Covalent Lithium Earl Grey Lithium Project

ENVIRONMENTAL REVIEW DOCUMENT
ASSESSMENT NO. 2123

Prepared by Strategen Environmental Consultants Pty Ltd
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Covalent Earl Grey Lithium Project

Environmental Review Document
Assessment No. 2123

January 2019
Version 6.0

Endorsement:

Colyn Louw, GM Organisational Development, on behalf of Covalent Lithium Pty. Ltd Level 18, 109 St Georges Terrace Perth, WA 6000 Document Control No. WAL18204_01 R001 Rev 6 Version 6.0, January 2019	Signed: Date: 18/1/2019

Invitation to make a submission

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

Covalent Lithium Pty. Ltd (the Proponent) are proposing development of the Earl Grey Lithium Project (the Proposal). A large, economic pegmatite–hosted lithium deposit was discovered in 2016. The deposit is situated at the previously abandoned Mt Holland mine site, located approximately 105 km south–southeast of Southern Cross in the Yilgarn Mineral Field of Western Australia. The Proposal would comprise open cut mining and processing of lithium ore. The mining proposal involves disturbance of 660 ha of land, including new clearing of up to 392 ha of native vegetation, which is habitat for significant fauna species.

The Environmental Review Document 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 **4 weeks** from **11 February 2019**, closing on **11 March 2019**.

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 Environmental Review Document, 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 Environmental Review Document.

When making comments on specific elements in the ER document:

- 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 page, 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: **11 March 2019.**

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 10, Joondalup DC, WA 6919, or
- delivered to: Environmental Protection Authority, 8 Davidson Terrace, Joondalup WA 6027.

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

Executive summary

Covalent Lithium Pty Ltd (the Proponent), a joint venture between Kidman Resources Limited (Kidman) and Sociedad Química y Minera (SQM), are proposing development of the Earl Grey Lithium Project (the Proposal). A large, economic pegmatite–hosted lithium deposit was discovered by Kidman in 2016. The deposit is situated at the previously abandoned Mt Holland mine site, located approximately 105 km south–southeast of Southern Cross in the Yilgarn Mineral Field of Western Australia. The site was operated as a gold mine between 1988 and 2001. The historic Mt Holland mine site comprises of open pits, an underground mine, a processing plant, waste rock dumps, tailings storage facilities (TSF) and other associated infrastructure. The Mt Holland mine site is largely unrehabilitated and is currently a liability of the State of Western Australia.

The Proposal comprises open cut mining and processing of lithium ore to upgrade to a concentrate and subsequent transport of a lithium concentrate to an existing Western Australian port for export to overseas markets or to a future proposed lithium refinery in Kwinana.

The Development Envelope covers an area of 1984 ha, with a Proposal footprint of 660 ha. The Proposal has been designed to maximise the use of existing disturbance with 40% of the Proposal located on 268 ha of existing disturbance associated with the historical abandoned Mt Holland mine site. The Proposal will require clearing of 392 ha of native vegetation for excavation of a new mine pit, storage of waste rock in new dumps and other ancillary infrastructure, including a new airstrip. Clearing of native vegetation and rehabilitation will occur progressively over a 40 year mine life.

Table ES1 provides a summary of the Proposal. Table ES2 provides a summary of potential impacts, proposed mitigation and outcomes for the Proposal.

Surveys of flora and vegetation undertaken by Mattiske (2017, 2018) and terrestrial fauna surveys by Western Wildlife (2017) have identified and confirmed the presence of conservation significant species including Ironcaps Banksia (*Banksia sphaerocarpa* var. *dolichostyla)*, Chuditch and Malleefowl, within and surrounding the Development Envelope. The site layout has been designed to avoid and minimise direct and indirect impacts to these conservation significant species. Further, the Proposal will not substantially reduce the extent of any local vegetation type or habitat within the Southern Cross area.

Stakeholder consultation has been undertaken throughout planning for the Proposal. Consultation will continue to develop as the Proposal progresses into the detailed design, construction and operational phases.

The Proposal can be implemented without significant impacts on the health, diversity or productivity of the environment. With the application of environmental management plans the Proposal will avoid or minimise impacts on identified environmental values. Potential residual impacts on Chuditch and Malleefowl habitat will be addressed through the application of a direct offset.

Overall, the Proposal is considered to pose a relatively low risk to key environmental factors, significant fauna and flora species and will achieve a net environmental benefit through rehabilitation of historic disturbance, contribution of scientific knowledge through implementation of monitoring programs, application of environmental offsets and contributions to conservation management through feral animal monitoring and control, considered one of the greatest risks to conservation significant species in the region.

Table ES1: Summary of the Proposal

Proposal title	Earl Grey Lithium Project
Proponents name	Covalent Lithium Pty. Ltd (Covalent).
Short description	This Proposal is for the development of an open cut lithium mine within the abandoned brownfield Mt Holland mine site, located approximately 105 km south–southeast of Southern Cross, Western Australia. The Proposal footprint covers an area of 660 ha with 392 ha of new clearing and 268 ha of existing disturbance with a life of mine of up to 40 years.

Element	Existing Disturbance (ha)	Proposed increase (this approval) (ha)	Proposed extent (total) (ha)
Mine and associated infrastructure (including waste rock dumps, tailings storage facility, airstrip, processing plant, accommodation village, wastewater treatment plant, landfill, water storage, explosives magazine, coreyard, topsoil stockpiles, power generation plant, workshop, admin facilities, pipelines, power lines, roads etc.).	268	392	660

The key environmental factors, the impacts of the Proposal and mitigation actions to address potential residual impacts are summarised in Table ES2. Based on the mitigation and management measures proposed, the Proposal is considered to meet the EPA's objective for relevant environmental factors.

Table ES2: Summary of potential impacts, proposed mitigation and outcomes

Element	Description
Flora and vegetation	
EPA objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.
Policy and guidance	• Environmental Factor Guideline – Flora and vegetation (EPA 2016a). • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment. Policies and guidelines prior to 13 December 2016 (EPA 2016b).
Potential impacts	• further loss and fragmentation of native vegetation and habitat.
	• spread of weeds and alteration of fire regimes.
	• dust deposition on vegetation from mining and related activities.
	• impact to flora and vegetation from overspray of hypersaline water used for dust suppression.
	• changes to vegetation structure and composition through altered surface drainage flow patterns.
	• impact to flora and vegetation from spillage of tailings, hypersaline water and hydrocarbons.
Mitigation	Avoid:
	• all populations of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) will have a 50 m buffer and development of new infrastructure within the buffer will be avoided if possible • avoid accidental clearing though implementation of an internal clearing permit procedure and preclearance surveys. • implement *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) specific measures that include avoidance, buffers and monitoring protocols.
	Minimise:
	• minimise direct and indirect impacts to Ironcaps Banksia (*Banksia sphaerocarpa* var. *dolichostyla)* and *Microcorys* sp. Mt Holland (D. Angus DA2397) local population to the maximum extent practicable through locating infrastructure outside of 50m protective buffer where possible. • all populations of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA2397) within 50 m buffers adjacent to disturbed areas will be demarcated and signed as Conservation Significant Flora Exclusion Zones

Element	Description
	• impacts caused by dust due to vehicle movements by keeping roads and other areas well-watered. Dust suppression measures that include maintenance of vehicles, cleared areas, and active stockpiles. • hypersaline water used for dust suppression will be applied to road surfaces by dribble bars and not allowed to overspray onto vegetated areas specifically where *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA2397) is located adjacent to existing roads. • weeds through implementation of control measures including vehicle hygiene procedures, stockpiling of on-site topsoil for reuse, and annual monitoring. • impacts due to uncontrolled fire through control of ignition sources, hot work procedures, maintenance of fire breaks and regional coordination of prescribed burns.
	Rehabilitate:
	• *Banksia sphaerocarpa* var. *dolichostyla* seeds and/or cuttings will collected and stored appropriately for rehabilitation (where seed is present). *Banksia sphaerocarpa* var. *dolichostyla* will be considered as part of the plant mix for rehabilitation areas near existing populations. • rehabilitation trials and research programs (in consultation with DBCA and Kings Park and Botanical Gardens) will be undertaken to increase translocation and rehabilitation success. • directly impacted individuals will be attempted to be translocated into an area of suitable habitat. • rehabilitation of areas will occur to provide suitable habitat for *Banksia sphaerocarpa* var. *dolichostyla*. • seeding of areas with suitable habitat within the Development Envelope with *Banksia sphaerocarpa* var. *dolichostyla* seeds will occur. • monitoring of translocated individuals and rehabilitated areas will be undertaken.
Outcomes	Residual Impact:
	The Proposal has the potential to impact one Declared Rare Flora, *Banksia sphaerocarpa* var. *dolichostyla*. The proposal would result in direct impact of less than 0.56% to the currently known local population (92 individuals of the currently known local population of 16,503) and 0.37% of the regional population. Indirect impacts have the potential to impact individuals that are located within 50 m of the Proposed Layout, with an additional potential indirect impact to 17.12% of the currently known local population (2,826 individuals of the currently known local population of 16,503) and 11.47% of the regional population. The Proposal has the potential to impact nine Priority Flora species, with the most significant risk to *Microcorys* sp. Mt Holland (D. Angus DA 2397). The Proposal directly impacts on 18.07% of the currently known local population of *Microcorys* sp. Mt Holland (D. Angus DA 2397) and has the potential to indirectly impact on 3.68%. The Proposal has been designed to minimise direct impacts on remaining *Banksia sphaerocarpa* var. *dolichostyla* local population to the maximum extent practicable, however direct loss will occur. During the detailed design stage of the Proposal, further attempts to minimise direct loss to individuals shall be implemented. Any direct loss of individuals will result in rehabilitation and translocation attempts to achieve no net loss of individuals in the currently known local population (16,503). Indirect impacts on *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) would be avoided through the placement of new infrastructure away from the existing populations and the management of driving to facilities within 50 m of existing individuals. Mitigating actions will reduce the potential for indirect impacts to this species, therefore the potential indirect impacts are considered conservative maximums. Cumulative impacts are expected to be low for *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) due to the potential for additional populations outside the Development Envelope and low pressures to the species as discussed in Section 5.3.9). Overall, the Project is considered to pose a relatively low risk to *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397), as less than 0.56% and 18.07% respectively of the currently known local population and 0.37% and 18.07% of the regional populations would be directly impacted by the proposed action. Given the size and extent of the local population outside of the Development Envelope and the mitigation measures, the Proposal is not expected to cause significant impact to flora and vegetation. However, uncertainty exists for the rehabilitation strategy proposed for the *Banksia sphaerocarpa* var. *dolichostyla* (if required) to achieve no net loss of individuals from the

Element	Description
	currently known local population (16,503 individuals). Whilst field observations have determined the species is a good candidate for rehabilitation, no research or trials have occurred to date, therefore uncertainty exists for effectiveness of the rehabilitation strategy and this presents a potential for significant impacts. Accordingly, it is expected that the Proposal will meet the EPA's objective for the flora and vegetation factor based on the mitigation measures and scale of impact, however there is the potential for significant impacts to the *Banksia sphaerocarpa* var. *dolichostyla* due to uncertainty associated with the rehabilitation program effectiveness.
	Offset:
	As discussed in Section 8.1, Significant Residual Impacts are anticipated for *Banksia sphaerocarpa* var. *dolichostyla* as its protected by statute and the uncertainty associated with the effectiveness of the rehabilitation strategy, although the scale of the Significant Residual Impacts is not considered sufficient to require an offset. Significant Residual Impacts are not anticipated for *Microcorys* sp. Mt Holland (D. Angus DA 2397) as the direct and indirect impacts to the species is not considered to increase its threat status. Therefore, an offset is not proposed.
Terrestrial fauna	
EPA objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
Policy and guidance	• Environmental Factor Guideline — Terrestrial Fauna (EPA 2016c).
	• Technical Guide — Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2016d).
	• *Survey guidelines for Australia's threatened birds* (Commonwealth Department of the Environment, Water, Heritage and the Arts, 2010).
	• *Survey guidelines for Australia's threatened mammals* (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities, 2011).
	• Chuditch (*Dasyurus geoffroii*) National Recovery Plan: Wildlife Management Program No. 54, (Department of Environment and Conservation, 2012).
Potential impacts	• further loss and fragmentation of habitat from vegetation clearing.
	• death, injury and displacement from construction and mining operations, vehicle strikes and changed fire regimes.
	• increased feral fauna from increased access into areas from new tracks and roads, and attraction to waste receptacles and rubbish tips.
	• secondary impact from dust, noise, lighting and vibration during construction and mining operations.
Mitigation	Avoid:
	• clearing of vegetation within 100 m of active Malleefowl mounds. • accidental clearing of faunal habitat. • removal of active mounds through implementation of an internal clearing permit system.
	Minimise:
	• ensure that a fauna specialist is present during clearing so that timely identification, avoidance, and relocation, can be undertaken if required. • if trapped during clearing, Chuditch will be relocated into bushland adjacent to the Development Envelope before nightfall or within the same day. • implement traffic management measures including speed limits and driving restrictions at dusk and dawn to reduce potential vehicle strikes. • implement dust suppression measures on roads and within cleared areas and on active stockpiles • prevent entrapment of animals in all excavations (including steep–walled holes or trenches which are more than one meter deep) by securing against inadvertent animal entry at the close of each day or ensuring that escape ramps are installed. • control feral predators (cats, wild dogs, foxes) by implementing local control measures.
	Rehabilitate:
	• if Malleefowl mounds have eggs and the mound is essential for removal, then with the approval of DBCA, eggs may be removed and incubated in a place approved by DBCA (e.g. Perth Zoo, Yongergnow Malleefowl Centre) with hatched chicks released on site unless otherwise approved by DBCA. • progressive rehabilitation to restore faunal habitat.

Element	Description
Outcomes	Residual Impact:
	Within the context of the Coolgardie vegetation region, the Proposal will result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations that provide faunal habitat for Chuditch and Malleefowl that are currently less than 1% cleared with 17% protected for conservation within the Southern Cross Bioregion. The Proposal has potential to affect two vulnerable species, Malleefowl and Chuditch populations within the Development Envelope principally through disturbance of breeding habitat and potential incidental mortality from operational activities, particularly traffic movement. Based on the current design and available survey information, the Proposal will not result in any direct loss of currently known, active Malleefowl mounds and will only have a small effect on Chuditch habitat, including potential breeding habitat. Management measures have been developed to avoid incidental mortalities of Malleefowl and Chuditch to the maximum extent practicable. Due to the compact nature of the proposal footprint and relatively small area of the Development Envelope, the risk of incidental mortalities to terrestrial fauna is considered not significant. Potentially significant residual impacts are likely to occur as a result of direct loss of higher quality unburnt habitats used by both Malleefowl and Chuditch. Once the mitigation measures and offset are taken into account, it is expected that the Proposal will meet the EPA's objective for the terrestrial fauna factor.
	Offset:
	As discussed in Section 8.1, Significant Residual Impacts are anticipated for Chuditch and Malleefowl fauna habitat impacts, therefore an offset is proposed. An offset proposal is defined in Section 8, *Offsets*. Covalent proposes to offset potentially Significant Residual Impacts through DBCA consultation to undertake land acquisition and management of up to 2,000 ha of similar or better quality land.

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1. Introduction

Covalent Lithium Pty. Ltd (the Proponent), a joint venture between Kidman Resources Limited (Kidman) and Sociedad Química y Minera (SQM), are proposing to develop the Earl Grey Lithium Project (the Proposal).

The project is located within the historical, abandoned Mt Holland mine site that currently comprises open pits, an underground mine, a processing plant, waste rock dumps, tailings storage facilities (TSF) and other associated infrastructure. The Mt Holland mine site is largely un-rehabilitated and is currently a liability of the State of Western Australia.

The Proposal includes open cut mining and processing of lithium ore, with transport of a lithium concentrate to an existing Western Australian port for export to overseas markets or a future potential lithium refinery in Kwinana. Within the Development Envelope (1984 ha) the total Proposal footprint is 660 ha with the full extent of the Proposal to be developed progressively over a 40-year period.

The Development Envelope covers an area of 1,984 ha with a Proposal footprint of 660 ha. The Proposal has been designed to maximise the use of existing disturbance areas resulting in clearing of 392 ha of native vegetation and utilisation of 268 ha of existing disturbed areas. The additional clearing is predominately required for an expansion of the existing mine pit, waste dumps, upgrade of the existing TSF and ancillary infrastructure. The Development Envelope and indicative Proposal layout are shown in Figure 1-2.

The Proposal is located approximately 105 km south–southeast of Southern Cross in the Yilgarn Mineral Field of Western Australia (Figure 1-1). Access to the site is by road from the Great Eastern Highway via Parker Range Road and Marvel Loch – Forrestania Road or alternatively via Hyden.

1.1 Purpose and scope of the ERD

The purpose of this document is to present an environmental review of the Proposal, including a detailed description of the key components, environmental impacts and proposed environmental management measures for the relevant environmental factors identified by the Environmental Scoping Document (ESD).

