disease are anticipated with the implementation of the proposed management measures.

6.6.1 Vegetation Monitoring

A Vegetation Monitoring Program has been prepared to assess the effectiveness of the above management actions and enable detection of any potential decline in condition of vegetation within the adjoining Yalgorup National Park. The program includes both vegetation adjacent to the subject site and 'reference sites' located away from the subject site, outside the potential area of indirect impact.

Reference Sites within the Yalgorup National Park will be identified, and monitoring of these sites will commence prior to commencement of the Proposal. The purpose of these sites is to enable comparison of potential impact site data with data from sites located away from the subject site to assist in determining whether any indirect impacts have resulted from Proposal implementation, as well as to assess the impact other factors may have on the viability of the vegetation, for example lower than average rainfall.

Monitoring will consist of photopoint monitoring, with species composition and vegetation health attributes as measurement parameters. Triggers, thresholds and contingency actions that will be implemented should monitoring indicate a decline in monitored parameters are detailed in **Appendix B**.

Table 6-11 identifies the proposed monitoring type and monitoring frequency associated with the Vegetation Monitoring Program.

Table 6-11. Vegetation monitoring program.

Timing	Monitoring Type	Monitoring Frequency
Prior to Proposal commencement	Photopoints	Annually (spring)
During Proposal	Photopoints	Once every 2 years (spring)
Post Proposal	Photopoints	Annually for 2 years (spring)

6.6.2 Proposed Rehabilitation

Rehabilitation of the cleared footprint within the quarry (approximately 14.6 ha) will be undertaken on a progressive basis. The overarching closure objective for the Proposal is to:

Establish safe and stable landforms supporting a sustainable native ecosystem similar to that which occurs in adjacent areas, and which:

- Return vegetation groups appropriate to the locality.
- Targets re-establishment of the Tuart woodland PEC.
- Provides habitat for local endemic native fauna species with particular focus on species listed under the BC Act and the EPBC Act, as of conservation significance.
- Is commensurate with the surrounding landscape.

Preliminary completion criteria, including specific targets and implementation strategies for rehabilitation have been developed for the key elements of the Proposal and are aligned with the *Rehabilitation and Closure Plan* (refer to **Appendix C**). These are provided below in **Table 6-12**.

Table 6-12. Indicative completion criteria.

Closure Objectives	Indicative Completion Criteria	Measurement Tool
Compliance		
All legal and stakeholder obligations relevant to closure and completion of the site are met.	Completed checklist and evidence demonstrating compliance with all legal and stakeholder obligations.	Obligations Checklist EPA acceptance of rehabilitation

Closure Objectives	Indicative Completion Criteria	Measurement Tool
The quarry is successfully relinquished for final land use.	Agreement with stakeholder regarding final land use.	Sign off on rehabilitation and closure completion criteria.
Landform		
Construction of landforms that are stable, free draining, nonpolluting, aesthetically compatible with the surrounding landscape and capable of supporting the end land use.	The land surface will be a gently undulating floor with sloping batters at less than 1:4 vertical to horizontal and some at 1:2 at the steeper northern and southern edges of the ridge.	Physical survey, visual inspection and monitoring results.
	The approved floor level of the excavation area is graded to an even surface.	
	Surface drainage lines will be established to control surface run-off and minimise potential erosion.	
	No contaminated sites (as defined by the *Contaminated Sites Act 2003*) requiring ongoing management.	
Revegetation		
Plant and maintain native vegetation to stabilise the landform.	Weed species are not unduly prevalent on rehabilitated areas.	Monitoring included in the Environmental Management Plan (EMP)
	Native seed used in rehabilitation is of local provenance.	
	The native vegetation will be self-sustaining.	
	Trees/shrub species providing preferential habitat for black cockatoos and western ringtail possums will be included in native seed mixes.	
	An adequate density, species richness and cover has developed based on the following: • A native density of approximately 1 plant/2m^2; • No less than 10 species of tree, shrub and herbs; and • Reduce weed cover to less than 15%.	
Water		
Changes to surface water flows or groundwater quality are within acceptable limits.	The minimum buffer distance between the excavation level and the groundwater level is at least 4m.	Monitoring bores. Visual inspection and site audit
	Drainage lines flow in the same direction and to the same catchments as they did pre-mining.	
	Groundwater level and quality results do not indicate any unexpected to changes.	Groundwater monitoring results

Closure Objectives	Indicative Completion Criteria	Measurement Tool
		(pre and post-closure).
Decommissioning		
No infrastructure left on site unless agreed to by regulators and post-mining land managers/owners.	No mining and processing equipment present on site.	Visual inspection and photographic record.
	Waste disposed of at appropriately licenced waste disposal facilities.	Visual inspection and site audit.
Heritage		
Preserve, protect and manage the cultural heritage values of the area in cooperation with the Traditional Owners and other stakeholders.	No sites are disturbed without appropriate permissions/ permits (both site-specific and legislative permissions and permits).	No buried material identified as having Aboriginal heritage significance identified.
Public Safety		
Site is left in a condition where the risk of adverse effects is reduced to acceptable level. stakeholders.	Fencing, signage and rubbish are removed.	Visual inspection and photographic record.
	Excavations are filled.	

6.6.2.1 Topsoil and Overburden Management

Topsoil contains seeds, soil organisms and nutrients, which are all vital to the successful re-establishment of vegetation.

The following procedures will be applied:

- Records of topsoil and subsoil removal and storage locations shall be maintained;
- Planning shall endeavour to facilitate the direct placement of topsoil and subsoil from disturbed areas to areas scheduled for rehabilitation;
- Stockpiles will be located sufficiently distant from quarrying operations so that they will not be disturbed prior to being used in rehabilitation;
- Topsoils will be stripped and stockpiled separately from sand stockpiles;
- Topsoils should be stripped to a depth of approximately 150 mm. In some areas, topsoil depth may differ due to the topography of the quarry;
- Topsoil will be augmented with an underlay of subsoil with reasonable properties for plant growth, utilising fines from the limestone processing; and
- After topsoil is spread, deep ripping of the surface on contour will be undertaken to key the soil material to the pit floor.

The above procedure will ensure that the soil profile will remain consistent with the pre-mining soil profile, with the only amendment being the removal of some limestone. The topsoil, overburden and other soil material will be replaced over approximately 3- 4m of limestone.

It is preferable not to stockpile topsoil for extended periods and therefore the proponent will be quarrying and rehabilitating on a progressive basis. This will ensure that topsoil is respread relatively soon after stripping.

The limestone extracted from a ridge and will result in the ends of the two dunes being reshaped down to the elevation of the intervening swale. The main ridge line will be maintained.

The above methodology has proven effective at numerous limestone quarries, being utilised at quarries in Myalup, Nowergup, Whitby, Yanchep and Lancelin. Photographs demonstrating the success of this methodology are provided below.

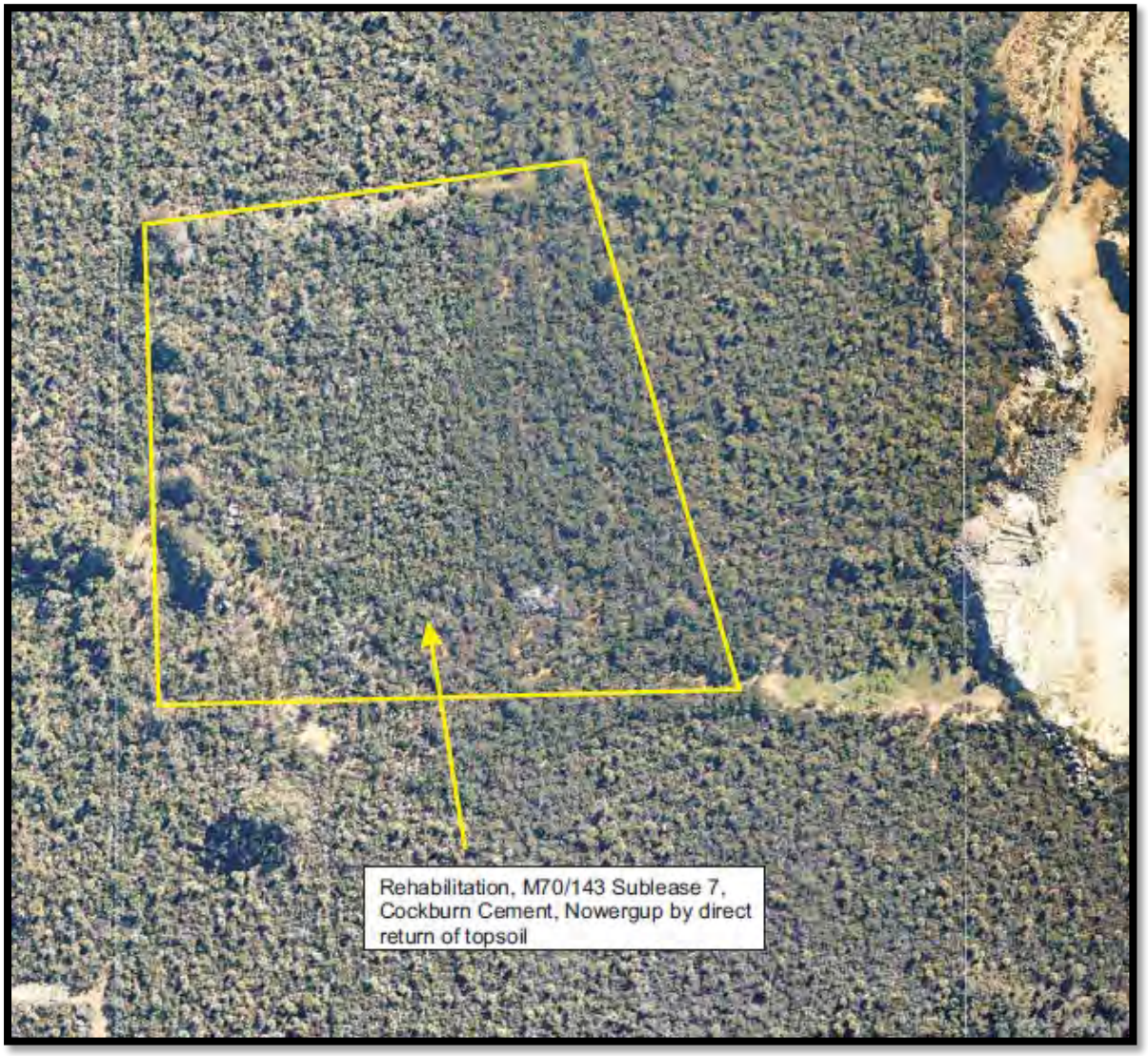


Figure 6-5: Rehabilitation within the Nowergup quarry.

Figure 6-6. Rehabilitation of limestone quarry at Lancelin.

Figure 6-7. Rehabilitation of a steep slope at a limestone quarry at Denmark.

6.6.2.2 Revegetation

Following the completion of a cell, deep ripping will occur at 1m intervals in two directions should low permeability soils be encountered at the base of the pit. Subsequently, topsoil will be respread using a front-end loader.

The final land surface will be smoothed and sloped to be compatible with the existing natural landform of the area. Revegetation will be undertaken during the first winter months upon completion of the restoration works for each particular stage.

Seed mixes for rehabilitation will be preferentially of local provenance. Specific seed mixes will be selected to provide a range of species appropriate to the desired habitat, taking into consideration landscape position and slope. In areas where erosion risks are identified, seed mixes may be modified to include or increase the portion of species that provide rapid cover. The following key species will be included within the revegetation program:

- *Acacia truncata*
- *Agonis flexuosa*
- *Banksia dallannyei*
- *Banksia sessilis*
- *Eremaea glabra*
- *Eucalyptus decipiens*
- *Eucalyptus foecunda*
- *Eucalyptus gomphocephala*
- *Eucalyptus petrensis*
- *Grevillea vestita*
- *Hakea lissocarpha*
- *Hakea prostrata*
- *Hakea trifurcate*
- *Lomandra spp.*
- *Hardenbergia comtoniana*
- *Kennedia prostrata*
- *Kunzea glabrescens*
- *Myoporum insulare*
- *Olearia axillaris*

The proposed management actions to mitigate potential impacts associated with weeds and pathogens include:

- All earthmoving and ground engaging equipment will be inspected and cleaned of vegetation, mud and soil prior to entry and exit of the quarry;
- Monitor spread of weeds onsite by controlling germination of weeds;
- Spot spraying and hand pulling of emergent weed species within the quarry will be undertaken to gradually deplete seed stocks and reduce or eliminate any new colonies;
- Pre-seeding weed control may be required after any potential weed seeds have been allowed to germinate;
- Any weeds likely to significantly impact on the rehabilitation are to be sprayed with broad spectrum spray or grass specific spray depending on the species involved.

6.7 Predicted Outcome

Following the application of the mitigation measures described above, the Proposal is expected to result in the following outcomes in relation to flora and vegetation:

- No decline in any vegetation association to a point below 30% pre-European extent.
- No loss or significant decline in any TEC or PEC.
- No loss of any conservation significant flora.
- No change (deterioration) in the status of any conservation significant flora species.
- No significant risk of an increase in the prevalence of weeds.
- Minimal risk of the introduction of dieback.
- No impact on native vegetation as a result of altered hydrological regimes.
- Improved vegetation condition following implementation of the progressive rehabilitation program.