The Proposal was referred under s38 of Part IV of the EP Act on 19 May 2017. The Environmental Protection Authority (EPA) determined the Proposal requires a Public Environmental Review (PER) level of assessment on 14 July 2017. The EPA prepared an ESD, approved on 21 December 2017, identifying the preliminary key environmental factors, impacts to be assessed and work required to prepare an Environmental Review Document to support the PER (Included in Appendix 1).

The ESD identified the following two key preliminary environmental factors:

1. Flora and Vegetation.
2. Terrestrial Fauna.

1.2 Proponent

The Proposal was referred in May 2017 under s 38 of the *Environmental Protection Act 1986* (EP Act) by Kidman Resources Limited (Kidman). Subsequent to the referral of the Proposal, Kidman entered into a joint venture with Sociedad Quimica y Minera (SQM) on 11 September 2017. As a result of the formation of the joint venture the Proponent for the Proposal is Covalent Lithium Pty Ltd (the Proponent). Covalent Lithium was formed to manage the Proposal on behalf of the joint venture and was approved as the Nominated Proponent on 21 May 2018.

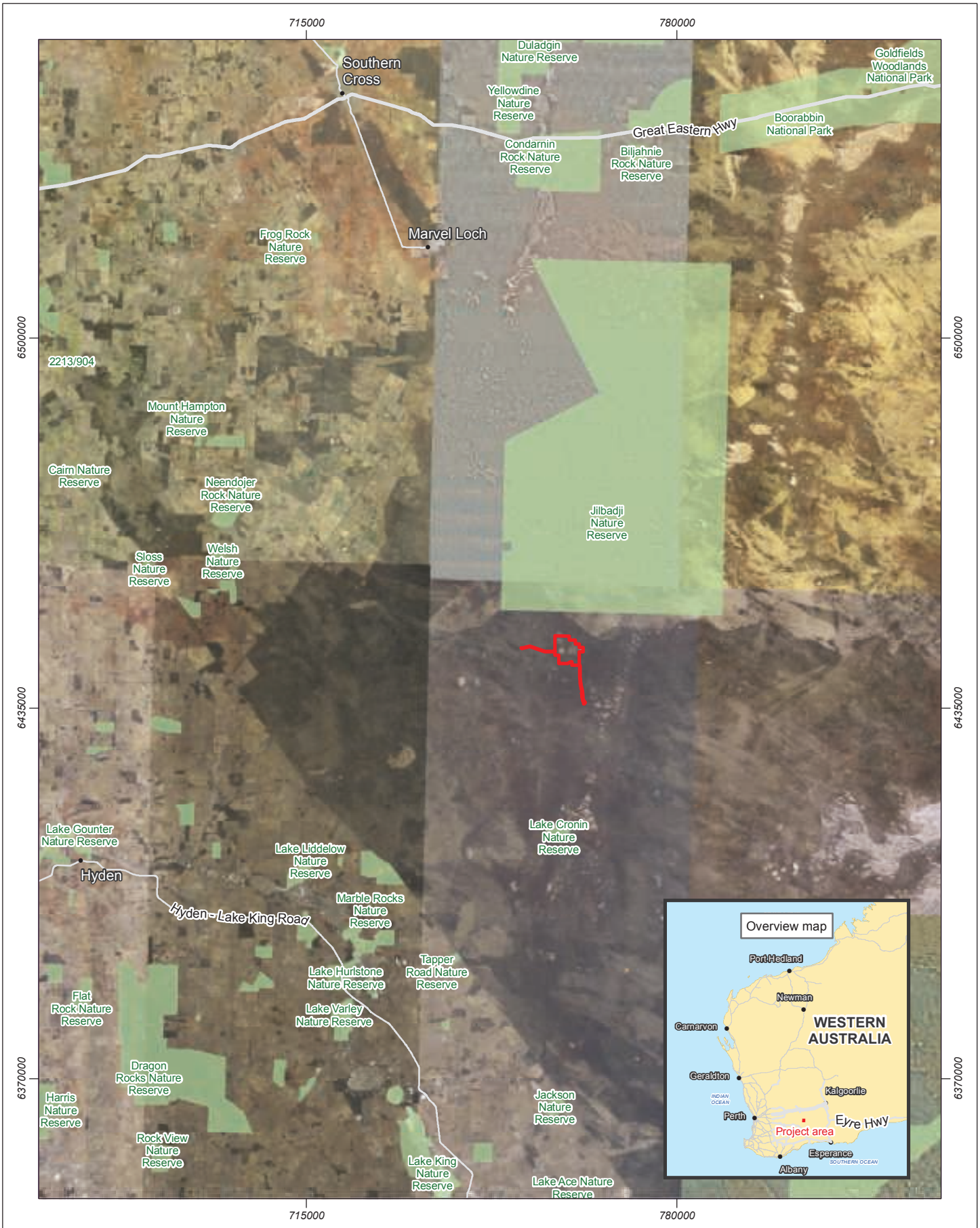

Figure 1-1: Regional location

Scale 1:900,000 at A4

0 6.5 13 19.5 km

N

Legend

- Development Envelope
- Nature reserve

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 20/07/2018

Author: vdinh

Source: Landgate: Aerial imagery - 2017;
SQM: Development envelop - 17/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G001_RevH.mxd

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Figure 1-2: Development Envelope and indicative Proposal footprint

Scale 1:60,000 at A4

0 600 1,200 1,800 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 12/01/2019
Author: vdinh
Source: SQM: Aerial imagery - 2017,
Development Envelope - 17/11/2017.
Path: C:\GIS\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G002_RevH.mxd

Legend

- Development Envelope
- Indicative Proposal footprint
- Holland track

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All compliance and regulatory requirements regarding this assessment document should be forwarded by email, post or courier to:

Proponent details:	Key contacts:
Covalent Lithium Pty. Ltd ACN: 623 090 139 *Address:* Level 18, 109 St Georges Terrace Perth, WA 6000	***Name:*** **Colyn Louw** *Title:* General Manager Organisational Development *Telephone:* +61 8 9226 3194 *E–mail:* Colyn.louw@covalentlithium.com

1.3 Environmental impact assessment process

This Environmental Review has been prepared in accordance with EPA *Instructions on how to prepare an Environmental Review Document* (EPA 2016a) to support referral of the Proposal under s 38 of the EP Act.

In accordance with s 3.1.3 of the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016*, this Environmental Review Document (ERD) has been prepared to provide sufficient information for the EPA to assess the Proposal and be made available for Public Review. This ERD describes the specific studies and investigations conducted by the Proponent in relation to the preliminary key environmental factors identified in the ESD. The objectives of the reviews and additional studies and investigations are to:

- ensure that the full environmental effects of the Proposal are properly understood
- inform mitigation and optimal management controls
- enable a reliable and knowledge–based environmental impact assessment to be conducted.

Consultation with Decision-Making Authorities (DMAs) has included describing the Proposal as well as determining steps to progress appropriate licences and secondary approvals to support the Proposal, subsequent to approval under Part IV of the EP Act.

1.4 Other approvals and regulation

1.4.1 Other Western Australian regulations

In addition to the requirements under Part IV of the EP Act, the Proposal will be required to obtain a Works Approval and Operating Licence under Part V of the EP Act and obtain an approved Mining Proposal under the *Mining Act 1978* (Mining Act). There are no registered native title claims in the Development Envelope although the requirements of the *Aboriginal Heritage Act 1972* will be implemented.

1.4.2 Australian Government environmental impact assessment process

While the states and territories have responsibility for environmental matters at a state and local level, the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to focus the Australian Government interests on protecting Matters of National Environmental Significance (MNES). The EPBC Act requires an assessment as to whether a proposed action is likely to have a significant effect on a MNES.

The Proponent has undertaken consultation with the Australian Government Department of Environment and Energy (DoEE). The Proposal was referred under the EPBC Act and received a 'Controlled Action' decision (2017/7950), which was authorised to be assessed under the WA assessment process.

The relevant MNES for this Proposal are:

- Chuditch (*Dasyurus geoffroii*) – Vulnerable
- Malleefowl (*Leipoa ocellata*) – Vulnerable
- Ironcaps Banksia (*Banksia sphaerocarpa* var. *dolichostyla*) – Vulnerable.

2. The Proposal

2.1 Background

2.1.1 History of the Mt Holland mine site

The Mt Holland mine site is a historic gold mining operation centred on the Bounty Mine, which forms the central infrastructure area of the site. Between 1988 and 2001, the historic processing plant received ore from numerous open pits within an approximate 10 km radius of the site, including the existing Earl Grey pit, which is located within the new Earl Grey Resource. The existing disturbance within and in the immediate vicinity of the Development Envelope is shown in Figure 1-2.

Mt Holland was owned and operated by various companies from 1988, including Aztec Mining Company Limited, Forrestania Gold NL and Lion Ore Mining International Limited. In 1999 the site was purchased by Viceroy Australia Pty Ltd which subsequently went into involuntary administration in 2002. The majority of leases associated with the Mt Holland Mine were allowed to expire and were subsequently surrendered to the State, with associated unconditional performance bonds called in by the State. Applications for new mining leases over the respective mining areas were granted in 2004.

In 2014, Convergent Minerals Limited (Convergent) acquired the tenements. Convergent submitted a Mining Proposal under the Mining Act to recommence mining at the Blue Vein Project, which is approximately 8 km south of Bounty Mine. The Blue Vein Project included using and upgrading the processing plant, accommodation village and other support facilities at the Mt Holland mine site. The Mining Proposal (REG ID 53033) was approved by the then Department of Mines and Petroleum (DMP) in May 2015. Convergent subsequently went into administration in 2015 and the Blue Vein Project was never implemented.

2.1.2 Tenure

All mining and infrastructure related tenements and tenement applications associated with the Proposal are shown on Figure 2-1.

2.1.3 Changes since referral

On 23 November 2017, the Proponent provided an application and supporting information for a Change to Proposal via section 43A of the EP Act. The proposed changes to the proposal include:

- increase of cell 2 of the TSF to increase capacity (resulting in a reduction of waste dump 2)
- incorporation of the existing road network that would be used into the proposal description
- modification of waste dump 3 to avoid a currently active Malleefowl mound.

With the change, the proposal footprint increased by 95 ha in total. 68 ha of the increase in footprint is located in pre-disturbed areas of the Development Envelope. The change to proposal also required clearing of an additional 27 ha of native vegetation. The EPA determined on 7 December 2017 that the changes to the proposal are not considered to be significant and provided consent for the Proposal to be amended.

On 24 May 2018, the Proponent provided an application and supporting information for a subsequent Change to Proposal via section 43A of the EP Act. The proposed changes to the proposal include:

- removal of the Bounty Tailings Storage Facility (TSF) originally proposed at the eastern edge of the Development Envelope, resulting in a reduction in native vegetation clearing of approximately 30 ha
- expansion in use of the existing Earl Grey TSF as an Integrated Waste Landform (IWL), resulting in an increase in native vegetation clearing of approximately 30 ha

- realignment of the airstrip footprint to accommodate the IWL height and meet current Civil Aviation Safety Authority (CASA) requirements, resulting in an increase in native vegetation clearing of approximately 14 ha
- refinements in processing and infrastructure layout that maximise use within the existing developed core of the former processing facility and reduce native vegetation clearing across the footprint by approximately 14 ha.

The overall outcome of the proposed change reflects the current Proposal, including a decrease in the footprint of the Proposal from 705 ha to 660 ha, with all the decrease occurring in areas of existing clearing. The extent of native vegetation clearing remained unchanged at 392 ha. The EPA determined on 17 July 2018 that the changes to the proposal are not considered to be significant and provided consent for the Proposal to be amended.

2.2 Justification

Development of the Proposal will provide additional lithium minerals required to meet the strong global demand for lithium, which is predominantly used in battery manufacturing; a growing requirement of the renewable energy markets and electric motor vehicle industry. This contributes to improving the environment by reducing dependence on fossil fuels.

The Proposal would be a significant source of direct and indirect employment, both during construction and in the operational phase. Indirect employment comprises flow–on employment effects (essentially reflecting the demand for goods and services and the employment that must be generated to provide them). During construction, a workforce of approximately 700 personnel will be required over an 18–month period. When operations commence, an estimated 300 full–time equivalent (FTE) personnel will be employed directly. Opportunities for local employment and supporting local industry could assist regional towns such as Southern Cross, Kalgoorlie, Kambalda, Coolgardie, Esperance, Hyden and Norseman.

The Proposal will provide a revenue stream to the government through the payment of royalties and taxes. The Western Australian government will receive royalties and taxes each year that the Proposal is in operation.

Implementation of the Proposal also provides the State of Western Australia with an opportunity to rehabilitate a proportion of the abandoned Mt Holland mine site. Implementation of the Proposal will result in utilisation and rehabilitation of some of the existing disturbance at Mt Holland and therefore a reduction of the State's abandoned mine liability disturbances.

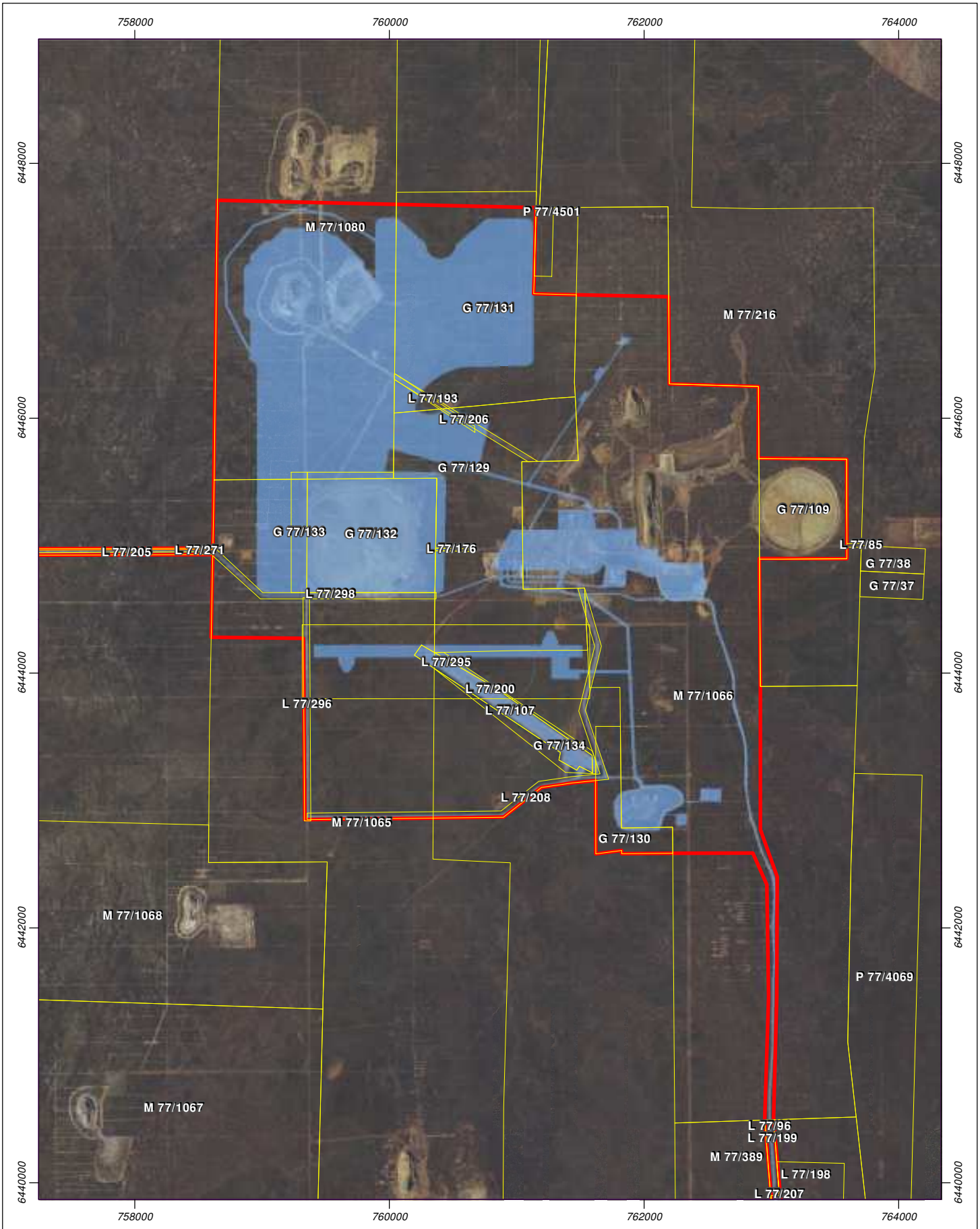

Figure 2-1: Tenure

Scale 1:40,000 at A4

0 400 800 1,200 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 19/11/2018

Author: vdinh

Source: Landgate: Aerial imagery - 2017; SQM: Development Envelope, Indicative proposal footprint - 17/11/2017; DMP: Mining tenement - 14/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G003_RevF.mxd

Legend

- Development Envelope
- Indicative Proposal footprint
- Mining Tenements (DMIRS)

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2.3 Proposal Description

The key characteristics of the proposed Earl Grey Lithium Mine are provided in Table 2-1. The proposed site layout and Development Envelope are shown in Figure 2-2.