With the applied controls, impacts on flora and vegetation from the Proposal are considered unlikely to result in significant residual impacts.

7 TERRESTRIAL FAUNA

7.1 EPA Objective

The EPA's objective for terrestrial fauna is to protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

7.2 Policy and Guidance

The following policies and guidance are relevant to the Terrestrial Fauna factor:

- Environmental Factor Guideline – Terrestrial fauna (EPA 2016);
- Environmental Factor Guideline – Flora and vegetation (EPA 2016);
- Guidance Statement No. 56 – *Terrestrial Fauna Surveys for Environmental Impact Assessment in WA (*EPA 2004);
- Technical Guide – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and Department of Parks and Wildlife 2015);
- Guidance Statement No. 20 – *Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia* (EPA 2009);
- Technical Guide – *Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2010); and
- EPA Report 1359 – *Strategic Environmental Advice on the Dawesville to Binningup Area* (EPA 2010).

7.3 Receiving Environment

7.3.1 Desktop Review

A review of the following databases to aid in the compilation of a list of vertebrate fauna potentially occurring within the project footprint was undertaken:

- DBCA's NatureMap database (combined data from DBCA, Western Australian Museum, Birds Australia and consultant's reports) (DBCA 2017); and
- DAWE's Protected matters search tool (PMST) (DotEE 2017).

A total of 75 conservation significant fauna were identified as having potential to occur within the project footprint, including threatened and priority species, and species otherwise protected under legislation and international agreements (refer to **Table 7-1**). NatureMap identified 32 conservation significant fauna species including one invertebrate, two reptiles, four mammal species, and 25 bird species. The PMST report outlined 64 species, 62 of which were birds. The DBCA database had records of 23 species in the local area, with five species recorded within the project footprint. The majority of the DBCA records of conservation significant fauna are from the surrounding wetland and marine areas (Natural Area 2019).

A review of the WALGA Environmental Planning Tool (2018) indicates the local area (which includes a buffer) is a confirmed breeding and roosting area for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*).

Table 7-1: Conservation significant fauna species that may be present in the area (Greg Harewood 2020).

Scientific Name	Common Name	DBCA Status	EPBC Status	NatureMap	PMST	DBCA
Birds						
Actitis hypoleucos	Common Sandpiper	IA	-	X		

Scientific Name	Common Name	DBCA Status	EPBC Status	NatureMap	PMST	DBCA
Anous stolidus	Common Noddy	-	MI		X	
Anous tenuirostris melanops	Australian Lesser Noddy	-	VU		X	
Apus pacificus	Fork-tailed Swift	-	MI		X	
Ardenna pacifica	Wedge-tailed Shearwater	IA	-	X		
Arenaria interpres	Ruddy Turnstone	IA	MI	X		X
Botaurus poiciloptilus	Australasian Bittern	-	EN		X	
Calidris acuminata	Sharp-tailed Sandpiper	IA	-	X		X
Calidris alba	Sanderling	IA	-	X		X
Calidris canutus	Red Knot	IA	EN	X	X	
Calidris ferruginea	Curlew Sandpiper	T	CR	X	X	X
Calidris melanotos	Pectoral Sandpiper	IA	-	X		
Calidris ruficollis	Red-necked Stint	IA	-	X		X
Calidris tenuirostris	Great Knot	T	CR	X	X	X
Calyptorhynchus banksii naso	Forrest Red-tailed Black-Cockatoo	T	VU	X	X	
Calyptorhynchus baudinii	Baudin's Cockatoo	T	EN	X	X	X
Calyptorhynchus latirostris	Carnaby's Cockatoo	T	EN	X	X	X
Charadrius bicinctus	Double-banded Plover	IA	-	X		
Charadrius leschenaultii	Greater Sand Plover	T	-	X		X
Charadrius mongolus	Lesser Sand Plover	-	EN		X	
Chlidonias leucopterus	White-winged Black Tern	IA	-	X		
Diomedea amsterdamensis	Amsterdam Albatross	-	EN		X	
Diomedea dabbenena	Tristan Albatross	-	EN		X	
Diomedea epomophora	Southern Royal Albatross	-	VU		X	
Diomedea exulans	Wandering Albatross	-	VU		X	
Diomedea sanfordi	Northern Royal Albatross	-	EN		X	
Falco hypoleucos	Grey Falcon	-	VU		X	
Falco peregrinus	Peregrine Falcon	S	-	X		
Gelochelidon nilotica	Gull-billed Tern	IA	-	X		
Halobaena caerulea	Blue Petrel	-	VU		X	
Hydrophone caspia	Caspian Tern	IA	MI	X	X	
Leipoa ocellata	Malleefowl	-	VU		X	
Limosa lapponica baueri	Bar-tailed Godwit	IA	-	X		
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	-	CR		X	
Limosa limosa	Black-tailed Godwit	IA	-	X		

Scientific Name	Common Name	DBCA Status	EPBC Status	NatureMap	PMST	DBCA
Macronectes giganteus	Southern Giant-Petrel	IA	EN	X	X	
Macronectes halli	Northern Giant Petrel	-	VU		X	
Numenius madagascariensis	Eastern Curlew	T	CR	X	X	X
Numenius phaeopus	Whimbrel	IA	-	X		X
Oceanites oceanicus	Wilson's Storm Petrel	IA	-	X		X
Onychoprion anaethetus	Bridled Tern	IA	MI	X	X	
Oxyura australis	Blue-billed Duck	P4	-	X		
Pandion haliaetus	Osprey	IA	-	X		
Pachyptila turtur subantarctica	Fairy Prion	-	VU		X	
Plegadis falcinellus	Glossy Ibis	IA		X		
Phoebetria fusca	Sooty Albatross		VU		X	
Pluvialis fulva	Pacific Golden Plover	IA	-	X		X
Pluvialis squatarola	Grey Plover	IA	-	X		X
Puffinus carneipes	Flesh-footed Shearwater	-	MI		X	
Pterodroma mollis	Soft-plumaged Petrel	-	VU		X	
Rostratula australis	Australian Painted Snipe	-	EN	X	X	
Sterna dougallii	Roseate Tern	-	MI		X	
Sterna hirundo	Common Tern	IA	-	X		
Sternula nereis nereis	Australian Fairy Tern	-	VU		X	
Thalassarche chlororhynchos	Atlantic Yellow-nosed Albatross	T	VU	X		X
Thalassarche carteri	Indian Yellow-nosed Albatross	-	VU		X	
Thalasseus bergii	Crested Tern	IA	-	X		
Thalassarche cauta cauta	Shy Albatross	-	VU		X	
Thalassarche cauta steadi	White-capped Albatross	-	VU		X	
Thalassarche impavida	Campbell Albatross	-	VU		X	
Thalassarche melanophris	Black-browed Albatross	-	VU		X	
Thinornis rubricollis	Hooded plover	P4	-	X		X
Tringa brevipes	Grey-tailed Tattler	IA	-	X		
Tringa glareola	Wood Sandpiper	IA	-	X		
Tringa nebularia	Common Greenshank	IA	-	X		X
Tringa stagnatilis	Marsh Sandpiper	IA	-	X		
Zosterops lateralis	Grey-breasted White-eye	IA	-	X		
Invertebrates						
Synemon gratiosa	Graceful Sunmoth	P4	-	X		X
Mammals						
Dasyurus geoffroii	Western Quoll	T	VU	X	X	X

Scientific Name	Common Name	DBCA Status	EPBC Status	NatureMap	PMST	DBCA
Hydromys chrysogaster	Water-rat, Rakali	P4	-	X		
Isoodon fusciventer	Southwestern Brown Bandicoot (Quenda)	P4	-	X		X
Phascogale tapoatafa wambenger	South-western Brush-tailed Phascogale	S	-	X		X
Pseudocheirus occidentalis	Western Ringtail Possum	T	CR	X	X	
Reptiles						
Ctenotus ora	Coastal Plains Skink	P3	-	X		X
Lerista lineata	Lined Skink	P3	-	X		

7.3.2 Fauna Surveys

To support the desktop review, two environmental scientists surveyed the broader project footprint over a two-day period from 20th to 21st November 2017 (Natural Area 2019).

A subsequent targeted survey was undertaken from April to May 2020 (Harewood 2020) (refer to **Appendix G**) to identify species of conservation with potential to occur in the subject site, including:

- Coastal Plains Skink *Ctenotus ora* (Priority 3)
- Lined Skink *Lerista lineata* (Priority 3)
- Sharp-tailed Sandpiper *Calidris acuminata* (Migratory)
- Baudin's Cockatoo *Calyptorhynchus baudinii* (Endangered)
- Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered)
- Forest Red-tailed black cockatoo *Calyptorhynchus banksii naso* (Vulnerable)
- Masked Owl *Tyto n. novaehollandiae* (Priority 3)
- Rainbow Bee-eater *Merops ornatus* (not listed)
- Western Ringtail Possum *Pseudocheirus occidentalis* (Critically Endangered)
- Quenda *Isoodon fusciventer* (Priority 4)
- South-western Brush-tailed Phascogale *Phascogale tapoatafa wambenger* (Conservation Dependent)
- Western Brush Wallaby (*Notamacropus irma*) (Priority 4)
- Western False Pipistrelle *Falsistrellus mackenziei* (Priority 4)

7.3.2.1 Habitat Types

Descriptions of the six broadly defined fauna habitats based primarily on vegetation units and landforms as identified during the flora and vegetation survey (Natural Area 2019), are listed in **Table 6-5** and depicted in **Figure 6-1** and **6-2**. This includes:

- Quarry:
    - Grasstree Shrubland - Shrubland of *Xanthorrhoea preissii*, *Melaleuca systena* and *Banksia dallanneyi* over *Lepidosperma gladiatum* in the herb layer;
    - *Eucalyptus decipiens* Woodland - *Eucalyptus decipiens* Woodland over *Xanthorrhoea preissii* shrubland;
    - Tuart and Peppermint Woodland - *Eucalyptus gomphocephala* and *Agonis flexuosa* Woodland over *Spyridium globulosum* or *Xanthorrhoea preissii* shrubland;

    - Trachyandra Herbland - herb layer of *Trachyandra divaricata*, *Euphorbia peplus*, *Crassula glomerata* and *Lysimachia arvensis*; *Eucalyptus gomphocephala* and *Agonis flexuosa* are associated with this vegetation type but comprise less than 2% of the canopy.
- Access Road:
    - Tuart and Peppermint Woodland - *Eucalyptus gomphocephala* and *Agonis flexuosa* Woodland over *Spyridium globulosum* or *Xanthorrhoea preissii* shrubland;
    - Trachyandra Herbland - herb layer of *Trachyandra divaricata*, *Euphorbia peplus*, *Crassula glomerata* and *Lysimachia arvensis*; *Eucalyptus gomphocephala* and *Agonis flexuosa* are associated with this vegetation type but comprise less than 2% of the canopy.
- Preston Beach Road North
    - Tuart and Peppermint Woodland - *Eucalyptus gomphocephala* and *Agonis flexuosa* Woodland over *Spyridium globulosum* or *Xanthorrhoea preissii* shrubland;
    - Trachyandra Herbland - herb layer of *Trachyandra divaricata*, *Euphorbia peplus*, *Crassula glomerata* and *Lysimachia arvensis*; *Eucalyptus gomphocephala* and *Agonis flexuosa* are associated with this vegetation type but comprise less than 2% of the canopy.
    - *Eucalyptus decipiens* Woodland - *Eucalyptus decipiens* Woodland over *Xanthorrhoea preissii* shrubland;
    - Banksia Jarrah Woodland - *Banksia attenuata* and *Eucalyptus marginata* Woodland over *Xanthorrhoea preissii* shrubland and a weedy understory of *Trachyandra divaricata;*
    - Coastal Shrubland- Shrubland of *Acacia cyclops*, *Melaleuca systena*, *Hibbertia racemosa* and *Spyridium globulosum* over a weedy understorey of *Trachyandra divaricata*.

The project footprint and adjacent areas do not contain riparian vegetation or habitat associated with wetlands, watercourses or marine environments.

7.3.2.2 Fauna Species

During the level 1 fauna survey, a total of 18 species of fauna were recorded. This included six arthropods (insects and spiders), five birds, two mammals and five reptile species. Species identification was based on visual observations or positively identified from foraging evidence, scats, tracks, skeletons or calls, within the project footprint during the survey period (Natural Area 2019).

Results from the targeted survey for conservation significant fauna are discussed below. This information has been extracted from the report *Lot 1002 Preston Beach Road North – Fauna Assessment* (Harewood 2020).

Coastal Plains Skink Ctenotus ora (Priority 3)

This species was not detected during the targeted fauna survey which may be attributed to the degraded nature of much of the subject site (Harewood 2020).

Ctenotus ora is a relatively newly described species of medium sized skink with a restricted range, mainly confined to the Swan Coastal Plain. The species prefers sandy substrates with low vegetation (including heath) in open Eucalyptus/Corymbia woodland over Banksia (Kay & Keogh 2012).

Nature Map (2020) shows 32 records of *Ctenotus ora*, only one of which is located within the bounds of Yalgorup National Park. The record, from 1980, plots within Lot 1002 however this would appear to be erroneous as at that location the area is a cleared paddock, unsuitable habitat for the species. It is assumed to have actually been collected nearby within bushland of the Yalgorup National Park (Harewood 2020).

It is difficult to predict the likelihood of this species occurring within the subject site, however the extent of suitable habitat is probably limited to the small areas of heathland along the eastern edge of the proposed extraction area and heath and banksia woodland areas bordering Lake Clifton Road North. The fact that it has not been collected within the Yalgorup National Park (or nearby) recently despite several detailed surveys over many years suggests it is at best, very uncommon (Harewood 2020).

Lined Skink Lerista lineata (Priority 3)

This species was not detected during the targeted fauna survey which may be attributed to the degraded nature of much of the subject site (Harewood 2020).

This small species of skink inhabits white sands (Storr *et al.* 1999) under areas of shrubs and heath where it inhabits loose soil and leaf litter particularly in association with banksias (Bush *et al.* 2007)

Nature Map (2020) shows 431 records of *Lerista lineata*, with several being form within the bounds of Yalgorup National Park. The species appears to be most common along the near coastal strip where it has been recorded in most surveys carried out in the area between Mandurah, Binningup and Kemerton (Harewood 2020).

It is difficult to predict the likelihood of this species occurring within the subject site, however the extent of suitable habitat is probably limited to the small areas of heathland along the eastern edge of the proposed extraction area and heath and banksia woodland areas bordering Lake Clifton Road North. While it has been collected during surveys in the area, it appears to be uncommon as only a small number of specimens were recorded in each case despite intensive trapping being employed (Harewood 2020).

Peregrine Falcon Falco Peregrinus (other specially protected fauna)

This species was not detected during the fauna survey (Harewood 2020).

Individuals of this species are uncommon/rare but wide ranging across Australia. The species occupies diverse habitats ranging from rainforest to arid shrublands, from coastal heath to alpine (Morcombe 2004). Mainly frequents cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998).

There are over 1,500 records of the peregrine falcon within NatureMap (2020) a small number of which are from with Yalgorup National Park (Harewood 2020).

This species may very occasionally fly over/forage with the subject site but would not be specifically attracted to the area. It is unlikely to breed within the subject site (Harewood 2020).

Masked Owl Tyto n. novaehollandiae (Priority 3)

This species was not detected during the fauna survey (Harewood 2020).

The masked owl is locally common in south west but generally uncommon (Johnstone and Storr 1998). They roost and nest in heavy forest and hunt over open woodlands and farmlands (Morcombe 2004).

There are 75 records of the masked owl within NatureMap (2020) none of which are from within Yalgorup National Park. The species has not been recorded during any previous fauna surveys in the general area (Harewood 2020).

It is difficult to predict the likelihood of this species occurring within the subject site, however given the lack of any previous records from Yalgorup it can be assumed to only occur rarely presumably due to habitat being generally unsuitable (Harewood 2020).

Sharp-tailed Sandpiper Calidris acuminata (Migratory)

This species was not detected during the fauna survey (Harewood 2020).

The sharp-tailed sandpiper is a common summer visitor to Australia. Generally, very numerous in fresh to saline inland wetlands but also forages in nearby damp grasslands and often utilises tidal flats (Menkhorst *et a*l. 2017).

This species would not be present within any section of the subject site under normal circumstance due to a complete absence of suitable habitat (Harewood 2020).

Baudin's Cockatoo Calyptorhynchus baudinii (Endangered)

This species was not detected during the fauna survey (Harewood 2020).

Baudin's cockatoo is confined to the south-west of Western Australia, north to Gidgegannup, east to Mt Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, North Dandalup, Yarloop, Wokalup and Bunbury (Johnstone and Storr 1998). On the southern Swan Coastal Plain this cockatoo is in some areas resident but mainly a migrant moving from the deep south-west to the central and northern Darling Range (Harewood 2020).

The survey did not identify any confirmed/existing breeding habitat trees within the subject site (i.e. tree with a large hollow confirmed as being in use/used for nesting purposes). Foraging habitat also appears to be generally low quality within the proposed extraction area. Some better quality foraging habitat (i.e. banksia woodland) occurs along Lake Preston Road North. No roosting activity was observed within the subject site (Harewood 2020).

The results of the literature review and field survey suggest that this species may occur in the general area on occasions but would not be specifically attracted the subject site itself as it for the most part represents low quality black cockatoo habitat (Harewood 2020).

Carnaby's Cockatoo Calyptorhynchus latirostris (Endangered)

This species was detected during the fauna survey with about four individuals observed flying overhead during the April 2020 survey period. No other evidence of the species utilising the subject site was recorded (Harewood 2020).

Carnaby's cockatoo is endemic to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noogar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Coondingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

The survey did not identify any confirmed/existing breeding habitat trees within the subject site (i.e. tree with a large hollow confirmed as being in use/used for nesting purposes). Foraging habitat also appears to be generally low quality within the proposed extraction area. Some better quality foraging habitat (i.e. banksia woodland) occurs along Lake Preston Road North. No roosting activity was observed within the subject site (Harewood 2020).

The results of the literature review and field survey suggest that this species may occur in the general area on occasions but would not be specifically attracted the subject site as it for the most part represents low quality black cockatoo habitat (Harewood 2020).

Forest Red-tailed black cockatoo Calyptorhynchus banksii naso (Vulnerable)

This species was not detected during the fauna survey.

This species is found in the humid and subhumid south west, mainly hilly interior, north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

The survey did not identify any confirmed/existing breeding habitat trees within the subject site (i.e. tree with a large hollow confirmed as being in use/used for nesting purposes). Foraging habitat also appears to be generally low quality within the proposed extraction area and other sections of the subject site. No roosting activity was observed within the subject site (Harewood 2020).

The results of the literature review and field survey suggest that this species may occur in the general area on occasions but would not be specifically attracted the subject site as it for the most part represents low quality black cockatoo habitat (Harewood 2020).

Rainbow Bee-eater Merops ornatus (not listed)

This species was not detected during the fauna survey (Harewood 2020).

The rainbow bee-eater is a common, widespread summer migrant to southern Australia but in the north they are resident (Morcombe 2004). In recent years this species has been removed from migratory bird lists at a federal and state level and is therefore no longer a "fauna species of conservation significance" under these criteria.

This species is likely to occur within the subject site during summer months but was not detected during the recent survey which was carried out in autumn. The majority of the proposed extraction area is unsuitable breeding habitat for this species due to shallow soil and outcropping limestone being dominant over much of the area (Harewood 2020).

Quenda Isoodon fusciventer (Priority 4)

This species was detected several times at several locations across the proposed extraction area during the fauna survey (Harewood 2020).

The species is widely distributed in the south west from near Cervantes north of Perth to east of Esperance and inland as far as Hyden, though it has a patchy distribution through the jarrah and karri forest and on the Swan Coastal Plain (Harewood 2020).

The species is most often recorded in areas of dense scrubby, often swampy, vegetation with dense cover up to one metre high. Quenda often feed 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. Quendas can thrive in more open habitat subject to exotic predator control (Harewood 2020).

This species is likely to occur anywhere within the subject site where dense ground cover persists (Harewood 2020). In addition, large tuart trees that provide potential roosting habitat for the Carnaby's Cockatoo where identified (Natural Area 2019). These mature trees have been excluded from the quarry footprint (refer to **Figure 7-1**).

Western Ringtail Possum Pseudocheirus occidentalis (Critically Endangered)

This species was detected in the subject site but only along the southern section of Preston Beach Road North. It was not detected within the proposed extraction area or access road.

The Western Ringtail Possum (WRP) once occurred throughout much of south-western Western Australia in a patchy distribution (Shortridge 1909; Maxwell *et al.* 1996). Early WA Museum records indicate its

presence from north of Perth to around Cranbrook and the Pallinup River in the south-east (Burbidge and de Tores 1998; de Tores *et al.* 2005a).

Vegetation communities critical to the species include long unburnt mature remnants of peppermint (*Agonis flexuosa*) woodlands with high canopy continuity and high foliage nutrients (high in nitrogen and low toxin levels); jarrah (*Eucalyptus marginata*)/marri (*Corymbia calophylla)* forests and woodlands with limited anthropogenic disturbance (unlogged or lightly logged, and a low intensity and low frequency fire history), that are intensively fox-baited and have low indices of fragmentation; coastal heath, jarrah/marri woodland and forest, peppermint woodlands, myrtaceous heaths and shrublands, Bullich (*Eucalyptus megacarpa*) dominated riparian zones and karri forest (Harewood 2020).

The apparent absence of the species from the proposed extraction area and access road despite intensive survey work suggests habitat in these areas is unsuitable or at best marginal for the species (Harewood 2020).

South-western Brush-tailed Phascogale Phascogale tapoatafa wambenger (Conservation Dependent)

This species was detected several times at several locations across the proposed extraction area during the fauna survey (Harewood 2020).

The present distribution of the south-western brush-tailed phascogale is believed to have been reduced to approximately 50 per cent of its former range. Now known from Perth and south to Albany, west of Albany Highway. Occurs at low densities in the northern jarrah forest. Highest densities occur in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton (DBCA information pamphlet). Records are less common from wetter forests. Can also persist in floristically degraded areas such as relatively dense and continuous, but parkland cleared woodland in farmland. Previous local records from Kemerton, Binningup, Dardanup and College Grove (Harewood 2020).

This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. A nocturnal carnivore relying on tree hollows as nest sites (Harewood 2020)

The survey results suggest this species is likely to occur anywhere within the subject site where woodland habitats (with some hollow bearing trees) occur (Harewood 2020).

Western Brush Wallaby (Notamacropus irma) (Priority 4)

This species was not detected during the fauna survey (Harewood 2020).

The western brush wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid. The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets (Harewood 2020).

There are no records of the western brush wallaby from the Yalgorup National Park. It has however been recorded nearby by during the DBNGP fauna survey along Riverdale Road (Harewood 2014). It has also been recorded at Kemerton (Harewood 2009, 2010). Hyder and Dell (2009) also report one siting south of Myalup (Harewood 2020).

This species may persist in Yalgorup National Park despite a lack of records. The proposed extraction area is however largely unsuitable for the species and therefore western brush wallabies can be expected to only occur as very occasional transients (Harewood 2020).

Western False Pipistrelle Falsistrellus mackenziei (Priority 4)

This species was detected several times at several locations across the proposed extraction area during the fauna survey (Harewood 2020).

Historically, the western false pipistrelle has been found in the Swan Coastal Plain and the jarrah forest as far north as the Great Eastern Highway. At 20 grams it is the second largest of the insectivorous bats that inhabit the South West forest and adjacent coastal plains. Due to its size, this bat requires a particularly productive habitat to persist. Its preferred habitat is hardwood forest and the open woodlands that adjoin it (Start and McKenzie 2008). It commonly roosts in tree hollows and branches (Bullen 2009).

This species has previously been recorded between Dawesville and Binningup at several localities (Bullen 2009) including some in or near Yalgorup National Park. It has also been recorded at Kemerton (Harewood 2010) and at two other nearby locations (Brunswick River and Kemerton Silica Sands) (Harewood 2014).

Summary

The following conservation significant fauna species were detected within the subject site during the course of the fauna survey (refer to **Figure 7-1** and **Figure 7-2**) (Harewood 2020).

- Carnaby's Cockatoo *Catyptorhynchus latirostris* (Endangered)
  A small group of individuals were observed flying over the proposed extraction area on one occasion.
- Quenda *Isoodon fusciventer* (Priority 4)
  Several individuals recorded within the proposed extraction area.
- South-western Brush-tailed Phascogale *Phascogale tapoatafa wambenger* (Conservation Dependent)
  Several individuals recorded within the proposed extraction area.
- Western Ringtail Possum *Pseudocheirus occidentalis* (Critically Endangered)
  Recoded along the southern section of Preston Beach Road North. Appears to be absent for the proposed extraction area.
- Western False Pipistrelle *Falsistrellus mackenziei* (Priority 4)
  Recorded several times within the proposed extraction area.