Table 2-1: Key Proposal characteristics

Proposal title	Earl Grey Lithium Project		
Proponents name	Covalent Lithium Pty. Ltd (Covalent).		
Short description	This Proposal is to develop a pegmatite-hosted lithium deposit at the abandoned Mt Holland mine site, in a Development Envelope of 1,984 ha. The proposal footprint covers an area of 660 ha, that includes 268 ha of existing disturbance and new clearing of up to 392 ha of native vegetation, which is habitat for significant fauna species.		
Element	**Existing Disturbance (ha)**	**Proposed increase (this approval) (ha)**	**Proposed extent (total) (ha)**
Mine and associated infrastructure (including waste rock dumps, tailings storage facility, airstrip, processing plant, accommodation village, wastewater treatment plant, landfill, water storage, explosives magazine, coreyard, topsoil stockpiles, power generation plant, workshop, admin facilities, pipelines, power lines, roads etc.).	268	392	660

The site layout has been optimised to use as much existing disturbed area as practicable. The total Development Envelope is approximately 1,984 ha, with a project footprint of 660 ha made up of 268 ha of existing disturbed land and 392 ha of new disturbance, as summarised in Table 2-1 and shown in Figure 2-3. Disturbance will be located wholly within tenure granted under the Mining Act.

In addition to maximising the use of existing disturbed areas, Progressive rehabilitation will be implemented during the life of the project and upon closure.

The site layout has also been designed to minimise impacts to conservation significant species (including State and Commonwealth vulnerable species *Banksia sphaerocarpa* var. *dolichostyla*, Chuditch and Malleefowl) and significant fauna habitat. Consequently, the location of infrastructure has been purposefully reconfigured to minimise impacts to the maximum extent practicable.

Key operational activities for the proposal would include:

- mining of the Earl Grey lithium deposit using conventional open cut drill and blast mining methods, over the life of mine (LOM), with transfer of ore to the run of mine (ROM) pad in preparation for processing
- processing of lithium ore (dominant lithium minerals being spodumene and petalite, which are both alumino silicates) at a rate of 3 million tonnes per annum (Mtpa), through a newly constructed gravity separation and flotation plant, constructed within the historic disturbance footprint
- production of a lithium concentrate that would be stored in a concentrate shed prior to being transported by road and/or road and rail to an existing Western Australian export facility or to a future proposal local refinery
- production of two chemically benign process waste streams, comprising:
    - a gravel sized reject that will be disposed of in waste rock dumps as well as being used for construction purposes (e.g. IWL, road base, fill, rehabilitation armouring)
    - a finer grained dry tailings stream that will be dry stacked within the designated IWL
- disposal of unmineralised waste rock to designated waste rock dump locations.

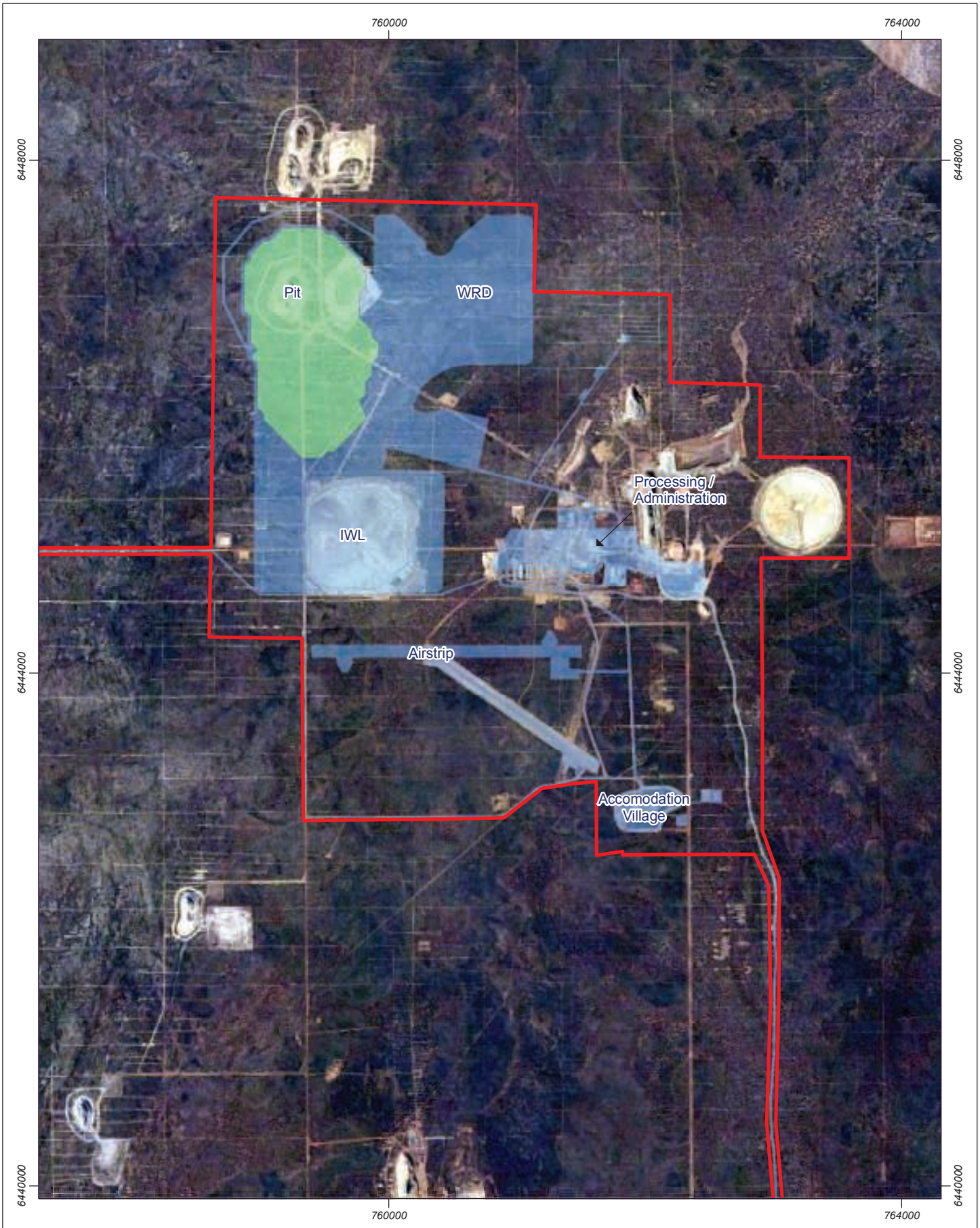

Figure 2-2: Proposed Site Layout

Scale 1:40,000 at A4

0 400 800 1,200 m

N

Legend

- Development Envelope
- Indicative Proposal footprint
- Mine pit

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 20/07/2018

Author: vdinh

Source: SQM: Aerial imagery - 2017,
Development Envelope, Mine layout - 17/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G004_RevH.mxd

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Figure 2-3: Use of existing disturbance area

N

Scale 1:40,000 at A4

0 0.5 1 km

Coordinate System:
GDA 1994 MGA Zone 50

Date: 8/01/2019

Legend

- Proposed clearing (392ha)
- Previously disturbed (268)
- Development Envelope

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Client: Earl Grey Mine. Created by: c.thatcher

2.3.1 Mine

The Earl Grey deposit is proposed to be mined via conventional open cut methods. The pit will be developed in multiple stages over a 40-year period. Approximately 100 million tonnes of ore will be mined over the life of mine. Development of the pit will be undertaken using conventional drilling and blasting. The pit is expected to be approximately 1,800 m long by 950 m wide at the completion of mining activities. Based on the current design, maximum pit floor depths would be approximately 185 m below ground level (bgl) in the south of the pit and 300 m bgl in the north.

Progressive clearing will track with the progression of mining at 3 Mtpa up to 5 Mtpa and is anticipated to reach 270 ha by the 20-year mark of the project, as shown in Table 2-2 and Figure 2-4.

Table 2-2: Approximate vegetation clearing timeline for Earl Grey Lithium Project.

	Year		
	3	**10**	**20**
Area (Ha)	90	150	270

Figure 2-4: Approximate progressive clearing

N

Scale 1:57,500 at A4

0 0.5 1 km

Coordinate System:
GDA 1994 MGA Zone 50

Date: 21/01/2019

Legend

- Development Envelope
- Indicative Proposal footprint
- Previous disturbance
- Holland track

Progressive Clearing
- Year 3
- Year 5
- Year 10
- Year 20

- Pit - Year 5
- Pit - Year 10
- Pit - Year 20

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Client: Earl Grey Mine. Created by: CJT

2.3.3 Processing Area

The location of the processing plant is shown in Figure 2-2. This was selected with consideration to the proximity of the proposed pit, process water supply, power reticulation and availability of existing cleared areas. The overall process is consistent with other hard rock lithium projects within Australia. Processing of ore to produce a lithium oxide concentrate would occur in four stages as follows.

Crushing

The processing circuit requires lithium ore to be crushed. This would be undertaken by feeding ore from the ROM in to a three-stage crushing circuit comprising of a primary jaw crusher, dry screens, secondary and tertiary crushers and fine ore storage bin at a design throughput of 3 Mtpa with potential capacity to increase to 5 Mtpa, producing crushed ore that can be fed to the first stage of the Dense Media Separation (DMS) processing plant.

Dense media separation (DMS)

Crushed ore is conveyed to the DMS processing plant from the fine ore storage bin. The first stage of the DMS plant concentrates the lithium ore by separating the lithium bearing minerals (spodumene, petalite) from other minerals (typically quartz and albite) based on differences in density. No reagents are used in this process other than the addition of environmentally benign granular ferrosilicon (FeSi) to control the pulp density such that it is maintained between the density of the lithium bearing minerals and other minerals.

The lithium bearing material from the first stage is further reduced in size to ensure maximum release of the spodumene and/or petalite from the other minerals. This material is then sent to a second stage of DMS. Non-lithium bearing minerals from both stages of DMS report to stockpile as a gravel product. Other finer fractions are sent to a flotation circuit.

Flotation

A flotation circuit will be used to further separate the ore into concentrate and waste material. Conventional flotation cells would be used and consist of rougher cells followed by cleaner and recleaner cells. Flotation cells will use minor quantities of benign and biodegradable reagents to assist the flotation process. The flotation concentrate would be thickened, filtered and stored prior to shipment. The tailings material will be sent to thickening and will be disposal to the integrated waste landform.

Thickening and tailings disposal

The tailings thickener receives dewatering and waste overflow streams from the flotation plant. The solids and liquids are combined with an environmentally benign and biodegradable flocculent and thickened prior to filtering and disposal.

The final lithium oxide (Li_2O) concentrate product will be stored in a storage facility immediately adjacent to the processing plant, prior to transport to an existing Western Australian port for export to overseas markets. Lithium oxide concentrate is environmentally benign and non-toxic, requiring no specific management measures other than containment (e.g. dust, runoff).

2.3.4 Waste Rock and Tailings Management

Mining of the Earl Grey lithium deposit would produce three primary waste material streams over the life of mine, comprising approximately:

- 200 million loose cubic metres (LCM) of waste rock (inclusive of gravel rejects)
- 35 Mt (16,500,000 m^3) of gravel rejects (coarse tailings)
- 45 Mt (32,000,000 m^3) of flotation filtered tails (to be dry stacked and/or co-mingled with run of mine waste rock disposal).

Gravel rejects would be managed as fresh waste rock or used as a construction material (e.g. road aggregate). Based on current designs, the Proposal is anticipated to use three waste rock landforms, as described below and shown in Figure 2-2 over the life of the mine.

- permanent integrated waste landform (IWL) covering the historic Earl Grey TSF
- permanent waste rock dump to the immediate east of the pit (WRD)
- backfilling of the pit to the maximum extent practicable, producing a permanent raised waste rock landform.

For the purpose of waste rock management, there are three types of waste to consider:

- fresh waste rock, which is geochemically benign and resistant to erosion
- transitional waste rock, which is slightly to moderately saline, low in soluble toxicants and of varying resistance to erosion
- oxide waste rock, which is low in soluble toxicants but highly saline and is prone to be dispersive.

The development of the pit is staged requiring mining of the varying types of waste rock (from oxide waste rock at the surface to fresh waste rock at depth) to expose fresh ore. This allows the construction of the WRD be staged to encapsulate the oxide and transitional waste rock within the fresh, competent waste rock as the pit development progresses. All dispersive oxide and transitional materials, in all waste rock landforms, will be completely encapsulated with fresh competent waste rock to minimise the potential for post closure erosion and sedimentation issues. The estimated composition of waste rock produced by the Earl Grey Lithium Project is provided in Table 2-3.

Table 2-3: Estimated Composition of Earl Grey Waste Rock

Weathering Zone	Estimate Waste Rock Volume (LCM)	Estimated % of Total Waste Rock
Alluvial/Oxide	18	9%
Transitional Zone	99	50%
Fresh (Mafic)	83	41%
Total	200	

The chemically benign DSM product would be managed as fresh waste rock or used as a construction material (e.g. road aggregate). Fine tailings require management within an integrated waste facility as either a slurry or preferably as a filtered dry stack material. Fine tailings properties are environmentally benign. The integrated waste storage facility will be designed in compliance with the *Mines Safety and Inspection Act 1994* and environmental matters under the Mining Act and in accordance with the Department of Mines, Industry Regulation and Safety (DMIRS) *Guide to the preparation of a design report for tailings storage facilities* (DMIRS 2013).

2.3.5 Other infrastructure

Other infrastructure necessary to operate the Project are summarised below. These facilities would be situated on existing disturbed land wherever practicable, as shown in Figure 2-2.

- **Airstrip.** The existing Mt Holland airstrip will be replaced with a new east-west aligned airstrip at the northern end of the existing airstrip that meets all current Civil Aviation Safety Authority (CASA) regulations.
- **Accommodations.** The accommodation village will be re-established within the previously existing footprint to house a 200-person workforce.
- **Communications.** Communication systems will be established, comprising four new and two existing point to point towers back to Kalgoorlie for telephone/internet, a 3G mobile network via range extender installed on site, and on-site radio communications.
- **Fuel Storage.** Six 100 kL fuel tanks providing a total storage of 600 kL. The facility will include lights, fuel management and level control systems, three fuel dispersing points, one being direct feed to the power plant, and oil/water recovery and separator unit.

- **Explosives Storage Compound.** Explosives will be stored within a licensed and secure compound north of the Bounty Mine site that is remote from other active areas of the mine operation.
- **Miscellaneous Buildings.** Three workshops will be located within the contractor's laydown area and a single workshop in the processing plant area for maintenance of plant, heavy and light vehicles. Additionally, an administration office, first aid centre, laboratory, crib room, mine offices, plant offices, and store rooms will be built within the existing cleared footprint of the site.
- **Power Generation Plant.** Power will be sourced from the State grid with a 132-kV substation located adjacent to the Project to supply power to the processing plant and site infrastructure. Small diesel generators will be used in outlying area (e.g. Borefield) on an as needs basis.
- **Vehicle Washdown Facility.** Vehicle washdown facilities will be established in the processing plant area and contractor's laydown area. These will comprise both light and heavy vehicle washdown areas and a high pressure, low volume cleaning system to minimise water usage and waste water generation. Sediment and waste water will drain to a primary settlement sump. Oily water will overflow to an adjacent cell where oil would be separated from the water using a skimmer. The waste oil will be stored for off-site disposal by a licenced contractor while the water will be recycled or evaporated.
- **Topsoil and Vegetation Stockpiles.** Topsoil and vegetation stripped from new disturbance areas will be stockpiled on the perimeter of the disturbance for later use in rehabilitation.
- **Roads.** The existing road network will be used to the maximum extent practicable. Purpose built on-site roads would be constructed to provide safe and controlled passage for light and heavy traffic and or mobile earthmoving equipment in the central areas of the facility.
- **Potable Water Treatment.** A water treatment system is proposed to be established in the accommodation village area and will be used to reticulate potable water where required.
- **Landfill.** As the existing landfill area contains a significant population of significant flora, the Proponent proposes to construct and operate two new Class II facilities for inert and putrescible waste, respectively. Both landfills would be located between the processing plant and Bounty mine areas within an existing disturbed footprint.
- **Waste Water Treatment.** A waste water treatment plant (WWTP) will be established at the accommodation village with excess treated water being disposed of to the existing evaporation ponds located east of the accommodation village.
- Construction or refurbishment of other supporting infrastructure.

2.3.6 Water Requirements

The Project is anticipated to require up to 1.5 GLpa. Water requirements, including use for processing, accommodation village and dust suppression around the mine site, would be met by the following:

- pit dewatering (approximately 0.13 GLpa from year 8 onwards)
- groundwater abstraction from the existing borefield and/or Bounty underground (0.87 GL – 1.0 GLpa)
- water recycling within the various process water circuits.

Pit Dewatering

Dewatering volumes are expected to be very low, with inflow rates of approximately 3 to 4 L/s at depth. A dewatering system would be installed to remove all groundwater inflows from the pit. Water removed from the pit would predominantly be used in processing as well as dust suppression. During large storm events, any excess water would be pumped to the Bounty pit which has a capacity of 1.5 million cubic metres (allowing for 10 m freeboard).

Bounty Mine Water Supply

A licence to take water was granted by the Department of Water in May 2015 under Section 5C of the *Rights in Water and Irrigation Act 1914*. The licence, GWL180267, allows for the abstraction of up to 630,000 kLpa and expires in May 2025. An amendment has been submitted to include the Bounty pit and underground workings. Abstraction from this location will be undertaken in accordance with the licence conditions.

Southern Borefield Water Supply

The Bounty mine water supply would be supplemented with water sourced from the existing southern borefield located approximately 8 km southeast of the accommodation village (Figure 2-2). The Proponent proposes to refurbish the existing southern borefield and will apply for a new groundwater licence under Section 5C of the *Rights in Water and Irrigation Act 1914*.

The southern borefield consists of seven production bores and a number of observation bores situated within the Mt Hope caprock aquifer. Water was abstracted from the borefield between 1988 and 2002 at a rate of up to 275,000 kLpa, with peak abstraction rates of 3000 kL/day. Recoverable storage volumes of the aquifer have been estimated to be approximately 20,000,000 kL (URS 2002). Groundwater quality in the borefield is hypersaline, with total dissolved solids (TDS) concentrations varying between 73,000 mg/L and 87,000 mg/L.

2.3.7 Workforce

The site would accommodate a workforce consistent with providing the expertise and services required, including but not limited to positions relating to:

- statutory management
- occupational health and safety
- environment
- administration
- technical services
- construction, mining, processing and maintenance
- haulage
- catering and janitorial.

Excluding external support services to the mine, the operational workforce is expected to consist of 300 employees. The majority of workers would be accommodated on site, with additional local employment from Southern Cross on a drive-in-drive-out basis expected.

2.3.8 Project Timeframes

Indicative timeframes for the Project are summarised in Table 2-4.

Table 2-4: Indicative Project Timeframes

Activity	Timeframe (Calendar Year)	Description
Clearing	Q4 2019	Commence clearing of areas in accordance with necessity for initial phase of mine development.
Prestrip	Q1 2020 – Q2 2020	Commence pre-strip of areas required for initial phase of mine development.
Construction	Q4 2019 – Q2 2020	Commence construction of facilities, services and process plant.
Mining	Q4 2020	Commence mining of starter pit.
Commence processing	Q4 2020	Commission processing facility and increase throughput to nameplate capacity.

2.3.9 Consideration of options/alternatives

Various options and alternatives have been considered for the Project. These are summarised below.

Processing Options

Feasibility studies support a purpose–built processing plant capable of 3.0 Mtpa throughput constructed at the Project predominately within the existing disturbed plant footprint. The Proponent also considered a short–term option to utilise the Poseidon Nickel Limited Lake Johnston processing facility located approximately 114 km southeast by road. This option was not advanced and is not included in the Proposal.

Mining Options

The ore reserve location cannot be changed and as such, the final pit footprint area is fixed. However, two different mining approaches were considered:

- Option 1: Open pit mining with progressive backfilling, to the maximum extent practicable, of the pit in combination with some external, permanent waste rock dumps
- Option 2: Open pit mining with no progressive backfilling of the pit and all waste rock stored in external, permanent waste rock dumps.

Option 1 was considered a preferred option due to its reduced impact on the environment by:

- minimising the project footprint (and associated impacts on native vegetation and habitat)
- minimising the area of open pit at closure.

Project Footprint

As there are areas of the Development Envelope previously disturbed from past mining operations, the Proponent had two alternatives available in terms of designing the Project layout:

1. Establish infrastructure in previously undisturbed areas, thereby avoiding the current closure liability being transferred to the Proponent.
2. Utilise existing disturbance where possible and in doing so, take on the closure and rehabilitation liability associated with these areas.

The design of the Proposal purposefully uses existing disturbed areas for 40% of the Proposal footprint for the following reasons:

- reduces the need to clear more vegetation and consequently reduces potential impacts to flora, fauna and habitat
- provides a practical opportunity for the Proponent to assist in the clean–up of abandoned mine landforms and infrastructure
- would result in an improvement in the health, safety and wellbeing of the environment, through appropriate rehabilitation of disturbances and infrastructure.

2.3.10 Preliminary mine closure and rehabilitation

Overview

A Mine Closure Plan (MCP) is being prepared in accordance with the joint DMIRS and Environmental Protection Authority (EPA) Guidelines for Preparing Mine Closure Plans (2015). This will be submitted as part of the DMIRS Mining Proposal Approval process. Closure provisions pertinent to rehabilitation of the site and key environmental outcomes are included in a Rehabilitation and Closure Plan (RCP) included in Appendix 2 and summarised in this Section.

Specific details provided in the RCP will include the following key elements of mine closure:

- closure specific obligations, commitments and legal requirements
- identification and management of key closure issues through completion of a formal risk assessment process and development of risk management measures
- stakeholder consultation including identification of stakeholders, future closure consultation, a stakeholder communication strategy and integration of consultation feedback into closure planning
- post-mining land use and closure objectives
- site specific and measurable completion criteria
- mine closure implementation plan, which includes planned and unplanned scenarios, general closure prescriptions for different disturbance types, specific closure tasks for each closure domain, a materials balance and a high-level closure and rehabilitation schedule
- monitoring program to assess the effectiveness of closure actions
- description of the process and methodology undertaken to estimate the financial cost of closure for the Project.

The abandoned Mt Holland mine site is a historic mine that was operated between 1988 and 2001 at which point the operator and lease holder, Viceroy Australia Pty Ltd, went into involuntary administration. The leases were surrendered and associated unconditional performance bonds were called in by the State. The majority of disturbed areas associated with the mine site are currently a State liability. The Proponent has chosen to maximise use of the existing disturbed areas as far as practical to minimise new disturbance. Existing disturbance areas that are utilised as part of this proposal will therefore become the liability of the Proponent, under the Mining Act and the *Mining Rehabilitation Fund Act 2012*.

Accordingly, the MCP will include provisions for the areas covered under this proposal, notably:

- Earl Grey pit
- waste rock disposal areas
- Earl Grey tailings storage facility
- areas of the processing plant area utilised for processing and other infrastructure
- the accommodation village
- airstrip
- supporting infrastructure (including waste water treatment facilities, landfills, water storage facilities, powerlines, pipelines, roads, explosives magazine, vegetation and topsoil stockpiles, coreyard, borrow pits, workshop and administration facilities).

Recommencement of mining at the historical Mt Holland site provides beneficial outcomes for closure of historically disturbed areas. This is particularly relevant for areas that represent a potential risk to the environment or human health and safety such as the historic TSFs and processing plant. While the MCP will only detail areas where Covalent has a legal obligation, should opportunities to rehabilitate other disturbances be identified that are mutually beneficial, the Proponent would continue to liaise directly with DMIRS.

Within the Development Envelope, the Proposal footprint involves areas that would be progressively rehabilitated during the operation of the mine and areas that would be closed at the completion of mining. The implementation of progressive rehabilitation during the life of the mine would allow rehabilitation methodologies to be refined and improved throughout the life of the mine. Adaptive improvement of rehabilitation methods during mining is expected to provide much greater rehabilitation outcomes for the mine site when the remaining areas are closed at the completion of mining. Progressive rehabilitation will also increase ecological functions in areas of the Development Envelope that will not be used for mining but are impacted by past activities such as exploration drill lines.

The progressive rehabilitation is anticipated to begin once the existing TSF is covered with mine waste. The progressive clearing of the mine envelope would generate sources of topsoil and vegetative material to be used progressively in the rehabilitation of the waste dump.

Post mining land use

Mining and mineral exploration has been the principal land use in the region for several decades. Prior to mining, the area comprised natural wooded and scrubland ecosystems.

In consideration of the historic and permanently altered landforms, the aim at closure would be to return the Project areas, where utilised by the Proponent, as far as practicable to a naturally functioning ecosystem in the form of Unallocated Crown Land. While a return to a natural habitat function is the ultimate end land use for the greater region, it is likely that further mining and mineral exploration by prospective companies would take place.

There are not considered to be any significant legacies or issues that would prevent the successful rehabilitation of the Project from meeting agreed post mining land uses. Given the long life of mine, details associated with the proposed final land use would be determined closer to the planned closure date within a revised MCP and in consultation with relevant stakeholders.

Closure objectives and completion criteria

The objectives detailed in the MCP will aim to facilitate well-planned and effective mine rehabilitation, closure and decommissioning of the Project, while providing a process to:

- enable all stakeholders to have interests considered during the mine closure process
- allow closure to occur in an orderly, cost effective and timely manner
- enable the cost of closure to be adequately represented in accounts of the Joint Venture
- provide clear accountability and adequate resources for closure
- establish a set of indicators which will demonstrate the success of the closure process
- reach a point where the Proponent has met agreed closure criteria to the satisfaction of the relevant authority.

The primary aim at closure would be to return areas used by the Proponent, as far as practicable, to the pre-mining land use of Unallocated Crown Land that supports natural habitats and ecosystems and/or mineral exploration. The overarching closure objective is to establish safe, physically and chemically stable landforms, with a self-sustaining and resilient vegetative cover similar to that of the surrounding landscape.

Preliminary completion criteria for the Project are provided in Table 2-5 and have been developed to address the stated closure objectives. These completion criteria would be refined during development of the MCP and through future iterations of the MCP for the life of mine.

Table 2-5: Summary of preliminary closure objectives

Aspect	Objectives
Safety	Ensure access to completed mine workings is restricted.
	Ensure waste and materials / infrastructure from operational areas are disposed or buried upon decommissioning such that they do not pose a risk to human safety.
	Ensure contaminated materials are managed in a manner such that no impacts to human health or the environment will occur.
Physical Stability	Ensure long-term stability of final landforms.
	Ensure long-term stability and functionality of drainage structures.
	Attain stable landforms with conditions suitable for the natural establishment of a self-sustaining vegetation community.
Chemical Stability	Ensure that the long-term water quality of local and regional surface water and groundwater resources is not compromised.
	Ensure soils are free of contamination.
	Ensure no pollution will migrate into the surrounding environment upon closure (e.g. acidic/alkaline seepage).

Aspect	Objectives
Ecological Function	To re-establish self-sustaining ecological communities on disturbed areas.
Visual Amenity	Final landforms integrate with the natural surroundings to the maximum extent practicable.
Next Land Use	Rehabilitate disturbed areas to a state that enables sustainable post mining land use.
	Any known mineral resources with potential value to future generations is, where practically possible, preserved for potential future exploitation.
	Retain transport facilities considered of value to stakeholders, where practical.
Regulatory Compliance	Compliance with mine closure permitting and regulatory requirements.
	Agreed closure indicators and criteria met and to the satisfaction of the relevant authority.

Management of closure issues

An assessment of potential closure risks for the Project will be detailed in the MCP. Based on all available information, including historic and recent baseline studies and Project design, there are no significant closure issues that could inhibit the successful closure and rehabilitation of the Project. Observed regeneration on previously cleared areas of the site, including waste rock dumps, anecdotally infer that rehabilitation is viable with a high likelihood of success. Key closure risks requiring consideration include:

- management of dispersive waste rock materials and associated long term stability of waste rock landforms
- contaminated sites, specifically the identification of historically contaminated areas used under this Proposal that require investigation to inform rehabilitation criteria
- management and preservation of topsoil and other rehabilitation materials for use in progressive rehabilitation activities
- public safety, specifically, ensuring access to the Earl Grey pit is restricted and associated infrastructure removed
- materials balance, notably availability of growth medium for existing disturbed areas.

Management of these issues is described in the following subsections, with most aspects covered in the general closure prescriptions that will be applied to the Project. Specific management strategies are provided for waste rock landforms, pits and the IWL.

General mine closure prescriptions

Closure and rehabilitation works generally involve a number of broad activities:

- decommissioning of plant and infrastructure
- demolition of remaining infrastructure
- management of residual contamination that was not remediated during operations
- rehabilitation of disturbed areas, including earthworks and revegetation.

These activities are discussed below and will apply to closure of areas covered under this proposal.

Decommissioning

This phase will commence once mining and mineral processing operations cease and generally involves the following actions:

- cleaning of all plant and equipment
- the removal/draining of all liquids/solids/materials (i.e. clearing out of all stores, chemicals, fuels, lubricants and supplies). Any remaining chemicals and hydrocarbon inventories will be returned to the supplier or sold to a third party
- the removal of all plant and equipment either for transfer to other sites, salvage (sale), or disposal
- the dismantling of all salvageable infrastructure and removal to temporary salvage laydown areas
- the demolition of all other infrastructure and removal to designated disposal sites
- the remediation of all identified contamination sites.

Demolition

The following preliminary demolition tasks have been identified for the decommissioning phase:

- all plant and permanent structures will be dismantled or demolished and removed. Recoverable materials may be sold if a suitable market can be found at the time of decommissioning
- all inert rubble and materials resulting from the demolition exercise will be disposed within an approved area (e.g. landfill). Liquid or hazardous wastes will be removed to appropriately licensed facilities off site
- where concrete foundations are not removed, these will be broken and covered with suitable material (e.g. waste rock, subsoil and topsoil)
- all surface pipelines, power cables/lines and security fences will be removed and materials will be sold or otherwise disposed in an approved area
- subsurface pipelines will remain if they cannot be economically salvaged, but will be appropriately drained, flushed and sealed (crimped or capped). Risers will be cut a minimum of 300 mm below the surface
- all potentially contaminated soils are to be identified and demarcated for remediation.

The Project facilities will only be provided to other users where formal agreement by the user to accept future liabilities is reached and where required, approval is obtained from the relevant Agencies.

Remediation

Potentially contaminated areas that remain at closure, following decommissioning and demolition, will be investigated and remediated in accordance with the *Contaminated Sites Act 2003*.

Rehabilitation

Rehabilitation is the return of disturbed land to a stable, productive and self-sustaining condition in consideration of beneficial uses of the land. The general objective is to return, as far as practicable, all areas impacted by mining to a self-sustaining condition that is comparable to the surrounding vegetation. Rehabilitation of disturbed areas generally involves:

- design of landforms to produce safe and stable slopes
- design of landforms to manage water, including construction of water management structures (e.g. crest bunds, toe drains)
- armouring of final surfaces with competent cover material to increase surface stability
- replacement of available topsoil
- ripping to break soil compaction and increase water infiltration ability
- seeding/planting and fertilising as required.

Rehabilitation studies and trials will be undertaken during operations to determine the most effective methodologies for rehabilitating the different landforms used under the Project. As there are already a number of rehabilitated landforms present within the abandoned Mt Holland mine site, with varying degrees of rehabilitation success, these would be assessed to further refine rehabilitation designs of new landforms.

The initial rehabilitation objective for the mine involves the reestablishment of native vegetation and fauna habitats. A substantial amount of data was collected in 2016, 2017 and 2018 on vegetation communities (Mattiske 2018a) and fauna habitat (Western Wildlife 2017). This information will inform the establishment of appropriate ecological post-closure considerations. Appropriate ecological analogues will be established prior to the commencement of rehabilitation, which is estimated to be commenced approximately five years after the commencement of mining. Rehabilitation trials will also include propagation tests for *Banksia sphaerocarpa* var. *dolicholstyla* to aid in the species recovery.

Open pit

Part of the Earl Grey pit is anticipated to be backfilled and rehabilitated during operations, as feasible. Backfilling activities are expected to result in a raised landform that covers up to 50% of the entire pit footprint. The remainder of the pit is expected to remain open, with the pit waste rock landform benching down to the base of the pit. An abandonment bund will be constructed around the open side of the pit.

Following cessation of mining, groundwater levels are anticipated to recover resulting in the formation of a permanent pit lake that would behave as a groundwater sink. It is anticipated that the water quality in the pit lake would be hypersaline, pH neutral with low concentrations of dissolved metals and nutrients.

Waste landforms

Mining operations will produce approximately 200 million LCM of waste rock, of which 18 million LCM is oxide waste rock material and 99 million LCM is classified as transitional waste rock material. The oxide material may be environmentally problematic due to its dispersive characteristics, salinity and naturally low pH, which is not favourable for vegetation growth. Management of environmentally problematic waste rock materials will be undertaken during operations. These wastes would be encapsulated using fresh, competent waste rock material (approximately 80 million LCM) including coarse gravel rejects, both of which are resistant to erosion.

The final waste rock landforms will be designed for long term stability and will be water retaining, with a top surface consisting of an inwardly draining concave profile or water embayments, subject to trials and further investigations. This would direct rainfall to the centre of the landform for storage and gradual release through infiltration and evapotranspiration processes. All waste rock landforms will have a crest bund to minimise runoff on the batters.

As part of rehabilitation earthworks, waste rock landform slopes will be battered down to a maximum gradient of 17˚, covered with a material that is resistant to erosion (e.g. fresh waste rock and subsoil blend) and growth medium, before being ripped and seeded with an appropriate selection of local, native species. Waste landform design will be refined during operations through more detailed waste characterisation, soil analysis, rehabilitation trials and monitoring.

The proposed WRD1 has significant benefits with respect to final closure and rehabilitation. As this landform would completely encapsulate the existing Earl Grey TSF, the following benefits are expected:

- reduction in oxidation rates of existing PAF tailings and subsequent release of acid mine drainage
- reduction in long term infiltration rates to the existing tailings thereby providing an overall reduction in seepage volumes
- prevention of contamination from wind-blown tailings dust
- prevention of contamination resulting from stormwater runoff
- rehabilitation of an existing high-risk landform.