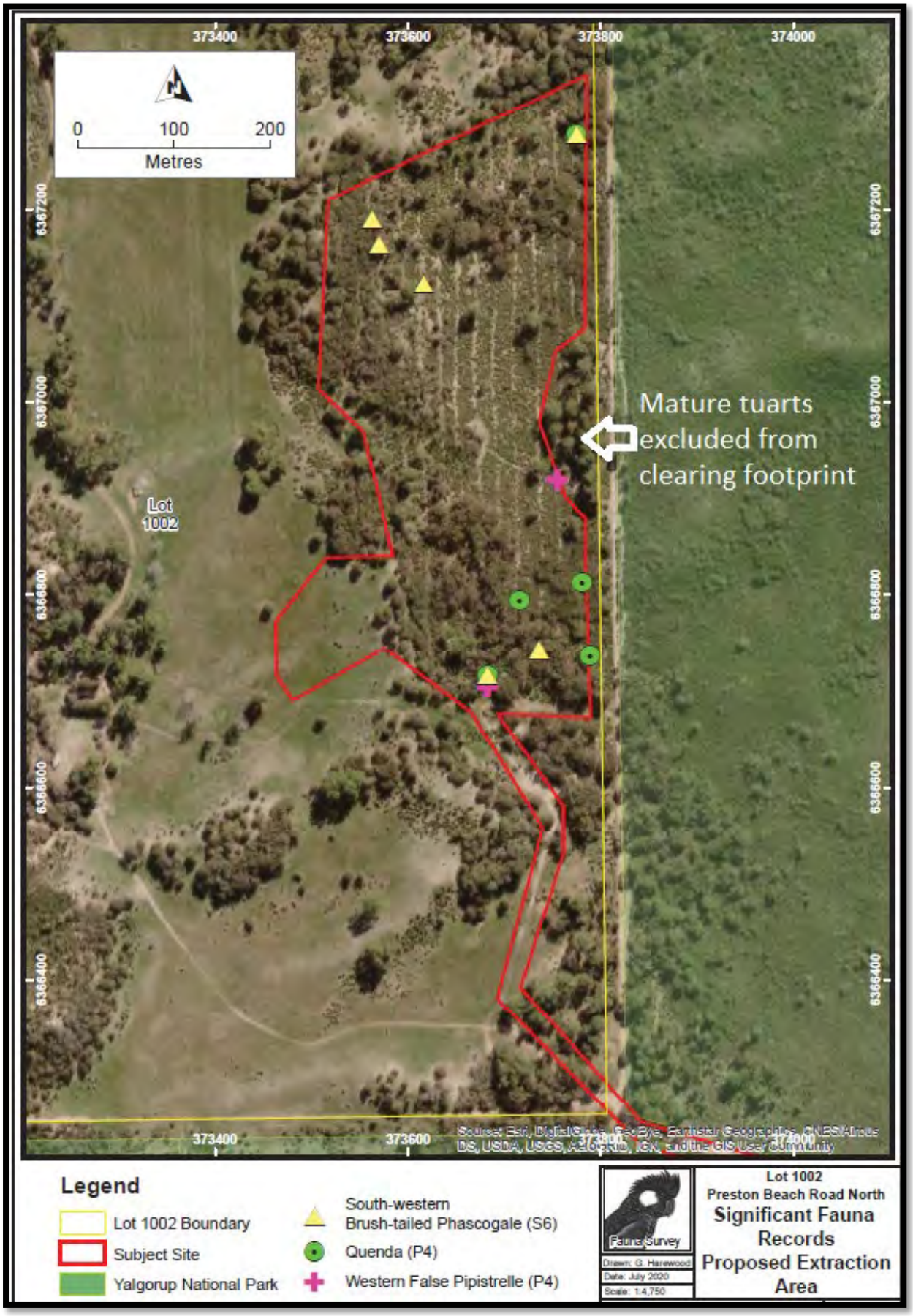


Figure 7-1. Fauna survey results (sourced from Harewood 2020).

Figure 7-2. Fauna survey results (sourced from Harewood 2020).

7.3.2.3 Black Cockatoo Habitat Assessment

Habitat Trees

Trees considered potentially suitable for black cockatoos to use as nesting habitat (subject to a suitable hollow being present and other factors) which were found within the subject site are comprised of the following species (Harewood 2020):

- Tuart – *Eucalyptus gomphocephala;*
- Limestone Marlock - *Eucalyptus decipiens;* and
- Jarrah - *Eucalyptus marginata*.

A summary of the potential black cockatoo breeding trees (using DAWE criteria i.e. any suitable tree species with a DBH ≥ 50cm (Commonwealth of Australia 2012)) observed within the subject site is provided below and their location shown in **Figure 7-3** (proposed extraction area only).

Table 7-2. Summary of Potential Cockatoo Breeding Habitat Trees (DBH ≥50cm) (Harewood 2020).

Area	Total Number of Habitat Trees	Number of Trees with No Hollows Observed	Number of Trees with Hollows Considered Unsuitable for Nesting Black Cockatoos	Number of Trees with Hollows Considered Possibly Suitable for Nesting Black Cockatoos	Tree Species		
					Tuart	Limestone Marlock	Jarrah
Extraction Area	52	45	7	0	39	13	0
Access Track	9	8	1	0	9	0	0
Lake Preston Road North	26	20	5	1	23	2	1
Total	87	73	13	1	71	15	1

The assessment identified a total of 87 trees with a DBH of >50cms within the subject site. Most (73, ~84%) were not observed to contain hollows of any size. Thirteen trees (~15%) contained one or more possible hollows considered by Harewood not to be suitable for black cockatoos to use for nesting purposes (Harewood 2020).

One tree (within the Preston Beach Road North reserve) was observed as potentially containing a hollow that appeared possibly big enough to allow the entry of a black cockatoo into a suitably sized and orientated branch/trunk though conclusive evidence of actual use by black cockatoos (e.g. chew marks) was not seen (Harewood 2020).

It should be noted that not all of the identified habitat trees will necessarily require removal, in particular those along Preston Road North and the access track are likely to mostly avoided.

In addition, limestone marlock is not documented in the literature as being use by black cockatoos as nesting habitat and the propensity of this tree species to develop hollows that are subsequently suitable for black cockatoos is unknown. Based on observations of the tree's growth habit, form and size it would

seem unlikely that trees of this species would develop hollows suitable for black cockatoos (Harewood 2020).

Foraging Habitat

A list of the main flora species observed within the subject site during the fauna assessment that are known and documented as being used as a direct food source (i.e. seeds, flowers, bark, invertebrates) by one or more species of black cockatoo are provided below (Harewood 2020):

- Orange Wattle - *Acacia saligna* (bark, invertebrates)
- Peppermint - *Agonis flexuosa* (bark, invertebrates)
- Slender Banksia - *Banksia attenuata* (flowers, seeds, invertebrate)
- Couch Honeypot Dryandra - *Banksia dallanneyi* (flowers, seeds)
- Parrot bush - *Banksia sessilis* (flowers, seeds)
- Tuart - *Eucalyptus gomphocephala* (flowers, seeds, nectar)
- Jarrah - *Eucalyptus marginata* (seeds)
- Harsh Hakea - *Hakea prostrata* (seeds)
- Candle Hakea - *Hakea ruscifolia* (seeds)
- Grey Stinkwood - *Jacksonia furcellata* (seeds)
- Grass Tree - *Xanthorrhoea preissii* (flowers, seeds)

The distribution and abundance the various species listed varies considerably across the subject site and therefore, the exact extent and quality is difficult to quantify. In some areas the favoured foraging species are absent or represented by only a small number of specimens. For example, the proposed extraction area, due to its history of disturbance, contains only a very small number of banksia and hakea specimens (Harewood 2020).

The grass trees present within the subject site also appear not to have ever produce flower spikes and therefore do not at this present time present a foraging resource. It should also be noted that some of the listed plant species (e.g. peppermint and tuart) are only foraged upon on infrequent occasions and therefore cannot be regarded as quality foraging habitat (Harewood 2020).

No foraging debris left by black cockatoos was observed within the subject site during the survey period (Harewood 2020).

Roosting Habitat

No evidence of black cockatoo roosting within trees located within the subject site was observed during the survey (Harewood 2020).

7.3.2.4 Western Ringtail Possum Assessment

The locations of WRP observations made during the site surveys are shown in **Figure 7-2**. Three WRP sightings were made during the spotlight surveys along Preston Beach Road North (two individuals on night 1 and one individual on night 2). No other evidence of the species (i.e. dreys, scats or skeletons) were recorded despite intensive searching particularly within the proposed extraction area (Harewood 2020).

The majority of the proposed extraction area (~60%) does not contain habitat suitable for WRPs (i.e. the mallee, shrubland, heathland and herbland areas). The forest/woodland habitat units (~40% of proposed extraction area) appear superficially to represent suitable habitat, at least in part, but the complete lack of evidence of the species suggests these areas are unsuitable (Harewood 2020).

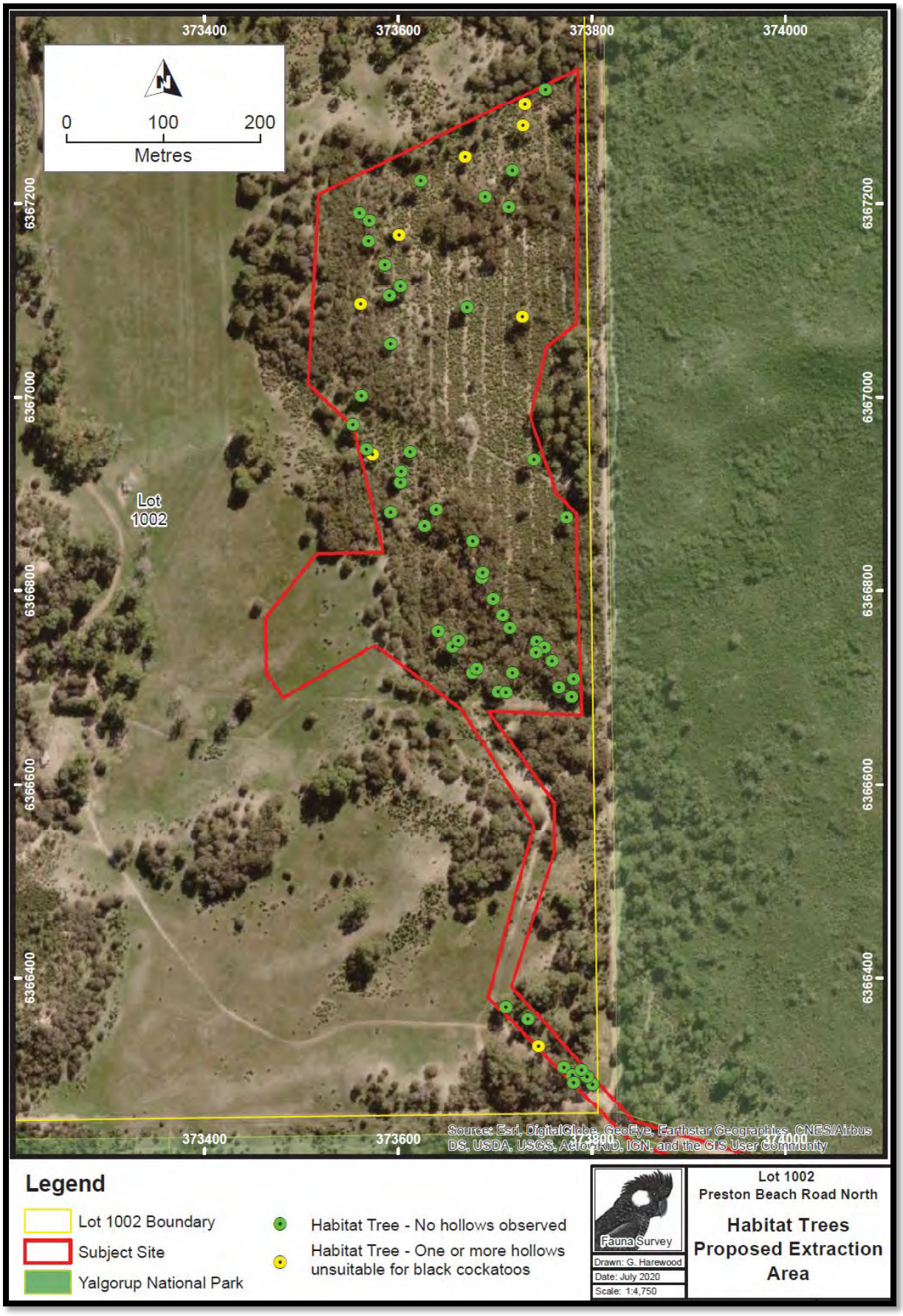


Figure 7-3. Black cockatoo habitat survey results (sourced from Harewood 2020).

7.3.2.5 Short Range Endemic Invertebrate Fauna

The isolation of invertebrates in specific habitats or bioregions, such as ability and opportunity to disperse, life history, physiology, habitat requirements and habitat availability, leads to endemism at various spatial scales. Short Range Endemic (SRE) invertebrates are species with restricted distributions, arbitrarily defined in Western Australia as less than 10,000 km^2 (Harvey 2002).

Based on general condition of the quarry as a result of historical agricultural land uses, no SRE invertebrates would be restricted to the area, as none of the habitats present would provide habitat isolates. All the vegetation units are laterally continuous within the region and are not limited to the quarry. Furthermore, adjoining habitat is of superior quality attributed to the absence of recent and historical anthropogenic disturbances.

The desktop review (refer to **Section 7.3.1**) indicated that only one invertebrate species of conservation significance has the potential to occur within the project footprint, this being the graceful sun moth (*Synemon gratiosa*). The PMST database search returned no invertebrate results (DotEE 2017).