Other project infrastructure

Upon closure of the Project, and in the absence of any third party transfer agreements (e.g. Shire), the majority of infrastructure including buildings, plant, pipelines, tanks and other structures will be decommissioned and removed from site for recycling or scrap. Any remaining structures would be demolished for burial in situ or in the pit.

As far as practicable, disturbed areas, including all historical disturbances used by the Proponent, would be reprofiled to blend in with the surrounding ground levels and to reinstate natural drainage. These areas would then be ripped to reduce compaction and increase infiltration, before being seeded with local native vegetation species, as required.

Access will be prohibited by rehabilitating all access tracks to the site except for the main entrance. Access via this entrance will be prevented via locked gates. A combination of bunds, gates and signs will also be used to minimise unauthorised access.

Rehabilitation materials balance

Due to the large areas of historic disturbance at the abandoned Mt Holland mine site, ensuring adequate materials are available to complete rehabilitation works is an important part of mine closure planning. Based on observations to date, soils suitable for use as a growth medium are plentiful in the Project area. Numerous miscellaneous stockpiles of topsoil and subsoil material are located throughout the development envelope.

While a detailed materials balance has not been completed, it is anticipated that a significant proportion of rehabilitation can be completed using material sourced from these stockpiles with additional material won from the surface excavation of the pit and waste landform footprint. Allowance has been made in the proposed footprint for storage of growth medium and vegetation. A rehabilitation materials balance will be developed for the Project and detailed within the MCP.

2.4 Local and regional context

The Development Envelope is within the Great Western Woodlands (GWW), generally situated on the western edge of the GWW boundary (Figure 2-5). The GWW are a 16 million ha area extending from the wheatbelt to the edge of the deserts and is the largest intact area of Mediterranean Woodland on earth. The GWW includes open eucalypt woodlands (63%), mallee eucalypt woodlands, shrublands and grasslands (Fox et al. 2016). Less common habitats in the GWW include granite outcrops, banded ironstone formations, salt lakes and freshwater wetlands (Fox et al. 2016). The relative intactness of the GWW is recognised as a key value by Fox et al. (2016), in that it provides connectivity for birds in a landscape that varies both spatially and temporally. The south-western half of the GWW provides habitat for many birds that are locally extinct or have reduced populations in the adjacent and substantially cleared wheatbelt (Fox et al. 2016).

There are many nature reserves within the GWW the two closest to the Development Envelope are shown in Figure 1-2 and described below:

- Jilbadji Nature Reserve is a large reserve of over 200,000 ha within the GWW, approximately 5 km north of the Development Envelope. Jilbadji Nature Reserve is known to support a range of fauna, including Malleefowl (*Leipoa ocellata*) (Keighery *et al*. 1995). A significant portion of the reserve was burnt in 2009, as well as more recently in 2015; and
- Lake Cronin Nature Reserve is a smaller reserve of around 1,000 ha and is also within the GWW, about 30 km south of the Development Envelope. Lake Cronin is the largest example of a semi-permanent freshwater lake in the region, and the areas in and around the reserve are recognized as including significant areas of sandplains, shrublands and woodlands (EPA 2009). Lake Cronin Nature Reserve supports a diverse faunal assemblage, including conservation significant species such as the Malleefowl, Lake Cronin Snake (*Paroplocephalus atriceps*) and Inland Western Rosella (*Platycercus icterotis xanthogenys*) (EPA 2009).

Under the Interim Biogeographic Regionalisation for Australia (IBRA) developed by the Department of Sustainability, Environment, Water, Population and Communities (now DoEE), the Development Envelope is located within the Southwest Interzone and Southern Cross Subregion of the Coolgardie Bioregion (Figure 2-5). The Southwest Interzone is the transitional area between the Southwest (Bassian) and Eremaean Provinces. These provinces are determined by vegetation mapping (Beard 1980) and broadly correspond to climactic regions, with the Southwest Province experiencing warm dry summers and cool wet winters and the Eremaean Province experiencing low, irregular rainfall.

The Southern Cross Subregion of the Coolgardie Bioregion is characterised by subdued relief, comprising gently undulating uplands dissected by broad valleys with bands of low greenstone hills and numerous saline playa lakes. The vegetation is dominated by Eucalyptus woodlands, shrublands of *Allocasuarina* and *Acacia*, and mixed heath of *Melaleuca* and *Acacia*. The dominant land-uses in this bioregion are Crown Reserves and Unallocated Crown Land (66.7%), grazing on native pastures (17%), conservation (11.5%) and dryland agriculture (2.3%) (Cowan *et al*. 2001). The greenstone hills, alluvial valleys and broad plains of calcareous earths support diverse eucalypt woodlands. The uplands support mallee woodlands and scrub-heaths on sandplains, gravelly sandplains and lateritic breakaways (Cowan *et al*. 2001). Chains of salt lakes with dwarf shrublands of samphire occur in the valleys.

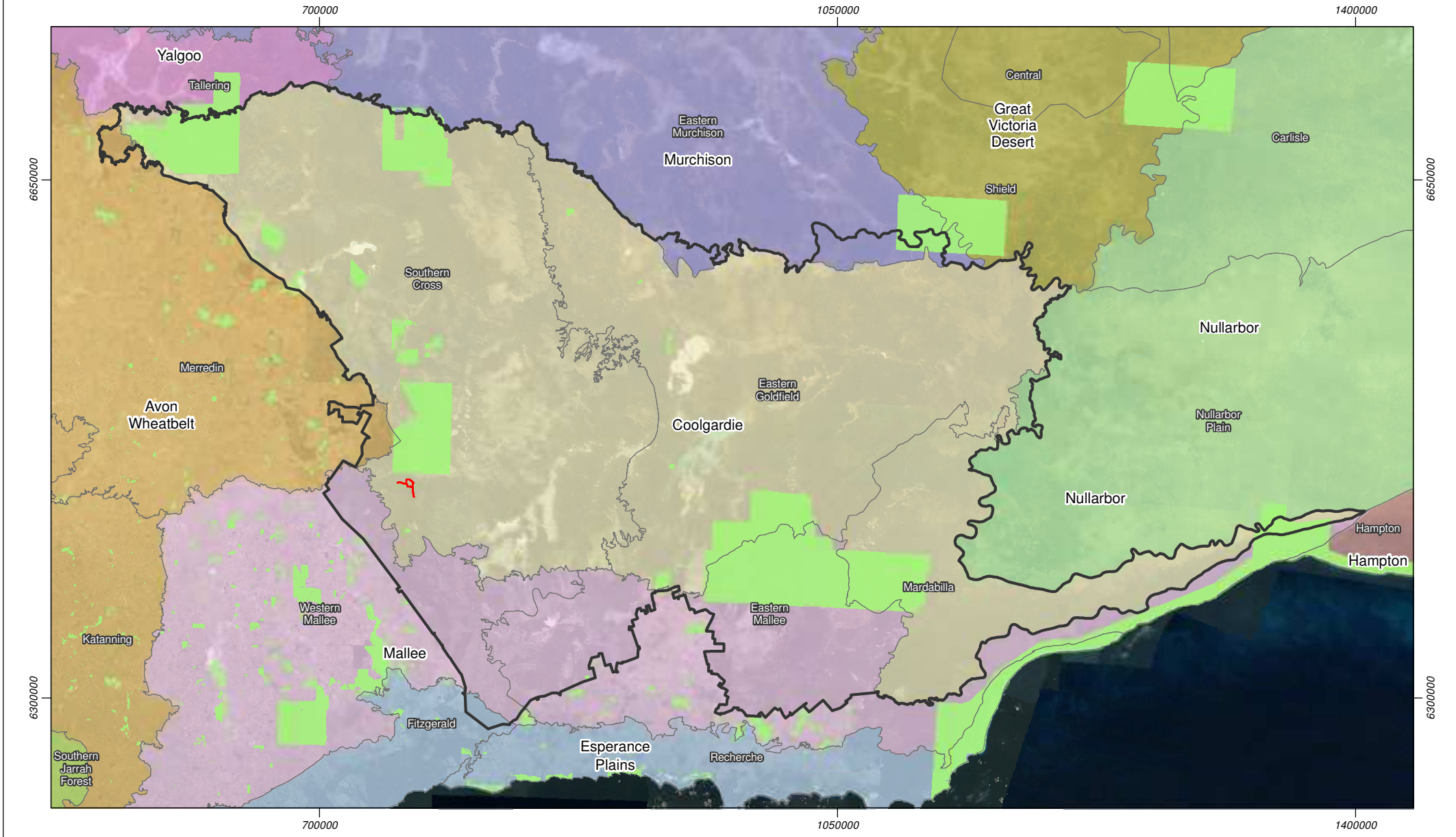

Figure 2-5: IBRA Regions/subregions and the Great Western Woodlands

Scale 1:3,500,000 at A4

0 35 70 105 km

Coordinate System: GDA 1994 MGA Zone 50

Date: 17/01/2019

Author: vdinh

Source: Landgate: Aerial imagery - 2017. SQM: Development Envelope, Greater Western Woodland boundary - 17/11/2017. DoEE: IBRA region - 2017.

Legend

- Development Envelope
- Greater Western Woodland boundary
- Nature reserve
- IBRA subregion

IBRA Region

- Avon Wheatbelt
- Coolgardie
- Esperance Plains
- Great Victoria Desert
- Hampton
- Jarrah Forest
- Mallee
- Murchison
- Nullarbor
- Yalgoo

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Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G005_RevE.mxd

3. Stakeholder engagement

3.1 Key stakeholders

The Proponent has commenced an extensive consultation process with key stakeholders, including:

- State government
- Federal government
- Local government
- Non–government organisations and interest groups.

A comprehensive list of key stakeholders is provided in Table 3-1. On July 1, 2017, a number of WA Government Agencies were amalgamated/renamed. Where consultation was conducted prior to this date the name of the agency at the time of consultation is used.

Table 3-1: Key Stakeholders

Stakeholder Group	Stakeholder	Key Interests
State Government	Office of the Environmental Protection Authority (OEPA) *Prior to 1 July 2017* Department of Water and Environmental Regulation (DWER) – Environmental Protection Authority Service Unit (EPASU) *as of 1 July 2017*	• Administration of the *Environmental Protection Act 1986* (EP Act) • Part IV (EP Act) Environmental Impact Assessments
	Department of Mines and Petroleum (DMP) *Prior to 1 July 2017* Department of Mines, Industry Regulation and Safety (DMIRS) *as of 1 July 2017*	• Administration of the *Mining Act 1978* (Mining Act) • Tenement conditions • Mining Proposals and Programs of Work • Mining Rehabilitation Fund (MRF) • Closure and rehabilitation • Safety
	Department of Parks and Wildlife Service (DPAW) *Prior to 1 July 2017* Department of Biodiversity, Conservation and Attractions (DBCA) *as of 1 July 2017*	• Administration of the *Biodiversity Conservation Act 2016* (BC Act) • Flora, fauna and habitat conservation
	Department of Aboriginal Affairs (DAA) *Prior to 1 July 2017* Department of Planning, Lands and Heritage (DPLH) *as of 1 July 2017*	• Native title and indigenous requirements • Heritage sites • Final end land use
	Department of Fire and Emergency Services (DFES)	• Emergency services • Fire breaks • Fire reduction
	Main Roads Western Australia (MRWA)	• Use of public roads
Federal Government	Department of the Environment and Energy (DoEE)	• Administration of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) • Referral and assessment of environmental impact assessments of matters of national environmental significance
Local Government	Shire of Yilgarn and Shire of Kondinin	• Use of public roads and infrastructure

Stakeholder Group	Stakeholder	Key Interests
Non–government organisations and interest groups	Conservation Council of Western Australia Wilderness Society Wildflower Society of Western Australia National Malleefowl Recovery Team	• Protection of conservation significant species • Potential interest in baseline flora and fauna survey data

3.2 Stakeholder engagement process

Stakeholder engagement with State Departments and Local Government Authorities commenced in late 2016. The Proponent has since developed and implemented an external stakeholder consultation strategy for ongoing social engagement and community investment.

The stakeholder consultation strategy has adopted the principles from the Ministerial Council on Mineral and Petroleum Resources (MCMPR) *Principles for Engagement with Communities and Stakeholders* (2005). This includes:

- open and effective communication:
  - two–way communication
  - clear, accurate and relevant information
  - timeliness
- transparency, requiring a process for communication and feedback
- collaboration, working cooperatively to seek mutually beneficial outcomes
- inclusiveness, with the aim of recognising, understanding and involving stakeholders early and throughout the process
- integrity, with engagement undertaken in a manner that fosters mutual respect and trust.

The outcomes of the consultation strategy are recorded in a Stakeholder Consultation Register. Consultation to date has comprised predominately of meetings and correspondence with a number of State and Federal Departments and Agencies, Local Government Authorities, Traditional Owners and non–government organisations and interest groups.

The Proponent is committed to ongoing stakeholder identification, communication, engagement and consultation through the planning and approval phase, and through to construction, operational and closure phases of the Project.

3.3 Stakeholder Consultation

Ongoing stakeholder consultation has been underway since late 2016. Key engagement to date is summarised in Table 3-2.

Table 3-2: Summary of Key Stakeholder Consultation

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
Department of Mines, Industry, Regulation and Safety (DMIRS)	16/02/2017	Meeting	**DMIRS**: Ian Mitchell (Team Leader – Operations, Environment), Richard Smetana (Environmental Officer). **Kidman**: Chris Williams (General Manager), Siobhan Pelliccia (Environmental Advisor, Blueprint Environmental Strategies).	Overview of project presented to DMIRS, focusing on proposed operations, environmental setting, baseline study results, presence of Chuditch, Malleefowl and vulnerable flora, opportunities for rehabilitation of abandoned mine site.	DMIRS commented on the potential positive outcomes associated with rehabilitation of historic disturbances. DMIRS suggested a pre–referral meeting be held with the Office of the Environmental Protection Authority to discuss conservation significant species.
Department of Water and Environmental Regulation– Environmental Protection Authority Service Unit (EPASU) and DMIRS	9/03/2017	Meeting	**EPASU**: Robert Hughes (Manager, Mining and Industrial South Branch) Helen Butterworth (Acting Principal Environmental Officer, Mining and Industrial South Branch). **DMIRS**: Ian Mitchell. **Kidman**: Chris Williams, Siobhan Pelliccia and James Cumming (Environmental Advisor, Blueprint Environmental Strategies).	Kidman delivered a presentation that provided details on: the Project (location, access, history); the abandoned mine status of the project; the proposed mining operation; the environmental setting, completed baseline studies and preliminary impact assessment; potential impacts on vulnerable species, focusing on the Chuditch, Malleefowl and Banksia; consultation that has occurred to date; the approvals pathway.	The EPASU recommended that Kidman consult with the Department of Parks and Wildlife the Commonwealth Department of the Environment and Energy, due to the presence of conservation significant species. DMIRS reaffirmed that any Mining Proposal would be referred to DBCA and/or the EPASU for advice due to the presence of conservation significant species.
Department of Biodiversity, Conservation and Attractions (DBCA) – Environmental Management Branch	9/03/2017	Phone Call	**Kidman**: Siobhan Pelliccia (Blueprint). **DBCA:** Daniel Coffey.	Informed DBCA of meeting with the EPASU and DMIRS and requested a meeting to discuss the conservation significant species in the Project area.	DBCA communicated that although the Project was of interest, DBCA could not meet with proponents unless their project was located in DBCA managed land, or a formal request was made by DMIRS or the EPASU through a formal process.
Department of the Environment and Energy (DoEE)	20/03/2017	Meeting in Canberra	**DoEE:** Dionne Cassanell (Senior Assessment Officer, Project Assessments West Section), Angela Gillman (Assistant Director, Project Assessments West Section), Karen Mexon (Assessment Officer), Cassandra Elliott (Assessment Officer). **Kidman**: Chris Williams, Michael Green (Exploration Manager), Siobhan Pelliccia, James Cumming.	Summary of project presented to DoEE (as described above for the EPASU) with a focus on matters of national significance, including the Chuditch, Malleefowl and *Banksia sphaerocarpa var. dolichostyla*.	Discussed possible approval pathways. DoEE commented that provision of fauna management plans would assist in the assessment process. DoEE would want to have a clear understanding of impacts and measures to avoid or minimise impacts and any residual impact remaining after implementation of management measures.
Shire of Kondinin	28/03/2017	Meeting	**Shire:** John Read (CEO) and Mark Burges (Manager of Works). **Kidman:** Kevin Dockery (Project Manager).	Overview of the Project and in particular use of Shire roads and maintenance thereof. Opportunities for local employment and use of local services.	Shire road maintenance agreements to be implemented.