The graceful sun moth is listed as Priority 4 by DBCA. No individuals were identified during the fauna survey and suitable habitat for the species (*Lomandra* spp.) is virtually absent (cover of *Lomandra hermaphrodita* and *L. maritima* was 0.3% in the quarry).

7.4 Potential Impacts

The Proposal has the potential to directly and indirectly impact on terrestrial fauna as follows:

- Temporary loss of marginal quality fauna habitat from vegetation clearing.
- Injury/mortality of fauna.
- Degradation of adjacent fauna habitat.
- Disturbance to fauna from noise and vibrations.
- Introduction of weeds and disease.

7.5 Assessment of Impacts

7.5.1 Loss of Habitat

The clearing footprint comprises approximately 13.9 ha within the quarry area of modified vegetation which provides limited value as habitat to fauna. Individual losses of fauna may occur during the staged clearing activities with less mobile species being particularly vulnerable. Indirect impacts to fauna are likely to be limited to potential habitat degradation as a result of the introduction and/or spread of weeds and disease.

The loss of potential fauna habitat as documented in **Table 6-7** is insignificant in comparison to the area of habitat in the adjoining Yalgorup National Park (12,888 ha) (DBCA 2019).

The project footprint does not contain any habitat that is unique and/or uncommon in the locality. There will be no impact to the hydrology of Lake Pollard (as discussed in **Section 5**) or any riparian vegetation associated with wetlands of conservation significance. Lake Pollard is located approximately 800 m east of the quarry, aquatic fauna and migratory waterbirds associated with wetlands of conservation significance will not be impacted by the Proposal.

Any SRE species within the project footprint not recorded during the fauna survey are unlikely to change conservation status as a result of the Proposal. It is noted that all habitats and vegetation types are well connected within the local area. When combined with the low likelihood of any SRE species occurring

within the project footprint, this results in a low risk to SRE species as a whole within the vicinity of the project footprint.

With limited area of clearing and the typically Degraded condition of the vegetation, impacts on fauna habitat are not expected to be significant. Furthermore, progressive rehabilitation is proposed denoting that loss of habitat will only be temporary.

7.5.2 Impacts to Conservation Significant Fauna

The potential impacts to conservation significant fauna as a result of the Proposal are provided in **Table 7-3.**

A number of migratory bird species (including shorebirds/wetland species) are listed as potentially occurring in the general area (Natural Area 2019). While habitats vary between species, generally this includes beaches and permanent/temporary wetlands such as swamps, lakes, floodplains, ponds, estuaries, lagoons, mudflats sandbars etc. These habitat types are not contained within the project footprint and therefore species associated with these habitat types are not considered further.

Table 7-3. Impact to fauna species potentially occurring within the project footprint.

Species and Conservation Status	Significance of Impacts
Calyptorhynchus baudinii Baudin`s Black-Cockatoo - S1 (BC Act), Endnagered (EPBC Act)	The project footprint contains limited foraging habitat for the species (i.e. absence of marri, jarrah and banksia trees). This is supported by the absence of any evidence of foraging occurring within the quarry (Harewood 2020). No evidence of breeding or roosting was recorded within the project footprint (Harewood 2020). The Proposal will require the clearing of up to seven potential habitat trees with hollows which are unsuitable for black cockatoos. The removal of these trees is not considered significant given that black cockatoos do not appear to be using the subject site for any purpose. No direct loss of black cockatoo individuals is expected as an impact of the Proposal. Due to the high mobility of black cockatoos, clearing operations conducted for the Proposal are not expected to directly affect any live individuals. The subject site is located within a property that has been subject to clearing for agricultural developments and roads. These land uses have resulted in 'edge effect' exposure which may lead to the introduction or spread of introduced flora taxa (weeds) or *Phytophthora* dieback. Whilst acknowledging the clearing of native vegetation for the Proposal will result in changed edges to the remnant vegetation, this vegetation has already been exposed to edge effects by the current land uses in the area for an extended time. The Proposal is therefore not expected to exacerbate the impact of the current edge effects or introduce any new types of edge effects which could result in a further degradation of habitat quality for black cockatoos. No significant impacts on black cockatoos are anticipated.
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo – S1 (BC Act), Vulnerable (EPBC Act)	
Calyptorhynchus latirostris Carnaby`s Black-Cockatoo – S1 (BC Act), Endangered (EPBC Act)	

Species and Conservation Status	Significance of Impacts
Isoodon obesulus fusciventer Southern Brown Bandicoot – P4 (BC Act)	While the regional extent of potential habitat for these species has not been modelled, the local extent of potential habitat within a 5 km radius of the Proposal has been estimated at 4,999 ha. The Proposal will require the clearing of up to 14.6 ha of potential habitat, representing approximately 0.2% of the modelled local extent of potential habitat. In consideration of the extent of potential habitat at a local scale, and the area of clearing required for the Proposal, the impact of the Proposal to habitat associated with these species is not considered to be significant.
Phascogale tapoatafa ssp Southern Brush-tailed Phascogale – Conservation Dependent	
Pseudocheirus occidentalis Western Ringtail Possum – Critically Endangered (EPBC Act)	No evidence of WRPs occurring with the proposed extraction area was recorded. The vegetation within this area is unlikely to provide suitable habitat for the species. WRPs were recorded along the southern extent of Preston Beach Road North. Project works within this area will be restricted to pruning (where required). Accordingly, no impacts to WRP habitat are expected.

7.5.3 Injury/Mortality of Fauna

Injury and mortality of fauna can result from both direct and indirect impacts from the Proposal. This includes:

- Fauna being injured/killed by collisions with earthmoving equipment and/or vehicles during clearing and excavation works.
- Vegetation clearing, which reduces the extent of fauna habitat and may result in the loss of individual fauna.
- Ground disturbance activities, which may result in the direct removal of fauna.

The risk of injury/mortality to fauna is not considered significant based on the following:

- Vegetation clearing will be undertaken on a staged basis;
- A pre-clearance survey will be undertaken with capture and relocation of fauna to an area where those species are known to be present, if required. The fauna handler/spotter will have a Section 40 'authorisation to disturb or handle threatened fauna', pursuant to the *Biodiversity and Conservation Act 2016*;
- A fauna spotter will be onsite to oversee vegetation clearing;
- Vehicles/machinery onsite will be restricted to one front-end loader and a truck;
- Speed limits for trucks will be restricted.

The potential impacts to fauna from collisions will not affect the conservation status of any of the species present and are not expected to be significant.

7.5.4 Adjacent Fauna Habitat

The Proposal has the potential to cause indirect impacts to fauna habitat adjacent to the project footprint within the Yalgorup National Park, from hydrocarbon spills, the alteration of surface water flows and increased sedimentation, as discussed below.

Altered surface water flows

Potential impacts to inland waters are detailed in **Section 5**. The predicted residual impacts of the Proposal on terrestrial fauna relevant to adjacent vegetation are:

- No change to groundwater levels is predicted.
- No change to surface water features (all located outside the project footprint).
- Minor contamination risk that can be appropriately managed, with no significant residual impact to inland water quality.

Based on the conclusions above, impacts to terrestrial fauna as a result of changes to hydrological regimes are not expected.

Increased spread of weeds and/or disease

Increased local weed incursion and the introduction of dieback into the fauna habitat adjacent to the project footprint may cause the degradation of fauna habitat values. These matters are discussed in **Section 6.5.4**.

The introduction of spread of existing weeds may result in impacts that, while not significant, could be detrimental to the condition of fauna habitat.

Noise and Vibration

Noise generated by machinery during construction may disrupt fauna behaviour; however, given the short-term and localised nature of the noise, it is anticipated that the impacts of noise on fauna will be negligible.

7.6 Mitigation and Management Measures

The planned management measures are designed in accordance with management hierarchy of avoid, minimise and rehabilitate to ensure impacts arising from the project on native fauna are as low as reasonably practicable and meet the EPA's objective for this factor. **Table 7-4** demonstrates how the EPA's mitigation hierarchy has been applied to terrestrial fauna to address key potential impacts.

Table 7-4. Mitigation hierarchy and residual impacts for terrestrial fauna.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
Temporary loss of habitat	• Excavation footprint has been modified to retain mature tuarts. • Access road will be designed to avoid mature tuarts. • Impacts along Preston Beach Road North have been reduced as far as practicable and are now limited to pruning. • The battle-axe road between the property and the Yalgorup National Park will not be used as an access road.	Prepare and implement EMP which will include the following management measures: • ensuring clearing does not exceed the authorised extent and is minimised where possible; • where possible, adjusting clearing areas to incorporate lower conservation significance areas; • clearing will be undertaking progressively with the amount of active disturbance minimised; • hygiene management measures; and • dust control.	All cleared areas within the quarry will be progressively rehabilitated. Revegetation will occur with locally endemic species and replacement of topsoil which may allow any eggs/larvae/dormant stages of some SRE's to recolonise previously cleared areas.	No residual impacts to fauna habitat as all cleared areas will be rehabilitated to vegetation of improved condition (comparative to the current state). The rehabilitation works will result in a net environmental benefit providing higher quality fauna habitat.
Injury/mortality of fauna	• Excavation footprint and access road has been modified to retain tuarts.	Implementation of the EMP which will include: • undertake progressive clearing to allow fauna to move away from clearing activities, promoting natural dispersal. • pre-clearing survey for fauna (including black cockatoos using a pole camera as required by DBCA) will be required for	Fauna injured during clearing or excavation works will be rehabilitated by a wildlife carer.	No residual impacts to fauna as result of injury/mortality are anticipated with the implementation of the proposed management measures. All areas subject to clearing will undergo a pre-clearing survey to avoid any impact to species of conservation significance.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
		all vegetation subject to clearing. • prior to works accurately delineate the approved clearing boundary to provide accuracy to the limits of the allowable clearing lines. • vehicles, machinery and personnel will be restricted to designated areas; • restricted speed limits within the subject site to 10km/hr and along the internal access road.		
Degradation of adjacent fauna habitat	• The battle-axe road between the property and the Yalgorup National Park will not be used as an access road.	A 20-60m vegetative buffer to the battleaxe road and the excavation area will be provided. Implementation of the EMP which will include: • Suitable surface water controls to ensure that it is contained within the excavation area; • No storage of chemicals or fuel will occur onsite; • Restrict clearing to the approved development envelope to avoid over clearing and to minimise indirect impacts to	Not applicable	No residual impacts to fauna as result of degradation to adjacent habitat are anticipated with the implementation of the proposed management measures.

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
		adjacent remnant vegetation • Weed management measures • Dieback management actions • dust control.		
Noise and vibration impacts	Not applicable	An EMP will be implemented which will include the following management measures: • Overburden and interburden dumps will be positioned where they can form screening barriers. • Maintain all plant in good condition with efficient mufflers and noise shielding. • Fit warning lights, rather than audible sirens or beepers, on mobile equipment wherever possible. • Truck movements limited from December to April. • Avoid the use of engine braking on product delivery trucks in built up areas.	Not applicable	No residual impacts to fauna as a result of noise and vibration are anticipated with the implementation of the proposed management measures.
Weeds and disease	• The battle-axe road between the property and the Yalgorup National	An EMP will be implemented which will include weed and	Not applicable	No residual impacts to fauna as a result of weeds and disease are anticipated with the

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual Impacts
	Park will not be used as an access road.	dieback hygiene management measures.		implementation of the proposed management measures.

7.7 Predicted Outcome

The following outcomes in relation to terrestrial fauna are anticipated with the implementation of suitable management measures which are contained within the EMP:

- No loss of habitat critical to the survival of species of conservation significance;
- No loss of conservation significant fauna at a species level; and
- No loss of important populations of conservation significant fauna.

There are no anticipated residual impacts associated with the Proposal in consideration of the following:

- It will not result in a change in the status of fauna of conservation significance;
- It will not represent a significant clearing of habitat types; and
- It will not significantly affect the regional distribution of fauna species.

In considering the outcome as described, the Proposal is expected to meet the EPA objectives for terrestrial fauna.

8 SOCIAL SURROUNDINGS

8.1 EPA Objective

The EPA's objective for social surroundings is to protect social surroundings from significant harm.

8.2 Policy and Guidance

The following policies and guidelines apply to Social Surroundings (Amenity):

- EPA Environmental Factor Guideline - Social surroundings (EPA 2016).
- Guidance Statement No. 3 – *Separation Distance Between Industrial and Sensitive Land Uses* (EPA 2005).

8.3 Receiving Environment

8.3.1 Visual Amenity

Pursuant to the *Town Planning Scheme No. 7* (the Scheme) the quarry is zoned 'Rural'. The quarry was historically and continues to be used for winter grazing by cattle. A road reserve runs along the eastern boundary of Lot 1002 and cuts Lot 1001. Lot 1002 was used as an airstrip for the aerial spreading of fertiliser and seed on local farming properties. The remaining remnant vegetation has previously been strip cleared and intensively grazed to increase the returns from grazing.

The Yalgorup National Park surrounds Lot 1002. The Yalgorup National Park is situated between Mandurah and Bunbury, approximately 100 km south of Perth. The linear park consists of a discontinuous vegetated area that runs from Tims Thicket in the north to Myalup in the south (refer to **Figure 2-2**).