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
Shire of Yilgarn	29/03/2017	Meeting	**Shire:** Brian Jones (CEO) and Robert Bosenberg (Manager of Works). **Kidman:** Kevin Dockery.	• Overview of the Project and in particular use of Shire roads and maintenance thereof. • Opportunities for local employment and use of local services.	Liaison with Shire of Yilgarn Regulatory Services was discussed in relation to Kidman ensuring compliance with current building codes and health regulations for buildings installed on site including construction of the accommodation village. Shire road maintenance agreements to be implemented.
DBCA – Western Shield Group	5/05/2017	Meeting	**DBCA**: Ashley Millar. **Kidman**: Chris Williams, Siobhan Pelliccia, Jill Woodhouse (Environmental Advisor) and Jenny Wilcox (Western Wildlife – Lead Zoologist).	Overview of Project presented with focus on findings of fauna survey, in particular, occurrence of Malleefowl and Chuditch.	Information on the Western Shield Program and ways in which Kidman can assist in the program through sponsorship and provision of survey results.
Non–Government Organisations	16/05/2017	Letters	**Conservation Council of WA**: Piers Verstegen (Director). **National Malleefowl Recovery Team**: Tim Burnard (National Coordinator). **Wilderness Society:** Peter Robertson (State Coordinator).	Introduction to Kidman and the Project. Recognition of stakeholder status. Invitation to meet to discuss the Project.	No comments received at time of submission.
DWER – EPA Service Unit	25/07/2017	Meeting	**EPASU**: Richard Sutherland (Principal Environmental Officer, Mining and Industrial Assessments (South). Nyomi Bowers (Senior Assessment Officer). **Kidman**: Chris Williams, Lance Bosch, Siobhan Pelliccia, James Cumming.	Discussion covered: • Key preliminary factors for the project. • Process and timeframe for a public environmental review. • Public and agency comments on the referral. • Perceived gaps in the environmental review document. • Approvals process for preliminary works.	Meeting minutes were taken and reviewed by EPA. Record maintained by Blueprint.
Department of Jobs, Tourism, Science and Innovation (DJTSI) & DMIRS	11/08/2017	Meeting	**DJTSI:** Gary Simmons (Executive Director) and Dylan Lipinski (General Manager – Strategic Projects). **DMIRS**: Ryan Hepworth (Senior Office – Environment), Tyler Sujdovic (Senior Office – Environment). **Kidman**: Kevin Dockery, Siobhan Pelliccia, Lance Bosch.	Discussion covered: • Overview of the project presented. • Discussion regarding hold up of PoWs – exploration.	DJTSI/DMIRS suggested: • Prepare a brief memo that describes the proposed work (i.e. the necessity to complete resource drilling and sterilisation drilling), but also gives more context in terms of it being within a surrounding disturbed area (brownfields site etc.). • Described how impacts to vulnerable flora/fauna would be managed. • Provide maps etc. • Provide the memo firstly to DMIRS to review and comment and then forward to the DoEE (cc'ing in JTSI, DMIRS and EPA). • DMIRS and JTSI will then most likely contact the EPA to discuss further if there are any issues.

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
DMIRS	18/08/2017	Memorandum	**Sent to:** **DMIRS:** Ryan Hepworth (Senior Office – Environment), Tyler Sujdovic (Senior Office – Environment). **Sent from:** Siobhan Pelliccia on behalf of Kidman.	Memorandum that described the proposed exploration activities at the Earl Grey Lithium Project. Provided for review and comment before being forwarded to the EPA and the DoEE.	• The document provides a good overview of the exploration activities that you are proposing, and how potential impacts to MNES will be avoided or managed. • Based on the information provided in the memo, the activities appear to be low–impact in nature and DMIRS would not consider the exploration programs to be an implementation of the broader Earl Grey Lithium project.
DWER (EPASU) and DoEE	28/08/2017	Memorandum	**Sent to:** **EPASU**: Richard Sutherland (Principal Environmental Officer, Mining and Industrial Assessments (South). Nyomi Bowers (Senior Assessment Officer). **DoEE:** Dionne Cassanell (Senior Assessment Officer, Project Assessments West Section). **Sent from:** Siobhan Pelliccia on behalf of Kidman.	Memorandum that described the proposed exploration activities at the Earl Grey Lithium Project. Provided for review and comment before being forwarded to the EPA and the DoEE.	• EPASU: No response. • DoEE: As these activities are not within the scope of the current referral, it is appropriate that you conduct a self assessment to determine whether there are, or are likely to be significant impacts to matters of national environmental significance. If you consider the activities are likely to have significant impacts, the activities should be separately referred to us. • The Department advised the safest approach, which provides legal certainty, would be to refer the action separately. The referral should include the proposed avoidance and mitigation measures discussed including the outcome of the onsite targeted survey for the Malleefowl proposed early in September 2017.

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
DMIRS – Environmental Branch	28/08/2017	Meeting	**DMIRS**: Clare Grosser (Acting General Manager Minerals – South), Ryan Hepworth. **Kidman**: Chris Williams, Siobhan Pelliccia.	Kidman delivered a presentation that provided: • An introduction to Kidman Resources Limited. • An overview of the Project (location, access, history). • A description of the abandoned mine status of the project. • A description of the proposed mining operation. • A description of the environmental setting, completed baseline studies and preliminary impact assessment. • A discussion of potential impacts on vulnerable species, focusing on the Chuditch and Malleefowl. • An overview of consultation that has occurred to date. • A discussion about the approvals pathway.	• The area is considered to have unique biodiversity values. Kidman should consider looking at other Projects in the area that have been through a formal assessment process (e.g. Koolyanobbing Project). • Kidman should ensure they have a sound understanding of the contaminated sites status of the project. • Re. PER, DMIRS will predominantly be providing input on aspects relating to waste rock management and mine closure. • Regarding potential early works, it is possible that existing mining proposals that have been approved could be implemented, however approval is still required from the EPA and the Commonwealth Department of the Environment and Energy. • Early works are generally limited to those that can be implemented through programs of work (e.g. borefield drilling, camp, exploration). • It may be possible for the Mining Proposal to be assessed in parallel with the ERD, however the Mining Proposal cannot be approved until after the Ministerial determination.
National Malleefowl Recovery Team	12/09/2017	Meeting	**National Malleefowl Recovery Team**: Dr Elizabeth Kington (Project Officer, WA). **Kidman**: Chris Williams, Siobhan Pelliccia, Belinda Bastow (Environmental Advisor, Integrate Sustainability).	Overview of project presented, focusing on proposed operations, environmental setting, baseline study results, presence of Chuditch, Malleefowl and vulnerable flora, opportunities for rehabilitation of abandoned mine site.	• Mound data being incorporated into the national data. • Project adopting the national mound monitoring protocol. • Joining the national mound monitoring network. • Approach adopted for remotely identifying mounds. • Project participating in the national adaptive management/predator control study. • No obvious concerns about the project.
Greening Australia	12/09/2017	Meeting	**Greening Australia**: Dr Blair Parsons (Director of Conservation – WA/NT), David Timmel (Business Development Manager). **Kidman**: Chris Williams, Siobhan Pelliccia, Belinda Bastow (Environmental Advisor, Integrate Sustainability).	Overview of project presented, focusing on proposed operations, environmental setting, baseline study results, presence of Chuditch, Malleefowl and vulnerable flora, opportunities for rehabilitation of abandoned mine site.	• Opportunities for traditional owner or aboriginal in the project. • Proximity to the Jilbadji Nature Reserve. • Intensity of the Malleefowl surveys. • Potential opportunities for GA to provide services to project in areas such as offsets, on–ground environmental work and rehabilitation work. • No obvious concerns about the project.

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
DMIRS – MRF Branch	14/09/2017	Meeting	**DMIRS:** Damian Montague (Acting Manager Abandoned Mines Program), Ryan Hepworth. **Kidman**: Chris Williams, Siobhan Pelliccia.	• Overview of Project abandoned site status and proposed operations. • Understanding of liabilities.	• DMIRS to seek advice on application of the MRF to areas that will be utilised by Kidman, in particular, where Kidman is rehabilitating liability landforms (such as the TSFs), how will MRF apply. • Kidman to prepare a memorandum that provides an overview of the proposed operation with respect to abandoned infrastructure and set out queries regarding assumed liabilities and application of the MRF, for DMIRs to follow up on.
DWER – EPA Services and Board	15/11/2017	Meeting	**EPA Board**: Tom Hatton. **EPA Services**: Anthony Sutton, Robert Hughes, Nyomi Bowers. **Kidman**: Chris Williams. **SQM**: Nicolas Velar, Ignacio Torrejon. **Strategen**: Darren Walsh, Mat Brook.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV.	• Discussion regarding project timing and Draft Environmental Scoping Document.
City of Kalgoorlie–Boulder	21/11/2017	Meeting	**City of Kalgoorlie–Boulder**: John Walker (Chief Executive Officer), John Bowler (Mayor), Alex Wiese (Executive Manager Economy and Growth). **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV. • Discussion of Mungari SIA and other locations in Kalgoorlie and accessibility of utilities.	• Requested information about tailings and waste characteristics.
Kalgoorlie Chamber of Minerals and Energy (CME)	21/11/2017	Meeting	**Kalgoorlie CME**: Rowena Olsen (Manager Eastern Region). **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV. • Understanding of labour market.	• Discussion regarding workforce characteristics and current market conditions.
Kalgoorlie-Boulder Chamber of Commerce and Industry (KBCCI)	21/11/2017	Meeting	**KBCCI**: Simone De Been (CEO). **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV. • Understanding of labour market.	• Discussion regarding workforce characteristics and current market conditions.

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
Port of Esperance	22/11/2017	Meeting	**Port of Esperance**: Alan Byers, (General Manager Ports), Scott Bates, Katie Williams. **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV. • Discussion of Port license, transport routes, on-site storage and handling.	• Provided information on DWER licence renewal. • Provided information on truck routing, loading options, and storage capacity on site. • Asked about port needs under future operational scenarios.
Shire of Esperance	22/11/2017	Meeting	**Shire of Esperance**: Victoria Brown (Mayor), Natalie Bowman, (Deputy Mayor), Matthew Scott (CEO), Matthew Walker (Director Asset Management), Shane Burge (Director Corporate Resources). **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV.	• Requested information on use of port and potentially project characteristics related to use of port. • Identified past issues and concerns regarding lead. • Provided information on local workforce.
Shire of Kondinin	22/11/2017	Meeting	**Shire of Kondinin**: John Read (CEO), Alan George (Deputy CEO), Mark Burgess (Manager of Works), Sue Meeking (Shire President), Allen Smoker (Councillor). **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV.	• Shire asked about the nature of the resource and the power and workforce requirements of the mine. • Shire would like Kidman to engage the works department of Council to do upkeep and maintenance of roads. Shire would like the opportunity to provide services for the road to keep it safe and well maintained.
Shire of Yilgarn	23/11/2017	Meeting	**Shire of Yilgarn**: Onida Truran (Shire President), Ray Hooper (Acting CEO), Robert Bosenberg (Executive Manager Infrastructure), Nic Warren (Manager Regulatory Services). **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV. • Council briefing and community meeting could be held around the time the ERD is released for public comment, or beforehand. Kidman to follow up in early 2018.	• Shire suggested Kidman hold briefing to full Council and a public meeting to introduce the project to the community. Also suggested a Fact Sheet could go into the local paper that is produced from the local resource centre. • Shire stressed importance of understanding Kidman's schedule for road upgrades. Shire does not want to upgrade roads until Kidman is ready to use them. • Shire enquired about water supply needs and food service standards/registration.
Shire of Coolgardie	24/11/2017	Meeting	**Shire of Coolgardie**: James Trail (CEO), Jill O'Brien (Deputy CEO). **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV.	• Shire enquired about workforce needs and characteristics of the resource.

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
Goldfields Esperance Development Commission (GEDC)	24/11/2017	Meeting	**GEDC**: Shayne Flanagan (CEO). **Cannings Purple**: Charlie Wilson-Clark. **Kidman**: Chris Williams.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV.	• Provided information on GEDC's role and advocacy role. • Provided information on ports, waste management, and workforce.
DMIRS	24/11/2017	Meeting	**DMIRS**: David Smith (Director General), Phil Gorey (Acting Deputy Director General). **Strategen**: Mat Brook. **Kidman**: Chris Williams.	• Discussion of stakeholder engagement conducted by Kidman with local shires and other local agency stakeholders. • Discussion of SQM operations and role of SQM in the Project.	• Enquiries regarding trucking and shipping of material, waste and existing liabilities. • Discussion of market for lithium and regional outlook.
Mt Holland Multi-Agency Site Visit	07/12/2017	Site Visit	**EPA Services**: Robert Hughes. **DMIRS**: Ryan Hepworth. **DoEE:** Angela Gillman, Mallory Owen, Denis Snowden. **DWER:** Tim Gentle, Louise Lavery. **DJTSI**: Steve Cosgrove, Steve Dawson. **Kidman**: Chris Williams. **SQM**: Nicolas Velar, Mark Fones. **Strategen**: Mat Brook, Matthew Jones.	• Site inspection and discussion of project, outcomes of environmental surveys.	• Offsets need to be considered. • Management plans need to be outcome focused.
Board Meeting	14/12/2017	EPA Board Meeting Presentation	**EPA Board and EPA Services.** **Kidman**: Chris Williams. **SQM**: Nicolas Velar. **Strategen**: Mat Brook.	• Provided overview of the Mt Holland project and introduced Kidman, SQM and the JV. • Discussion of outcomes of environmental surveys.	• Discussion regarding project timing and Draft Environmental Scoping Document.
DWER – EPA Services	29/03/2018	Meeting	**EPA Services**: Robert Hughes, Nyomi Bowers. **Covalent**: David English. **Kidman**: Chris Williams. **Strategen**: Kane Moyle.	• Notification of formalisation of joint venture and joint venture management entity, WA Lithium (now known as Covalent Lithium Pty Ltd.). • Discussion of proposed changes to site layout. • Discussion of outcomes of environmental work and proposed surveys. • Discussion of anticipated residual impacts. • Discussion of proposed timeline and next steps.	

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
Department of the Environment and Energy (DoEE)	10/05/2018	Meeting in Canberra	**DoEE:** Dionne Cassanell (Senior Assessment Officer, Project Assessments West Section), Rod Whyte (Director, Project Assessments West Section). **Covalent**: David English. **Kidman**: Chris Williams. **Strategen**: Matthew Jones.	• Notification of formalisation of joint venture and joint venture management entity, WA Lithium (now known as Covalent Lithium Pty Ltd.). • Discussion of proposed changes to site layout. • Discussion of outcomes of environmental work and recent surveys. • Discussion of anticipated residual impacts and potential offsets for MNES. • Discussion of proposed timeline and next steps.	• Offsets need to be considered. Proposals for offsets need to be consistent and provide certainty for both parties.
DWER – EPA Services	18/09/2018	Meeting	**EPA Services:** Anthony Sutton, Nyomi Bowers, Robert Hughes. **Covalent:** David English, Colyn Louw. **Strategen:** Kane Moyle**.**	• Update of proposed project timelines and next steps. • Anticipated receipt of DMA comments. • Potential Minor and Preliminary Works application.	• DMA comments to be received in October 2018. • Covalent to send updated approvals schedule to EPA.
DMIRS	5/10/2018	Meeting	**DMIRS:** Karen Caple, Mike Wilde, Dan Endacott. **Covalent:** Colyn Louw, Nicholas Vickery. **Strategen:** Kane Moyle. .	• Timing for the Mining Proposal submission. • Minor and Preliminary Works. • Interfaces with the EPA approvals.	
DWER – EPA Services	10/10/2018	Meeting	**EPA Services:** Robert Hughes, Nyomi Bowers, Bec Ryan. **Covalent:** Jan de Jage. **Strategen:** Kane Moyle, Tristan Sleigh, Matthew Jones.	• Discussion on DMA comments. • Adequacy of flora surveys for conservation significant species. • Statistical Comparison of Vegetation within the Earl Grey Lithium Project with the Ironcap Hills Vegetation Complex. • Environmental offsets and consideration in the ERD.	• Covalent to consider additional targeted surveys for significant flora.
DWER – EPA Services	19/10/2018	Meeting	**EPA Services**: Nyomi Bowers. **Covalent**: Colyn Louw. **Strategen**: Matthew Jones. **Mattiske**: David Angus.	• Review of DMA comment regarding targeted surveys for significant flora. • Field survey methods for proposed additional targeted flora surveys.	• Covalent to conduct additional targeted surveys in November 2018 for significant flora. • Results to be incorporated into the updated ERD.
DWER – EPA Services	14/11/2018	Meeting Memorandum	**EPA Services**: Robert Hughes, Nyomi Bowers. **Covalent**: Susanna Beech, Colyn Louw. **Strategen**: Matthew Jones.	• Discussion of additional targeted significant flora survey results. • Timing of resubmission of the updated ERD.	
DoEE	28/11/2018	Telephone	**DoEE:** Dionne Cassanell. **Covalent:** Susanna Beech.	• Discussion of a review conducted on the Offsets section in the ERD.	

Stakeholder	Date	Type of Consultation	Persons Involved	Summary of Communication	Comments Received
Office of Honourable Minister Stephen Dawson MLC Minister for the Environment; Disability Services	28/11/2018	Meeting	**Minister's Office:** Darren Forster. **Covalent:** Susanna Beech, Mark Fones. **Cannings Purple Strategic Communications:** Michael Cairnduff.	• Discussion of the Proposal and status of approvals.	• Recommendations for key stakeholders were provided.
Wilderness Society Wildflower Society of Western Australia Great Western Woodlands	13/12/18	Meeting	**Wilderness Society:** Kit Sainsbury. **Wildflower Society of Western Australia:** Brian Moyle. **Great Western Woodlands:** Peter Prices. **Covalent:** Susanna Beech, Colyn Louw. **Strategen:** Kane Moyle, Louise Whitley. **Mattiske Consulting:** David Angus. **Western Wildlife:** Jen Wilcox.	• Discussion of the Proposal and status of approvals.	• Recommendations for conservation group engagement were provided.