The Lake Pollard walk trail is a 6 km trail which commences at the entrance to Martins Tank campground on Preston Beach Road North. The trail extends to an established bird hide on the southern side of Lake Pollard. The bird hide is north facing and is located in excess of one kilometre from the quarry. The original trail involved hikers retracing their steps back towards the campground. However, an alternative loop trail option may be used, which follows a fire break on private property (Lot 1001) and a rural road (Rural 3a pursuant to the Shire of Waroona's *Local Planning Scheme No. 7*) adjacent to the quarry, before following the Preston Beach Road North back to Martin Tank's campsite (refer to **Figure 8-1**).

The Martins Tank campground is used at all times of the year but more commonly in the spring, and summer public holidays. A campground exists at Martin's Tank where camping bays, barbecue and picnic facilities are present.

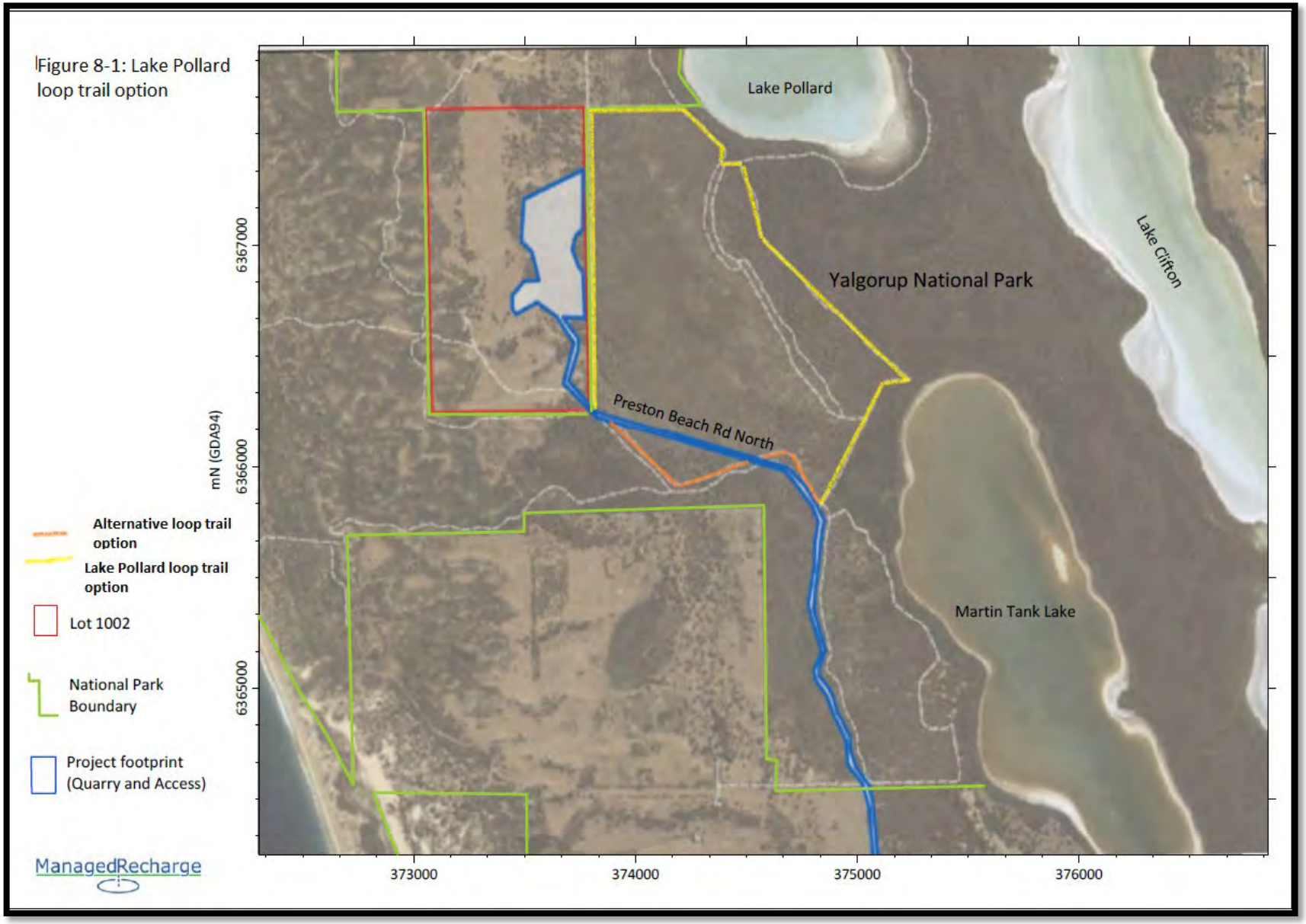


Figure 8-1: Lake Pollard loop trail option
Lake Pollard
Yalgorup National Park
Lake Clifton
Preston Beach Rd North
Martin Tank Lake
mN (GDA94)
6367000
6366000
6365000
373000
374000
375000
376000
Alternative loop trail option
Lake Pollard loop trail option
Lot 1002
National Park Boundary
Project footprint (Quarry and Access)
ManagedRecharge

Landscape Units

The landscape features of the locality (topography, vegetation and land use features) combine in various ways to create an area of relative visual uniformity that can be defined as visual landscape units. The visual landscape units that will be impacted by the Proposal include:

- Relatively flat pastoral lands:
  Characterized by flat land that has predominantly been cleared of vegetation and used for broad paddock grazing (refer to **Figure 8-2**); and
- Regrowth vegetation (following historical clearing):
  Characterised by regrowth vegetation in a predominantly Degraded condition (refer to **Figure 8-3**).

The Yalgorup National Park is associated with the following visual landscape units:

- Brackish and saline wetland system; and
- Riparian and woodland vegetation complexes.

The Yalgorup National Park visual landscape units will not be impacted by the Proposal given the location of the quarry (i.e. on rural land) and the natural screening features including a 20 – 60 m vegetative buffer on the property boundary and the presence of an elevated limestone ridge.

Figure 8-2: Typical rural setting in the Preston Beach locality.

Figure 8-3: Regrowth vegetation within Lot 1002.

Landscape Significance

Landscape significance combines the aesthetic quality of the landscape and viewer sensitivity to give a measure of relative importance of the landscape. Significant landscapes provide the opportunity for the highest enjoyment of the region's natural landscapes. Significant landscapes are the most vulnerable to change, resulting in visual impacts.

The Shire of Waroona's *Local Planning Strategy* maps the quarry within the *General Agricultural* area of the *Coastal Precinct* which has no provisions relating to visual amenity. Furthermore, the quarry does not contain any significant landscape features.

Views and Visibility

Potentially sensitive viewing locations are restricted to the portion of the walk trail loop option that traverses the adjacent unnamed rural road, and the firebreak abutting Lot 1001 (refer to **Figure 8-1**). **Appendix H** provides a series of photographs from the walk trail looking towards the proposed quarry.

The quarry is not visible from any other locations within the Yalgorup National Park, or residential dwellings.

The quarry is viewed within the context of the surrounding rural land. There are no views of the quarry from residential dwellings, significant routes or locations within the adjacent Yalgorup National Park (i.e. the bird hide or Martin's Tank campground).

Visual Sensitivity

Visual sensitivity is a measure of how critically a change in the existing landscape is viewed by people from different land use areas in the vicinity of the quarry.

In this regard, tourists and hikers generally have a higher visual sensitivity than other land use areas. This is because land uses with a higher visual sensitivity, such as recreational, use the scenic amenity values of the surrounding landscape and may be used as part of a leisure experience.

Notwithstanding, the visual sensitivity of any viewing location ranges from high to low depending on the following factors:

- Screening effects associated with intervening topography or vegetation – view from the unnamed road and the firebreak adjoining Lot 1001 to the quarry will be partially screened by existing vegetation (refer to **Appendix H**); and
- General orientation of the development to areas of significant landscape value – the quarry is located to the west of the areas of local landscape significance (i.e. Lake Pollard and Martin's Tank Lake). Viewing locations to these areas are orientated to the east, away from the quarry, and therefore these views will not be impacted.

8.3.2 Setbacks

Generic separation distances between sensitive and industrial land uses have been developed by the EPA in recognition that a site-specific study to determine a buffer may not always be necessary. These are referred to as Guidance Statement No. 3 *Separation Distances between Industrial and Sensitive Land Uses* (2005) (herein referred to as EPA 2005) and were developed based on the experience of the DWER's and other regulatory authorities, and limited site-specific quantitative scientific assessment. A site-specific technical study to determine separation distances is generally only expected in the case of a major heavy industrial estate, or a general industrial estate where emissions may result in cumulative impacts (EPA 2005).

In accordance with EPA 2005, the recommended separation distance between an extractive industry and a sensitive receptor is 300-500 m. Separation distances from the quarry to sensitive receptors are as displayed in **Figure 8-5** and provided below follows:

- Residential dwelling – 1 km east of Lake Clifton;
- Lake Pollard bird hide – 1 km east of the quarry;
- Original Lake Pollard walk trail – 800 m east of the quarry;
- Loop trail option which traverses a rural road and Preston Beach Road North – 20 m east from the quarry; and
- Martin's Tank campground – 2 km south-east of the quarry.
- Martin's Tank campground – 509 m from Preston Beach Road North.

The separation distances from sensitive receptors to the extraction area boundary comply with EPA 2005, excluding a portion of the loop trail option. However, the loop trail option traverses designated roads immediately adjacent to private property, and road users are not deemed sensitive receptors pursuant to the EPA Guidance Statement (2005). Accordingly, no specific dust and/or noise monitoring is required.

8.3.3 Noise

Lot 1002 is a mixed-use pastoral enterprise including grazing of cattle and growing fodder crops. Periodically during the year there are different activities undertaken on the farm including ploughing, using seed drills, harvesting and feeding out. All the activities involve the use of heavy machinery.

The baseline existing noise environment has been characterised through noise monitoring. The baseline noise monitoring was carried out over the period 4th to 11th June 2020 (refer to **Appendix I**).

Weather conditions were obtained from the Bunbury Bureau of Meteorology (BOM) web site, this being the nearest available weather monitoring site.

The monitoring period covered a range of wind conditions, including low windspeed conditions, which typically are the wind conditions where greatest sound propagation occurs and also the condition when

background noise is lowest. The lower background noise levels associated with low wind speeds are because wind induced noise generated by the tree canopy are minimized (Herring Storer Acoustics 2020).

From the statistical monitoring (refer to page 2 and 3 of **Appendix I**), it is evident that the subject site is a relatively quiet location, with the typical range of noise levels during the lower wind-speed conditions being:

- LA90 20 – 25 dB(A)
- LA10 30 – 35 dB(A)

The main sources of background noise are wind induced tree noise, fauna and insects, coastal wave noise and traffic noise from Forrest Highway (Herring Storer Acoustics 2020).

8.3.4 Air Quality

SLR Consultants completed an Air Quality Impact Assessment to determine potential air quality impacts associated with the development of the quarry (refer to **Appendix J**). The key pollutants associated with mining and extractive industries are suspended particulate matter and dust deposition. In common usage, the terms “dust” and “particulates” are often used interchangeably. The term “particulate matter” refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is terms total suspended particulate (TSP) (SLR Consultants 2021).

Particulate matter has the capacity to affect health and to cause nuisance effects and is categorised by size and/or by chemical composition. The potential for harmful effects depends on both. The particulate size ranges are commonly described as:

- TSP – refers to all suspended particles in the air
- PM_{10} – refers to all particles with equivalent aerodynamic diameters of less than 10 µm
- $PM_{2.5}$ – refers to all particles with equivalent aerodynamic diameters of less than 2.5 µm
- Deposited dust – refers to particulate that settles out over a given area and time under the influence of gravity.

Baseline Ambient Dust Levels

Emission Assessments Pty Ltd undertook an investigation into baseline ambient dust levels at the subject site and surrounding sensitive receptors from 04/06/2020 to 11/09/2020 (refer to **Appendix K**). These sensitive receptor locations include:

1. Martins Tank Camp Site
2. Lake Pollard walk trail loop
3. Pollard Lake Bird Hide
4. Residential Dwelling South
5. Site boundary of Lot 1002

The monitoring locations are provided on **Figure 8-4**.

The monitoring program was initiated to quantify the level of ambient dust at these premises over a period of three months (90 days) between the following dates:

- Thursday 4th June 2020 – Friday 3rd July 2020
- Monday 13th July 2020 – Thursday 13th August 2020
- Thursday 13th August 2020 – Monday 11th September 2020

Monitoring was undertaken in accordance with '*AS/NZ 3580.10.1:2003 - Determination of Particulate Matter - Deposited matter - Gravimetric method*.' A Standard Dust Deposition Gauge was used for the dust deposition rate measurements over defined exposure periods of 30 ± 4 days (Emission Assessments 2020).

The gauge was comprised of an open-faced gauge positioned in an upwards orientation and mounted on a tripod stand so that the top of the deposition gauge is situated at a height of 2.0m ±0.2m. The gauge comprises a wide-mouth collection funnel mounted on a collection vessel. Prior to commencement of sampling a measured 10.0mL aliquot of copper sulphate solution was added to the collection vessel to prevent algal growth which may affect the measured results (Emission Assessments 2020).

Airborne particles entrained in the local ambient air are deposited in the gauge via natural processes (wind, rainfall etc.) and are passively collected in a bottle along with any accumulated rainwater.

Upon completion of each monitoring period the inside surfaces of the funnel were rinsed with deionised water to remove any dust collected. This was combined with the contents of the collection vessel, which was then stoppered and labelled with a unique identification number. The bottles were then submitted to MPL Laboratories, a NATA accredited laboratory, for analysis of total solids. The total solids results are expressed as a deposition rate of grams per square meter per month (g/m2/month) and total grams per sample (g) (Emission Assessments 2020).

Figure 8-4: Dust monitoring locations.

The results for dust deposition have been summarised in **Table 8-1.**

Table 8-1. Summary of results for dust deposition monitoring (Emission Assessments 2020).

Position	Analyte	Unit	04/06/2020 to 02/07/2020	13/07/2020 to 13/08/2020	13/08/2020 to 11/09/2020
1	Total Solids	g/m^2/month	-	5.8	7.4
	Dust Weight	g	-	0.108	0.130
2	Total Solids	g/m^2/month	-	3.0	7.4
	Dust Weight	g	-	0.056	0.131
3	Total Solids	g/m^2/month	13	2.8	57
	Dust Weight	g	0.215	0.052	1.00
4	Total Solids	g/m^2/month	12	15	4.3
	Dust Weight	g	0.221	0.279	0.076

The prevailing wind direction during the sampling period was westerly. It should be noted that the proposed operations intend to operate between the drier months of December to April, during which the prevailing wind direction changes to southerly and rainfall is significantly less (Emission Assessments 2020).

Monitoring conducted during this period in 2020 is used to set a baseline of representative normal conditions and levels of dust prior to any potential additional dust generated from proposed quarry activities (Emission Assessments 2020).

Figure 8-5: Sensitive receptors.

Air Quality Assessment Results

Emissions from the Proposal were modelled using a combination of the TAPM, CALMET and CALPUFF models. The predicted maximum 24-hour and annual average PM_{10} concentrations at discrete receptors are presented in **Table 8-2.** The cumulative concentrations include the estimated background concentrations and indicate that there are no exceedances of the 24-hour or annual average PM_{10} criteria for both the controlled and uncontrolled emissions scenarios (SLR Consultants 2021).

Table 8-2 Predicted Incremental and Cumulative 24-Hour and Annual Average PM10 Concentrations.

Scenario	Receptor ID	Increment (µg/m³)		Cumulative (µg/m³)	
		Maximum 24-Hour	Annual	Maximum 24-Hour	Annual
Controlled	R1	3.5	0.21	23	17
	R2	2.4	<0.1	22	17
	R3	2.2	<0.1	21	17
	R4	4.3	0.10	23	17
Uncontrolled	R1	3.5	0.21	23	17
	R2	2.4	<0.1	222	17
	R3	2.2	<0.1	21	17
	R4	4.3	0.10	23	17
			Criteria	**50**	**25**

The predicted maximum 24-hour and annual average $PM_{2.5}$ echo the results of the PM_{10} predictions with no increase in incremental impact at the sensitive receptors under the controlled scenario condition when compared with controlled scenario because impacts from the Proposal at the sensitive receptors are negligible. The incremental impacts are predicted to be low relative to the estimated background concentrations and therefore there is unlikely to be any significant elevation in ambient $PM_{2.5}$ concentrations due to the Proposal (SLR Consultants 2021).

All off-site cumulative 24-hour and annual average ground level PM_{10} and $PM_{2.5}$ concentrations are predicted to comply with the adopted criteria at the nearest sensitive receptors or that the incremental impact predicted for the Proposal operations is negligible compared to the assumed background levels. Dust deposition rates are also predicted to comply with the criterion at the nearest sensitive receptors (SLR Consultants 2021).

Additionally, the prevailing wind conditions during the summer months when the Proposal will be operating are generally from the southern directions meaning the nearest sensitive receptors will rarely be down wind of the Proposal and therefore unlikely to be impacted by dust emissions (SLR Consultants 2021).

The Lake Pollard walk trail loop, which runs directly alongside the Proposal, is predicted to be negligibly impacted by emissions or dust from quarry operations. It is highly unlikely users of the trail will spend greater than an hour at these locations and therefore their 24-hour exposure to PM_{10} and $PM_{2.5}$ would be significantly less than the than the PM_{10} and $PM_{2.5}$ criteria. Additionally, areas of the walking trail that are not located along Preston Beach Rd North would be minimally impacted as indicated by the isopleth illustrated in **Figure 8-6** (SLR Consultants 2021).

Figure 8-6 Incremental 24-Hour Average PM_{10} GLCs (SLR Consultants 2021)

8.4 Potential Impacts

The Proposal has the potential to impact social surroundings during construction and operation phases as follows:

- Visual impacts to hikers using a portion of the loop trail option.
- Noise disturbance to hikers traversing the roads associated with the loop trail option from December to April.
- If not adequately controlled, dust can cause nuisance risks to hikers.
- Amenity and safety issues for hikers walking along Preston Beach Road North.

8.5 Assessment of Impacts

8.5.1 Visual Amenity

From a visual perspective, the key project element will be the operational quarry, comprised of approximately two hectares throughout the life of the quarry (in consideration of progressive rehabilitation). The operational quarry will be cleared of vegetation, contain a single front-end loader and a small mobile screening/crushing plant.

The Proposal will not result in any direct impacts to the landscape values of the Yalgorup National Park given intervening topography and screening vegetation. The quarry will only be visible from an elevated location along the loop trail option when looking west (away from Yalgorup National Park). Furthermore, the quarry will be located in existing rural land which has largely been cleared of vegetation.

Aside from this single location, the quarry will not be visible from key viewpoints, due to it being below the visual plane of viewers, coupled with the effect of vegetation screening from existing vegetation. It is unlikely that the quarry will constitute a high visual impact given its location in an existing rural setting, vegetative screening and intervening topography.

8.5.2 Noise

Residential receptors in the vicinity have background noise levels typical of a rural setting. These receptors may, if the equipment has strong characteristics such as tonality, be exposed to noise characteristic from limestone extraction operations. Where noise emissions are dominant, loader crusher and screen noise emissions can exhibit tonal characteristic. At distance, loader noise emissions are generally not tonal. The operation of an excavator and trucks are unlikely to exhibit noise characteristic at receptors (Herring Storer Acoustics 2020).

Key receptors and influencing factors have been determined based on rural land use zoning near the receptors. The identified receptors and calculated influencing factors / assigned levels are listed in **Table 8-2**. Note that only residential receptors have assigned levels determined by the influencing factor. All other receptor types have fixed assigned levels (Herring Storer Acoustics 2020).

R1 residence is a “Noise sensitive premises: highly sensitive area”. The rural properties at distances greater than 15m from the dwellings are “Noise sensitive premises: any area other than highly sensitive area”. The Martins Tank campground is an official signed campground, however there are no accommodation buildings, so it is a “Noise sensitive premises: any area other than highly sensitive area”. Similarly, the park area used for hiking and the bird hide is also classified as “Noise sensitive premises: any area other than highly sensitive area” (Herring Storer Acoustics 2020).

Noise levels were predicted using the acoustic software "SoundPlan" for worst case wind conditions as per the DER '*Draft Guideline on Environmental Noise for Prescribed Premises (May 2016)*' for day operation.

Various operating scenarios were modelled. These were:

- Initial Extraction at ground surface
- Extraction at northern end of site
- Extraction near eastern boundary

It is noted that the subject site will only be operated during the period December to April, as limestone is extracted and trucked directly for use. Agricultural limestone is usually applied once crops have been harvested. The prevailing wind conditions for summer are predominantly easterly winds throughout the morning and mid-day period, with south-westerly winds in the afternoon (Herring Storer Acoustics 2020).

Noise levels were predicted to identified receptor locations. These are shown in **Table 8-3.**

Table 8-2. Predicted sound levels during worst case conditions (Herring Storer Acoustics 2020).

Receptor	Weekday 'assigned level', LA10 dB(A)	Initial Extraction Sound Level, dB(A)	North Extraction Sound Level, dB(A)	West Boundary Extraction Sound Level, dB(A)	Comment
R1 – Rural residence to the south	45	20	35	18	Complies
R2 - > 15m from R1 dwelling at property boundary	60	39	37	41	Complies
R3– Martins Tank campground	60	35	33	31	Complies
R4– Martins Tank campground	60	27	25	23	Complies
R5 – Bird hide (lakes edge)	60	36	31	31	Complies
R6 – hike trail / park boundary	60	59	49	58	Complies

Acoustic modelling for the crusher and screening plant within 100m of the eastern boundary incorporates a 6m high stockpile on the eastern side of the crusher and screen (Herring Storer Acoustics 2020).

The maximum predicted noise emission at the bird hide and Martins Tank campgrounds under conditions of maximum sound propagation is 36 dB(A). It is noted however, that during the extraction months December – April, prevailing winds are easterly or south westerly, therefore much of the extraction period noise emissions at these locations will be reduced (Herring Storer Acoustics 2020).

The acoustic modelling shows that the proposed sand and limestone extraction will comply with the requirements of the *Environmental Protection (Noise) Regulations 1997*.

8.5.3 Dust

The construction and operational actions associated with the Proposal have the potential to generate dust that, if not adequately controlled, can cause nuisance risks to hikers. Excavation of the sand itself is not expected to be a significant source of dust emissions given the relatively coarse composition of the material, and as demonstrated in the Air Quality Assessment (SLR Consultants 2021). In-pit operations also tend to generate less dust than surrounding activities due to the reduced airflow within the pit. The removal and replacement of topsoil material has the highest risk associated with dust generation due to the large volumes of material involved and generally lower levels of soil moisture.

In accordance with the DWER's "*A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities*", a risk assessment for dust emissions at the quarry has been prepared.

For a site that is generating uncontaminated dust, such as extractive industry sites, the site classification chart in Appendix 1 of the DWER guideline can be used for assessing the site risk. Appendix 1 also details the provisions and contingency arrangements for dust management which apply to each site classification score.

The site classification assessment is provided below.

Part A. Nature of site

Item	Score Options				Score
1.Nuisance potential of soil when disturbed	Very low - 1	Low – 2 *Material is of course composition*	Medium - 4	High - 6	2
2. Topography and protection provided by undisturbed vegetation	Sheltered and screened - 1	Medium screening – 6 *Vegetated buffers will be provided on all boundaries and pit will not be exposed*	Little screening - 12	Exposed and wind prone - 18	6
3. Area of site disturbed by the works	Less than 1ha - 1	Between 1 and 5ha – 3 *Only 2ha will be excavated at any time.*	Between 5 and 10ha - 6	More than 10ha - 9	3
4. Type of work being done	Roads and trenches - 1	Roads, drains and medium deep sewers - 3	Roads, drains, sewers and partial earthworks - 6	Bulk earthworks – 9 *Sand extraction*	9

Total score for Part A	20

Part B. Proximity of site to other land uses

Item	Score Options				Score
1.Distance of other land uses from site	More than 1km - 1	Between 1km and 500m – 6 *Approximately 700m*	Between 100m and 500m - 12	Less than 100m - 18	6
2. Affect of prevailing wind direction (easterly) on other land uses	Not affected - 1	Isolated land uses affected by one wind direction – 6	Dense land uses affected by one wind direction – 9 *The prevailing easterly wind in summer*	Dense/sensitive land uses highly affected by prevailing winds - 12	9
Total score for Part A					12

Site Classification Score (A x B) = 240

*Classification 2 (score between 200 and 399, considered **low risk**)*

Based on the DWER's guideline and the results from the Air Quality Assessment (SLR Consultants 2021), the Proposal is considered a low risk to sensitive receptors.

Minimal off-site impacts have been predicted and therefore no instrument-based air quality monitoring programs are recommended.

8.5.4 Preston Beach Road North

As discussed in **Section 8.3.1**, a small section of the Lake Pollard loop trail option accesses Preston Beach Road North.

There is no obvious reason for directing hikers along the road and this option does present existing safety issues. An existing track (which was formerly Preston Beach Road North) could be used as an alternative (refer to **Figure 8-1**) which would reduce safety issues and improve the hikers experience.

The proponent proposes to undertake consultation with the DBCA regarding the above proposal and subject to approval, would commit to undertaking trail construction works as a component of the road upgrade works.

Lime products are to be transported from the quarry from December to April. This will involve the use of semi-trailer truck or rigid (8) wheeler trucks to a 5 axle dog trailer. It is calculated that "as of right" 19 m long semitrailer combinations with approximately 30 tonne payloads would equate to 1563 loads from quarry. That is a maximum of 10 loads per day which equates to a maximum of two movements per hour.