4. Environmental principles and factors

4.1 Identification of key factors and their significance

The Proposal was referred under s 38 of the EP Act on 19 May 2017. The Environmental Protection Authority (EPA) determined the Proposal requires a Public Environmental Review (PER) level of assessment on 14 July 2017. The EPA approved an Environmental Scoping Document (ESD) on 14 December 2017 identifying the preliminary key environmental factors, impacts to be assessed and work required to prepare the ERD (Appendix 1). The ESD identified the following two key preliminary environmental factors:

1. Flora and Vegetation.
2. Terrestrial Fauna.

4.2 Relevant factors

The EPA has also identified the following other environmental factors or matters relevant to the Proposal that must be addressed during the environmental review and discussed in the Environmental Review Document:

- **Terrestrial Environmental Quality** — if water is present in the existing TSF1, placing waste material on the TSF to construct WRD1 may increase hydraulic pressure (head) resulting in an increase in the rate of seepage. Therefore, if water is present in the existing TSF, the proponent is required to determine if placing the TSF on top of an existing facility would change the seepage rate.
- **Subterranean Fauna** - provide comment using site characteristics (geology and groundwater salinity) if there are likely to be stygofauna present on the site and impacted by the proposal. If stygofauna are likely to be present and would be impacted by the proposal, undertake stygofauna work in accordance with EPA guidance.
- **Social Surroundings** - investigate if the proposal is likely to result in an adverse impact, or reduction in access, to the Holland Track. If it is, implement actions that ensure access to the Holland Track is maintained for all users.
- **Air Quality** (Greenhouse Gas Emissions) — an estimate of the annual GHG emissions as a result of the Proposal, and any mitigation measures committed to by the proponent.

4.3 Consistency with environmental principles

The EP Act identifies a series of principles for environmental management. The environmental principles are the highest assessment level that a Proposal or scheme must meet in order to be found environmentally acceptable by the EPA. The Proponent has considered these principles in relation to the development and implementation of the Proposal. Table 4-1 outlines how the principles relate to the Proposal.

Table 4-1: EP Act principles

Principle	How it will be address by the Proposal
Precautionary principle Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: • careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and • an assessment of the risk-weighted consequences of various options.	The Proposal has used existing environmental data during design and has supplemented it with additional studies and peer review of proposed management measures. The Proponent has maintained engagement with relevant government agencies (as discussed in Table 3-2) to minimise any uncertainty surrounding the environmental impact of the Proposal. Design plans that reuse existing infrastructure, environmental management plans and closure plans would avoid or minimise impacts on identified environmental values.
Intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Proposal has been designed and will be implemented without significant residual impacts on the health, diversity or productivity of the environment. The implementation of progressive rehabilitation during the life of the mine would allow rehabilitation methodologies to be refined and improved throughout the life of the mine, providing better rehabilitation outcomes at the completion of mining.
Conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integration should be a fundamental consideration.	Survey work has been used to identify and confirm the range and condition of the environmental factors within and surrounding the Proposal Development Envelope. The Proposal would not substantially reduce the extent of any vegetation type or habitat within the Southern Cross area. The findings indicate that with appropriate design, management plans and progressive rehabilitation that no likely significant biodiversity or ecological impacts would result from the proposed development at local or regional scales.
Improved valuation, pricing and incentive mechanisms Environmental factors should be included in the valuation of assets and services. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. 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 structures, including market mechanisms, which benefit and/or minimise costs to develop their own solutions and responses to environmental problems.	Environmental constraint avoidance and management costs have been considered in the design of the Proposal.
Waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Waste would be minimised by adopting the hierarchy of waste controls; avoid, minimise, reuse, recycle and safe disposal. Rehabilitation of existing State liabilities will reduce existing waste liabilities.

4.4 Consistency with expectations of EPA for environmental impact assessment

The Proposal was also referred under the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and received a 'Controlled Action' decision (2017/7950), which was authorised to be assessed under the WA bilateral assessment process.

The relevant Matters of National Environmental Significance (MNES) for this Proposal are:

- Chuditch (*Dasyurus geoffroii*) – Vulnerable
- Malleefowl (*Leipoa ocellata*) – Vulnerable
- Ironcaps Banksia (*Banksia sphaerocarpa* var. *dolichostyla*) – Vulnerable.

While the states and territories have responsibility for environmental matters at a state and local level, the EPBC Act aims to focus the Australian Government interests on protecting MNES. The EPBC Act requires an assessment as to whether a proposed action is likely to have a significant effect on a MNES.

5. Flora and Vegetation

5.1 EPA objectives, policies, guidelines, and potential impacts

The ESD outlines the work required for the environmental impact assessment of key environmental factors and potential impacts of the Proposal in the ERD. The ESD requirements for flora and vegetation, including the relevant Sections where each requirement is addressed, are outlined in Table 5-1.

Table 5-1: ESD requirements for flora and vegetation

EPA objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	
Relevant aspects	Clearing of up to 392 ha of native vegetation to extend the existing Earl Grey pit and establish new support infrastructure.	Relevant ERD section
Potential impacts and risks	The Proposal may have the following effects: • direct loss of flora and native vegetation due to clearing • indirect impacts on flora and vegetation from operation of mine and support infrastructure.	5.3.1
	• dust deposition on vegetation from mining and related activities.	5.3.2
	• impact to flora and vegetation from overspray of hypersaline water used for dust suppression.	5.3.4
	• impact to flora and vegetation from spillage of tailings, hypersaline water and hydrocarbons.	5.3.5
	• changes to vegetation structure and composition through altered surface drainage flow patterns.	5.3.6
	• spread of weeds and alteration of fire regimes.	5.3.7
Required work	1. Identify and characterise flora and vegetation in the proposal area in accordance with the requirements of EPA Guidance. The survey needs to include all areas that are likely to be directly or indirectly impacted (including by changes to groundwater, or surface water flow) as a result of the proposal.	5.2.1, Appendix 3
	2. Provide an analysis of the vegetation and significant flora species present, and likely to be present, within the proposal area including the EPBC listed flora species *Banksia sphaerocarpa* var. *dolichostyla,* and the *Ironcap Hills vegetation complexes (Mt Holland Middle, North and South Ironcap Hills, Digger Rock and Hatter Hill) (banded ironstone formation)* Priority Ecological Community (PEC).	5.2
	3. Identify any areas in the Development Envelope where flora and vegetation surveys have not previously been undertaken and undertake field surveys in these areas in accordance with EPA guidance. Surveys being undertaken in new areas should have a focus on identification of significant flora species such as the EPBC listed *Banksia sphaerocarpa var. dolichostyla,* and the *Ironcap Hills vegetation complexes* PEC.	5.2, Appendix 3
	4. Undertake baseline weed mapping in all areas likely to be directly or indirectly impacted by the proposal.	5.2.4
	5. Provide figures of the proposed clearing and predicted indirect impact to vegetation and significant flora species including threatened/priority ecological communities, threatened/priority flora, and significant flora and significant vegetation as defined by EPA guidance.	5.3.1
	6. Assess the direct and indirect impacts from the proposed mining. Discuss the significance of the direct and indirect impacts from the mining activities on flora and vegetation at a local and regional level.	5.3
	7. Provide a detailed description of the cumulative impacts associated with the proposal and demonstrate that 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.	5.3.9

EPA objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	
	8. Demonstrate that the proposal has been designed to avoid and minimise impacts, such as the placement of access roads and infrastructure has had regard to utilising existing areas of disturbance, and risk from stormwater runoff and impediments to surface and sheet flow drainage, have been considered.	5.2.5
	9. Discuss proposed management, monitoring and mitigation methods to be implemented demonstrating that the proposal has addressed the mitigation hierarchy and ensure residual impacts (direct and indirect) are not greater than predicted.	0, 5.6, Appendix 4
	10. Describe the proposed rehabilitation methodology for areas within the Development Envelope, including but not limited to: a. characteristics of soil and soil profile b. topsoil management c. retention or reuse of vegetative material (where feasible) d. return of species and communities (where feasible) consistent with the pre-existing composition of the affected area e. timeframes for rehabilitation.	2.3.10
	11. 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: a. areas previously disturbed which would be rehabilitated b. closure objectives and completion criteria (qualitative at this stage) addressing post mining landforms and soil profile reconstruction, native vegetation and habitat for significant fauna c. identify vegetation and fauna reference and analogue sites, to inform completion criteria.	Appendix 2
	12. Demonstrate and document in the PER how the EPA's objective for this factor can be met.	5.6, 8, 10
	13. 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) and include reference to the Commonwealth Assessment Guide for any MNES.	5.6, 8
	14. 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.	8
Relevant policy	***EPA policy and guidance***	
	Environmental Factor Guideline — Flora and Vegetation (EPA 2016a).	
	Technical Guide — Flora and Vegetation Surveys for Environmental Impact Assessment (EPA and Department of Parks and Wildlife 2015).	
	Guidance Statement No. 6 — Rehabilitation of Terrestrial Ecosystems (EPA 2006).	
	EPA Policy and Guidance Guidelines for Preparing Mine Closure Plans (DMP and EPA 2015).	
	Instructions on how to prepare an Environmental Review Document (EPA 2016e).	
	Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans (EPA 2016f).	
	Commonwealth policies and guidance	
	Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (Commonwealth Department of the Environment, 2014).	
	Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (Department of Sustainability, Environment, Water, Population and Communities, 2012).	
	Other policy and guidance	
	WA Environmental Offsets Policy (Government of Western Australia, 2011).	
	WA Environmental Offsets Guidelines (Government of Western Australia, 2014).	

5.2 Receiving environment

5.2.1 Flora and vegetation studies

The results from floristic and vegetation surveys outlined in Table 5-2 have been used to support the assessment of potential impacts of the Proposal on flora and vegetation. The most recent comprehensive floristic and vegetation survey reports (Mattiske 2018a, Mattiske 2018b, Mattiske 2018d) are included in Appendix 3.

The surveys were done in accordance with the standards set out in *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016b) and *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016a).

Table 5-2: Flora and vegetation studies completed for the Proposal

Investigation	Scope	Number of Personnel	Survey Effort (Person Days)
Mattiske Consulting Pty Ltd (2018d).	Mattiske Consulting and Strategen Environmental conducted targeted floristic surveys focused on Priority 1 flora, range extensions and new species with potential to be impacted by the Proposal in November 2018. Species of noted focus due to potential presence in the Development Envelope and potential impacts included: • *Brachyloma stenolobum* (P1) • *Grevillea lissopleura* (P1) • *Grevillea marriottii* (P1) • *Labichea rossii* (P1) • *Microcorys* sp. Mt Holland (D. Angus DA 2397) (P1) • *Acacia* sp. 1 (undescribed) • *Acacia* sp. Mt Holland (B. Ellery BE1147) (P1) • *Eremophila verticillate* (Threatened) (previously stated as *Eremophila* sp. aff. *verticillate)* • *Hibbertia* aff. *oligantha* (undescribed) • *Acacia undosa (P3)* • *Eutaxia lasiocalyx (P2)* • *Hakea pendens* (P3) • *Dicrastylis capitellata* (P1) • *Daviesia newbeyi* (P3) • *Stenanthemum bremerense* (P4) • *Daviesia sarissa subsp. redacta* (P2) • *Olearia laciniifolia* (P2) • *Orianthera exilis* (P2) • *Chorizema circinale* (P2) • *Callitris verrucosa* (range extension) • *Centrolepis strigosa subsp. rupestris* (range extension). Targeted surveys were conducted both within and outside the Development Envelope to characterise local context in addition to understanding the direct impacts of the Proposal.	5	25

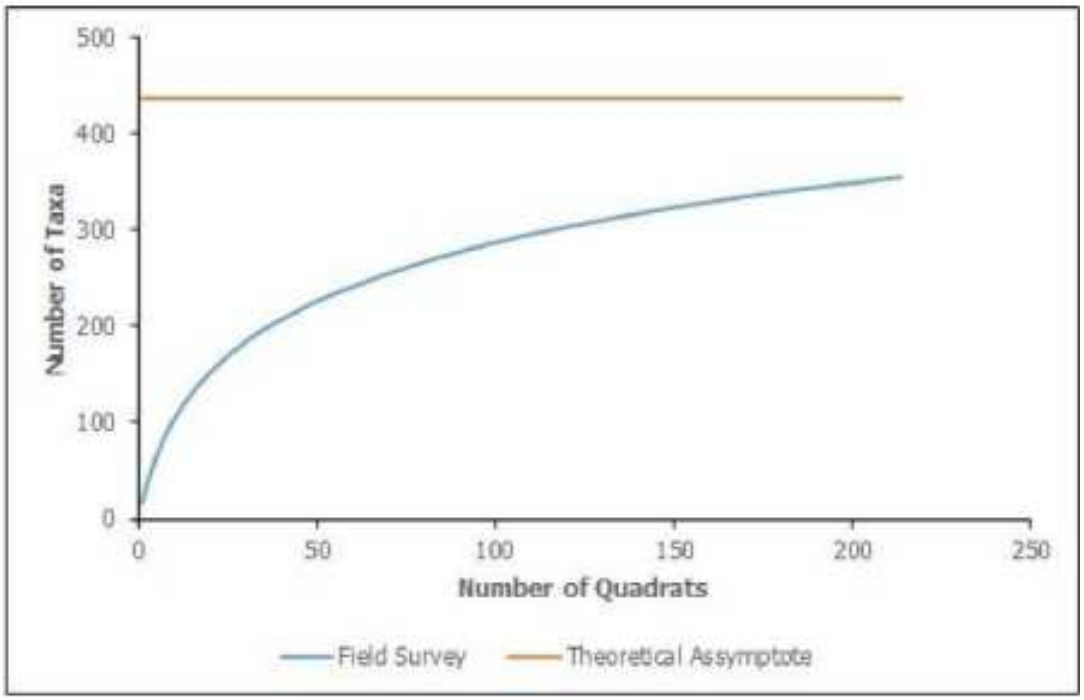
Investigation	Scope	Number of Personnel	Survey Effort (Person Days)
Mattiske Consulting Pty Ltd (2018b).	Mattiske Consulting Pty Ltd was commissioned between April and June of 2018 by Western Australian Lithium Pty Ltd to undertake a survey of the threatened *Banksia sphaerocarpa* var. *dolichostyla* both within the Earl Grey Lithium Development Envelope and within the broader region surrounding the proposal area. 18 individual populations of *Banksia sphaerocarpa* var. *dolichostyla* were recorded during the surveys. A total of 16,503 *Banksia sphaerocarpa* var. *dolichostyla* individuals were recorded across all the areas surveyed. Population estimates for two populations of *Banksia sphaerocarpa* var. *dolichostyla* outside the Development indicated an additional 6,083 individuals, therefore, the estimated local population is anticipated to be 22,586 plants.	3-4	36
Mattiske Consulting Pty Ltd (2018a).	Flora and vegetation surveys have been conducted within the Earl Grey Lithium Project development envelope, a 1 km area around the Development Envelope and 200 m either side of the centre line of the access routes. The total area surveyed was 4,417.83 ha, of which 1,993.59 ha was within the Earl Grey Lithium Project Development Envelope. A total of 214 vegetation survey quadrats were established and surveyed across the survey area.	4	36
Blueprint Environmental Strategies (2017).	In April 2017, Goldfields Landcare Services conducted surveys for *Banksia sphaerocarpa* var. *dolichostyla* within proposed landform and infrastructure areas of the Development Envelope.	2	6
Mattiske Consulting Pty Ltd (2017).	The assessment of the flora and vegetation of the project areas at Mt Holland was undertaken by Mattiske, from the 24 to 26 October 2016 and 9 to 10 November 2016. A total of 43 vegetation survey quadrats were established.	2	10
Native Vegetation Solutions (2016).	In September 2016, Native Vegetation Solutions conducted surveys for *Banksia sphaerocarpa* var. *dolichostyla* within proposed exploration areas of the Earl Grey deposit.	Not defined	Not defined
Native Vegetation Solutions (2014).	Native Vegetation Solutions (NVS) conducted surveys for *Banksia sphaerocarpa* var. *dolichostyla* around existing infrastructure areas (including roads, the historic camp, landfill and airstrip) of the site.	Not defined	Not defined

Survey adequacy

A species accumulation plot based on accumulated species recorded versus sites surveyed within the Proposal Survey Area was used to provide an indication of the level of adequacy of the survey effort. As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

A species accumulation curve based on the species accumulation analysis of Colwell (2013) was used to evaluate the adequacy of sampling (Figure 5-1). The asymptotic value was determined using Michaelis-Menten modelling. Using this analysis, the incidence based coverage estimator of species richness (ICE, Chao 2004) was calculated to be 437.29 species occurring within the Proposal Survey Area. Based on this value, and the total of 355 species recorded in the 214 survey quadrats, approximately 84.38 % of the flora species potentially present within the survey area were recorded. The number of species used for the species accumulation analysis is lower than the actual number of species reported in the survey (369 species) because opportunistically collected taxa (i.e. those taxa which were recorded outside survey quadrats) were excluded from this analysis.