In order to determine the suitability of the Preston Beach Road North as a transport corridor associated with the Proposal, Greenfield Technical Services was commissioned to undertake a road assessment in June 2014 (refer to **Appendix D**). The assessment determined that a road network upgrade is required for Preston Beach Road North to enable the necessary increase in truck traffic, including grading of the road,

trimming of roadside vegetation to improve sight-lines, 50 m realignment of a public walking trail (if the DBCA agree to this approach), and intersection and signage upgrades.

In 2015 the Shire of Waroona in consultation with the Department of Biodiversity, Conservation and Attractions (DBCA) undertook road maintenance works to Preston Beach Road North to accommodate caravans and motorhomes. This involved the use of heavy machinery and it is understood that vegetation pruning was undertaken. DBCA has also identified upgrades will be required for any further increased traffic. The Greenfield Technical Services report predates these road maintenance works and therefore they are not considered in the report. .

The Greenfield Technical Services report notes that Preston Beach Road North is a public road and therefore there is no restriction on 19 metre semi-trailer trucks. However, the Shire has erected a sign on the road stating “Closed to all vehicles Class 3 and over”. The proponent has consulted with the Shire of Waroona regarding this matter. The Shire have provided written advice that the required trucks could be used on Preston Beach Road North as an exemption to the local by-law, with conditions.

While further consultation with the Shire of Waroona and DBCA will be required, the proposed road upgrades (as per Option 2B of the Greenfield Technical Services report (**Appendix D**)), which will provide a safer road for all users; will include the following:

- The road network will be upgraded to take the required truck traffic.
- Upgraded intersection work and signage.
- Trimming of road vegetation to increase sightlines.
- Grading of the road.
- Additional signage.

For further consideration:

- Carting will be restricted to December to April inclusive which will avoid the busy spring season.
- During transport, a water cart will be provided on site to ensure the road is treated for dust as required.
- Speed restrictions will be placed on trucks associated with the Proposal.

8.6 Mitigation

8.6.1 Visual Amenity

The numerous mitigation measures incorporated in the design and operating plans for the Proposal will reduce the visual effect and mitigate the visual impact on sensitive viewing locations.

Design and onsite mitigation treatment developed for the Proposal are as follows:

- The siting of the quarry between existing topographic features to achieve screening;
- Timely construction and implementation of progressive rehabilitation during mining operations to reduce visual impacts;
- Retention of existing vegetation to provide screening; and
- Reducing the extent of clearing and disturbance.

8.6.2 Noise

The topography of the quarry lends itself to reducing any noise emissions to hikers to the east. The high ridges on the eastern sides will act as noise bunds reducing any noise travelling excessively in those directions.

The proponent will also implement noise management measures (refer to **Appendix B**) to further reduce potential noise emissions which will include the following:

- Overburden and interburden dumps will be positioned where they can form screening barriers.
- Maintain haul road and hardstand surfaces in good condition (free of potholes, rills and product spillages) and with suitable grades.
- Maintain all plant in good condition with efficient mufflers and noise shielding.
- Fit warning lights, rather than audible sirens or beepers, on mobile equipment wherever possible.
- No excavation works or truck movements on Sunday or public holidays.
- Excavation and truck movements limited from December to April.
- Avoid the use of engine braking on product delivery trucks in built up areas.
- Provide a complaints recording, investigation, action and reporting procedure.

8.6.3 Dust

In accordance with the DWER's "*A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities*", for a low risk site the following management and mitigation measures are required:

- Provisions:

  The developer shall supply a contingency plan to the local government, which shall detail the activities to be undertaken should dust impact occur.

- Contingency arrangements:

  Include an allowance for water-cart operation, wind fencing and surface stabilisation during construction period for the purposes of dust suppression.
  All areas of disturbed land should be stabilised to ensure that the disturbed area exposed at any time is kept to a practical minimum.

- Monitoring requirements:

  Complaints management system in place.
  Notice to be erected at the site providing contact details of the person to be contacted.

In an attempt to reduce the potential impacts associated with dust emissions from the Proposal, the proponent has committed to undertaking the following:

- Provide vegetated buffers to reduce dust movement on the eastern boundary of Lot 1002;
- Provide speed limits for vehicles;
- Utilise a water cart onsite and along Preston Beach Road North as required; and
- Undertake clearing/excavations on a staged basis, exposing only 2 ha at any point in time. Progressive rehabilitation of each stage will also help to prevent the area of exposed surfaces.

Furthermore, the topography of the quarry will lend itself to reducing any dust emissions to hikers walking along the rural road to the east of the quarry. The high ridges on the eastern sides will act as bunds reducing any excess dust travelling in those directions.

While the potential impacts to amenity from dust emissions are considered low, dust suppression measures will be implemented, as provided within **Appendix B**.

8.7 Predicted Outcome

The Proposal has the potential to cause the following impacts to social surroundings:

- Minor visual amenity impacts from a location along the loop trail option;
- Minor nuisance dust impacts to hikers walking directly past the quarry;
- Noise disturbance to hikers walking directly past the quarry and along Preston Beach Road North.

Through the implementation of the EPA's mitigation hierarchy, the residual impacts of the Proposal to social surroundings are not considered significant. As such, there are no residual impacts and offsets are not required.

In consideration of the proposed management measures, the proponent considers that this Proposal can be managed to meet the EPA's objective for social surroundings.

9 OTHER ENVIRONMENTAL FACTORS OR MATTERS

Other relevant environmental factors for the Proposal comprise the following:

- Subterranean Fauna.
- Landforms.
- Air Quality.
- Other matters - consistency with government environment policy.

Due to the low level of impact, application of industry standard controls and other regulatory mechanisms, these factors are not expected to be required to be assessed in detail by the EPA. **Table 9-1** provides a summary of the impacts, mitigations and outcomes for these factors.

Table 9-1. Other environmental factors.

Aspect	Description
Subterranean Fauna	
EPA objective	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.
Potential impacts	• Potential impacts to subterranean fauna through hydrogeological alterations. • Potential impacts to subterranean fauna through removal of potential habitats.
Mitigation	**Avoid:** A reconnaissance survey to investigate the potential presence of cavities within the limestone that could provide habitat for subterranean fauna was undertaken by Landform Research (2016). This report found that "*there is no evidence of cavities or karst which could lead to the development of stygofauna or troglofaunal and there is no evidence of significant potential for voids and cavities which favour these organisms*". Stygofauna would be present at the water table if any cavities occurred at that location, however a 4 metre vertical buffer to the water table is to be maintained therefore impacts on these communities, if they existed in the area, are unlikely to occur (Landform 2016). **Minimise** Not applicable.
Outcomes	The Proposal would not affect subterranean fauna values.
Landforms	
EPA objective	To maintain the variety, integrity, ecological functions and environmental values of landforms
Potential impacts	• Post-mining landforms are inconsistent with the surroundings. • Post-mining landforms are unstable.
Mitigation	**Avoid** Not applicable **Minimise**

Aspect	Description
	The limestone will be extracted from a ridge and will result in the ends of the two dunes being reshaped down to the elevation of the intervening swale. The main ridge line will not be modified but maintained. Management measures for constructed landforms are detailed in the preliminary Rehabilitation and Closure Plan.
Outcomes	Due to the lack of impact on existing landforms, and the predicted low impact of constructed landforms, it is considered that the environmental objective for landforms will be met.
Air Quality	
EPA Objective	To maintain air quality and minimise emissions so that environmental values are protected.
Potential Impact	• Combustion emissions affecting air quality.
Mitigation	**Avoid** The requirement to operate diesel generators on-site will be reviewed and avoided if possible. **Minimise** The primary source of greenhouse gas (GHG) emissions would be the onsite diesel generators which would only be used sporadically. In addition, there would also be a range of mobile fleet that would contribute greenhouse gas emission. Haulage routes have been minimised as far as practicable. **Scope 1 Green House Gas Emissions** Scope 1 greenhouse gas emissions will be produced as a result of operating generators (if required) and machinery onsite which consume diesel fuel. The following formula was adopted to determine the Scope 1 greenhouse gas emissions: E = Q x EC x EF/1000 Where: E= the amount of estimated greenhouse gas emissions in tonnes. Q= the volume of fuel used (40 kL) EC= the heat content of specific fuel type (38.6 GJ/kL) EF= the greenhouse gas emission factor specific to fuel type (69.2) Applying the above formula, the annual greenhouse gas emissions from diesel use is approximately 106 tCO_2.
Outcome	The Proposal would not affect a significant impact on air quality values.
Other Matters	**State Planning Policy 2.0: Environment and Natural Resources Policy** This policy provides for the protection of all natural resources under a number of sections, the most relevant to this proposal being Section 5.7 Mineral Petroleum and Basic Raw Materials. The proposal is consistent with this policy in that the extraction of the resources will be followed closely by rehabilitation. **South Metropolitan Peel Sub-Regional Planning Framework (WAPC 2018)** The Framework outlines twelve key principles, including the following two which are relevant to this proposal: • *Avoid, protect and mitigate impacts on environmental attributes (with an emphasis on avoiding and protecting) when allocating proposed land uses, or address impacts through*

Aspect	Description
	an improved conservation estate where those impacts cannot be avoided or mitigated, especially the Peel-Harvey Catchment area. • *Identify ultimate land uses for industrial and public purposes sites, while promoting access to finite basic raw materials, through the staging and sequencing of development." (WAPC 2018)*. Section 3.7 Environment and landscape outlines the following Objective: *To preserve and enhance the environmental and landscape values of the sub-region for future generations to enjoy*. Protected environmental landscape features within the sub-region include: • Lake and wetland chains and portions of limestone ridges that parallel the coast. • The coastal lake system and tuart forest south of the Peel-Harvey estuary. The quarry is classified at 'open space investigation – nature/passive recreation' under the framework. These areas have been subject to preliminary assessment however require further investigation to be undertaken prior to consideration for future protection and/or reservation under the MRS or PRS. The classification of these areas should not be construed as the WAPCs support for future protection and/or reservation, as this will depend upon the outcome of further investigations." Section 3.8 Natural Resources outlines the following objects: To manage the availability and use of natural resources to ensure existing and potential land uses can be balances against broader environmental outcomes. In this section Basic Raw Materials are described as 'a finite resource and access to basic raw materials with cost-effective proximity to future growth areas is important to housing affordability and moderating the cost of future infrastructure projects". The proposed quarry site is mapped as a Basic Raw Material in this section.

10 HOLISTIC IMPACT ASSESSMENT

The preliminary key environmental factors relevant to the Proposal are:

- Inland waters.
- Flora and vegetation.
- Terrestrial fauna.
- Social surroundings.

These factors are addressed individually in **Sections 5** to **8** which includes predicted outcomes in relation to the EPA's environmental objectives, after the application of the EPA's mitigation hierarchy (avoid, minimise, rehabilitate).

The linkages between environmental factors require consideration and management to achieve good environmental outcomes. **Table 10-1** provides a summary of the key linkages between the preliminary key environmental factors and the proposed mitigation that reflect the linkages (shared with mitigation proposed for individual environmental factors).

The linkages between environmental factors have been identified and the mitigation proposed in this ERD is considered sufficient to meet the principles contained in the EP Act and the EPA's objectives for individual factors. No significant residual impacts have been identified as a result of this assessment.

The impacts identified as a result of this assessment are:

- Clearing of 14.6 ha of regrowth vegetation in a Degraded to Good condition, which includes:
  - 0.5 ha of the Tuart Woodland PEC (Degraded condition); and
  - 1.2 ha of fragmented Tuart Woodland PEC (Good condition).

Rehabilitation of the entire clearing footprint (comprised of vegetation in a predominately Degraded condition) will be undertaken on a progressive basis, denoting that there will no net loss of vegetation. Where possible, management and mitigation measures have been considered from a holistic perspective.

Table 10-1. Key linkages between environmental factors.

Factor	Key Linkage	Mitigation Measures
Inland water	• Habitat for fauna (including subterranean fauna). • Support flora and vegetation.	• No storage of chemicals or fuel onsite.
Flora and vegetation	• Habitat for terrestrial fauna. • Maintenance of subterranean fauna habitat. • Maintenance of inland water quality.	• Vegetation clearing has been reduced and setbacks have been provided. • Rehabilitation program is proposed with the objective to provide a self-sustaining ecosystem (in better condition than pre-mining).
Terrestrial fauna	• Disperse and pollinate flora and vegetation. • Contribute to health of ecosystem.	
Visual amenity	• Maintain biological values	

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APPENDICIES

Appendix A. Environmental Scoping Document

Available at http://www.epa.wa.gov.au/proposals/limestone-and-sand-quarry-lot-1002-preston-beach

Appendix B. Environmental Management Plan

Appendix C. Rehabilitation and Mine Closure Plan

Appendix D. Road Assessment (Greenfields Technical Services 2014)

Appendix E. Hydrological Assessment (Managed Recharge 2021)

Appendix F. Flora, Vegetation and Fauna Survey (Natural Area 2019)

Appendix G. Targeted Fauna Survey (Harewood 2020)

Appendix H. Visual Record of Quarry Views

Appendix I. Noise Assessment (Herring Storer 2020)

Appendix J. Dust Assessment (Emission Assessments 2020)

Appendix K. Appendix K. Air Quality Impact Assessment (SLR Consultants 2021)