Figure 5-1: Average randomised species accumulation curve



Targeted Surveys

Surveys to define the distribution, boundaries and populations of *Banksia sphaerocarpa* var. *dolichostyla* within the vegetation survey area were undertaken between April and June of 2018 based on known locations of populations of *Banksia sphaerocarpa* var. *dolichostyla* which had been identified during the course of previous vegetation surveys or which had been uncovered through a process of statistical identification of potential habitat location based on known landscape attributes associated with populations of this taxon.

Additional follow up surveys for Priority species and new species was undertaken in November 2018 as requested by the EPA following DMA comments. Consultation with the EPA regarding the survey methodology occurred prior to conducting the survey. Targeted surveys were conducted for the following species:

- *Grevillea lissopleura* (P1)
- *Grevillea marriottii* (P1)
- *Labichea rossii* (P1)
- *Microcorys* sp. Mt Holland (D. Angus DA 2397) (P1)
- *Daviesia sarissa* subsp. *redacta* (P2)
- *Eutaxia lasiocalyx* (P2)
- *Olearia laciniifolia* (P2)
- *Orianthera exilis* (P2)
- *Acacia undosa* (P3)
- *Hakea pendens* (P3)
- *Chorizema circinale* (P3)
- *Acacia* sp. 1 (undescribed)
- *Acacia sp. Mt Holland (B. Ellery BE1147)* (P1)
- *Eremophila verticillata* (Threatened) (previously stated as *Eremophila* sp. aff. *verticillata)*

- *Hibbertia* aff. *oligantha* (undescribed)
- *Callitris verrucose* (range extension)
- *Centrolepis strigosa subsp. rupestris* (range extension)
- *Dicrastylis capitellata* (P1)
- *Daviesia newbeyi* (P3)
- *Stenanthemum bremerense* (P4).

Threatened Flora

Broad pre-planned search polygon boundaries were populated with transects spaced 20 m apart in a north-south orientation. These transects were used as guides for foot traverses of each polygon. The search for *Banksia sphaerocarpa* var. *dolichostyla* was continued in both the north-south and east west directions until a combination of factors indicated that further searching was not warranted. This included the lack of recording of the taxon, a change in the vegetation community in which the taxon is known to occur (including coexisting species), and a change in the soil type to one which does not support the habitat of the *Banksia sphaerocarpa* var. *dolichostyla*.

In situations where it was not possible to record all individual plants within an identifiable population, an estimate of the total population was calculated using Esri ArcGIS. Polygons of the population boundary were created using field records and high resolution imagery and estimates of total plant population based on partially recorded population to estimate plant densities and numbers across the entire polygon. This method was used when recorded data was available for over 50% of the population portion.

With newly uncovered populations, it was not appropriate to use the above-mentioned estimated methodology as recorded density data was not available for over 50% of the population portion. Therefore, a conservative population boundary was established using high resolution imagery and an average population density from a separately recorded population with sufficient data was applied.

Priority and other conservation significant flora

Searches for the conservation significant taxa listed above were undertaken in selected areas of the Development Envelope on the following basis:

1. The vegetation community was known, or suspected to provide habitat for one or more of the listed conservation significant species; and,
2. The vegetation community represented was likely to experience higher levels of clearing based on the infrastructure footprint made available to Mattiske Consulting.

Broad pre-planned search polygon boundaries were populated with transects spaced 10 m apart in a north-south or east-west orientation, as appropriate. These transects were used as guides for foot traverses of each polygon.

During the field surveys, botanists had access to all relevant data in the Esri iOS application, Collector for ArcGIS on Apple iPads (provided and maintained by CAD Resources). Data layers accessible in the field included the Development Envelope and vegetation survey boundaries, the boundaries of planned significant flora search areas and associated 10 or 20 m spaced search transect lines, boundaries of proposed infrastructure areas (disturbance footprint), locations of all known significant flora from both historical and contemporary surveys and aerial imagery supplied by either Covalent or acquired by CAD Resources. The locations of any conservation significant flora were recorded with the Esri iOS application, Collector for ArcGIS. During the field survey botanists also had access to detailed data on all potential conservation significant species which may potentially be encountered during the field survey.

Survey areas for both 2017 and 2018 targeted surveys are shown in Figure 5-2 and survey results are described in detail in Section 5.2.3.

Local populations of conservation significant flora were estimated based on the data recorded within each of the vegetation communities surveyed (S2, S3, MW6, MW7, W4, W9, W11 and W13) during the 2018 targeted flora survey (Mattiske 2018d). Population estimates were made if the species was recorded in sufficient number and the vegetation community was sufficiently surveyed. The estimation is based on the assumption that the species would be present consistently across the vegetation community. The species estimated within these vegetation communities were:

- *Acacia* sp. Mt Holland (B. Ellery BE1147)
- *Acacia undosa*
- *Labichea rossii*
- *Microcorys* sp. Mt Holland (D. Angus DA2397).

Verticordia stenopetala, *Hakea pendens* and *Eutaxia lasiocalyx* were recorded within the vegetation communities, however insufficient records were available to estimate the population.

Other species recorded during the survey were not included in the local population size estimates because these taxa were recorded exclusively outside of the Development Envelope, principally in vegetation communities which do not intersect the Development Envelope, and hence will not be impacted by infrastructure development within the Development Envelope.

Estimates of local population sizes for species recorded within the W4, W9, W11 and W13 communities will have a much greater level of uncertainty associated with them due to the relatively small (less than 5%) areas of the respective vegetation communities surveyed. Nonetheless, the estimated local population will assist in providing an indication of potential impacts to the species present. The local population estimates are detailed in Table 5-3 and include impacts to the S3 vegetation community (12.7 ha of S3 to be cleared as the Proposed Layout), although efforts will be undertaken to avoid the S3 community where possible, due to its association with conservation significant flora species.

Table 5-3: Local population estimations for conservation significant species

Species	Vegetation Community	Individuals Recorded	Estimated population	Individuals within Proposed Layout
Acacia sp. Mt Holland (B. Ellery BE1147)	W4	2338	109,426	458
Acacia undosa	W13	11	265	30
	S3	182	1,311	157
	W9	25	842	32
Labichea rossii	Total	207	2,153	189
	MW6	24	141	67
	MW7	1037	4,108	2,711
	S2	200	2,215	670
	S3	4438	31,980	3,835
	W11	16	492	110
	W13	4	96	11
	W9	72	2,460	94
Microcorys sp. Mt Holland (D. Angus DA 2397)	Total	5791	41,492	7,498

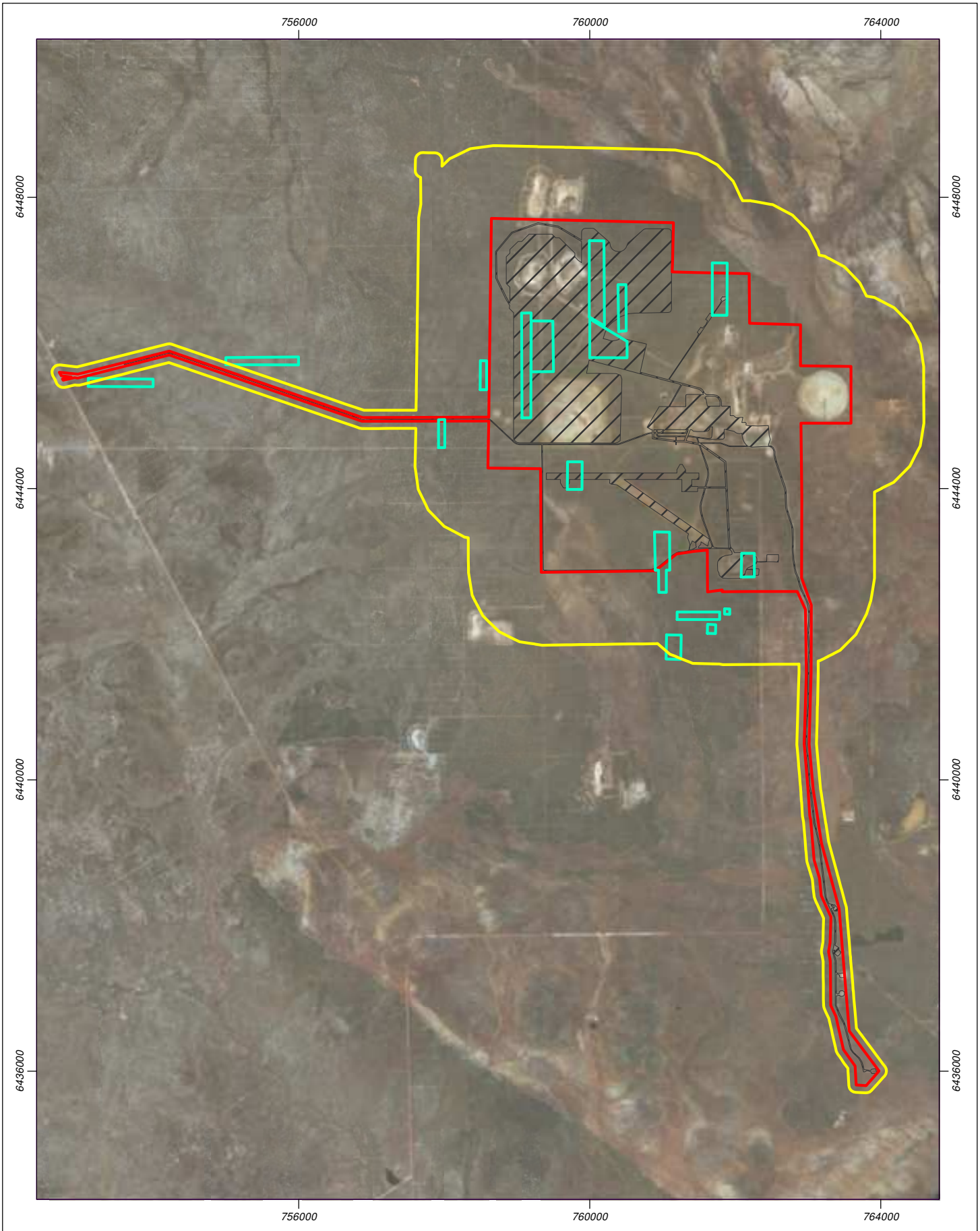


Figure 5-2: Targeted Priority Flora Survey Areas

Scale 1:70,000 at A4

0 400 800 1,200 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 12/01/2019

Author: vdinh

Source: SQM: Aerial imagery - 2017,
Development Envelope, Chuditch records - 17/11/2017.

Path: C:\GIS\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G041_RevA.mxd

Legend

- Development Envelope
- Indicative proposed footprint
- *Banksia sphaerocarpa* var. *dolichostyla* Survey Area
- Priority Flora Survey

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5.2.2 Regional vegetation context

Regional vegetation associations

The Proposal is located in the Southern Cross subregion of the Coolgardie Bioregion based on the Interim Biogeographic Regionalisation for Australia (IBRA) (Figure 5-3). The major greenstone belts in the district that form the banded ironstone hills are the main source of topographical relief. The Development Envelope is situated within the designated area and buffer for Ironcap Hills Vegetation Complexes (Mt Holland, Middle, North and South Ironcap Hills, Digger Rock and Hatter Hill) (banded ironstone), a Priority 3 ecological community, as shown in Figure 5-3. However, the Development Envelope vegetation is more consistent with Eucalyptus woodland characteristic of flat areas of the Bioregion.

Approximately 5 km north of the proposed Development Envelope is the Jilbadji Nature Reserve which is classified as an Environmentally Sensitive Area (ESA).

Two regional Beard vegetation system associations, Forrestania 511 and Skeleton Rock 519, are represented within the Development Envelope (Figure 5-4). Forrestania 511 is characterised by salmon gum and morrel medium woodland. Skeleton Rock 519 is characterised by shrublands and mallee scrub dominated by *Eucalyptus eremophila*. The regional extent of clearing for each Vegetation association occurring in the Development Envelope is shown only for the Southern Cross Subregion in Figure 5-3, as both vegetation associations occur within the Southern Cross subregion of the greater Coolgardie Region. Less than 2% of each of these vegetation associations has been cleared within the Coolgardie Region and the Southern Cross Subregion, showing negligible loss of vegetation to date at both a regional and subregional scale.

Table 5-4: Extent and clearing of vegetation associations (GoWA 2018)

Vegetation association	Total area Vegetation association within Southern Cross Subregion – pre-European extent (ha)	% Cleared within Southern Cross Subregion	% Uncleared within Southern Cross Subregion	% in Conservation within Southern Cross Subregion
Forrestania (511)	153,641.65	0.42%	99.58%	9.68%
Skeleton Rock (519)	56,013.47	1.13%	98.87%	27.89%

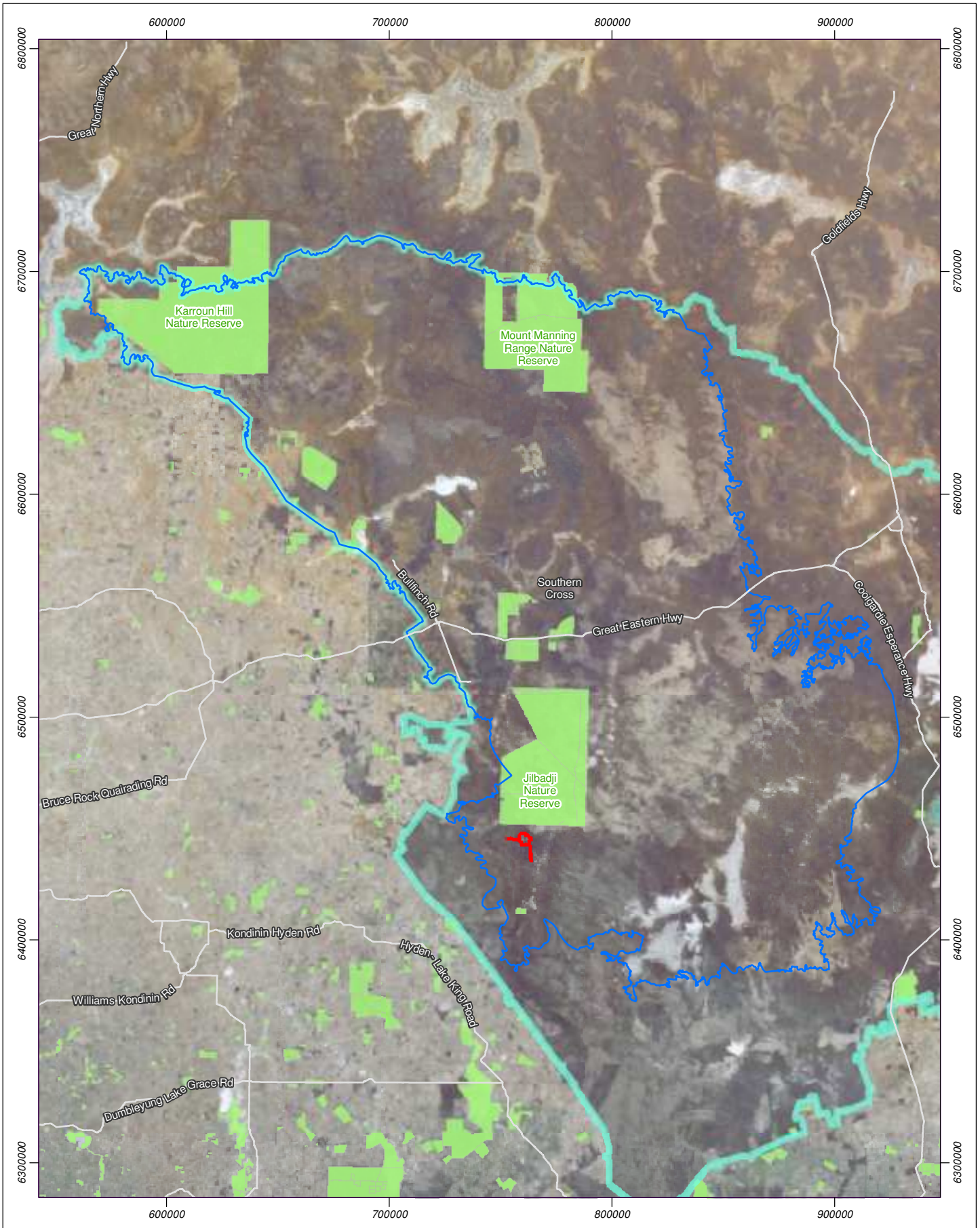

Figure 5–3: Southern Cross Sub-region

Scale 1:2,300,000 at A4

0 23 46 69 Km

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 30/11/2018

Author: vdinh

Source: Landgate: Aerial imagery - 2017; SQM: Development Envelope, DooE: IBRA subregion - 04/12/2017. DWER: Nature reserve - 2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G020_RevC.mxd

Legend

- Development Envelope
- Nature reserve
- IBRA subregion COO02
- Greater Western Woodland boundary

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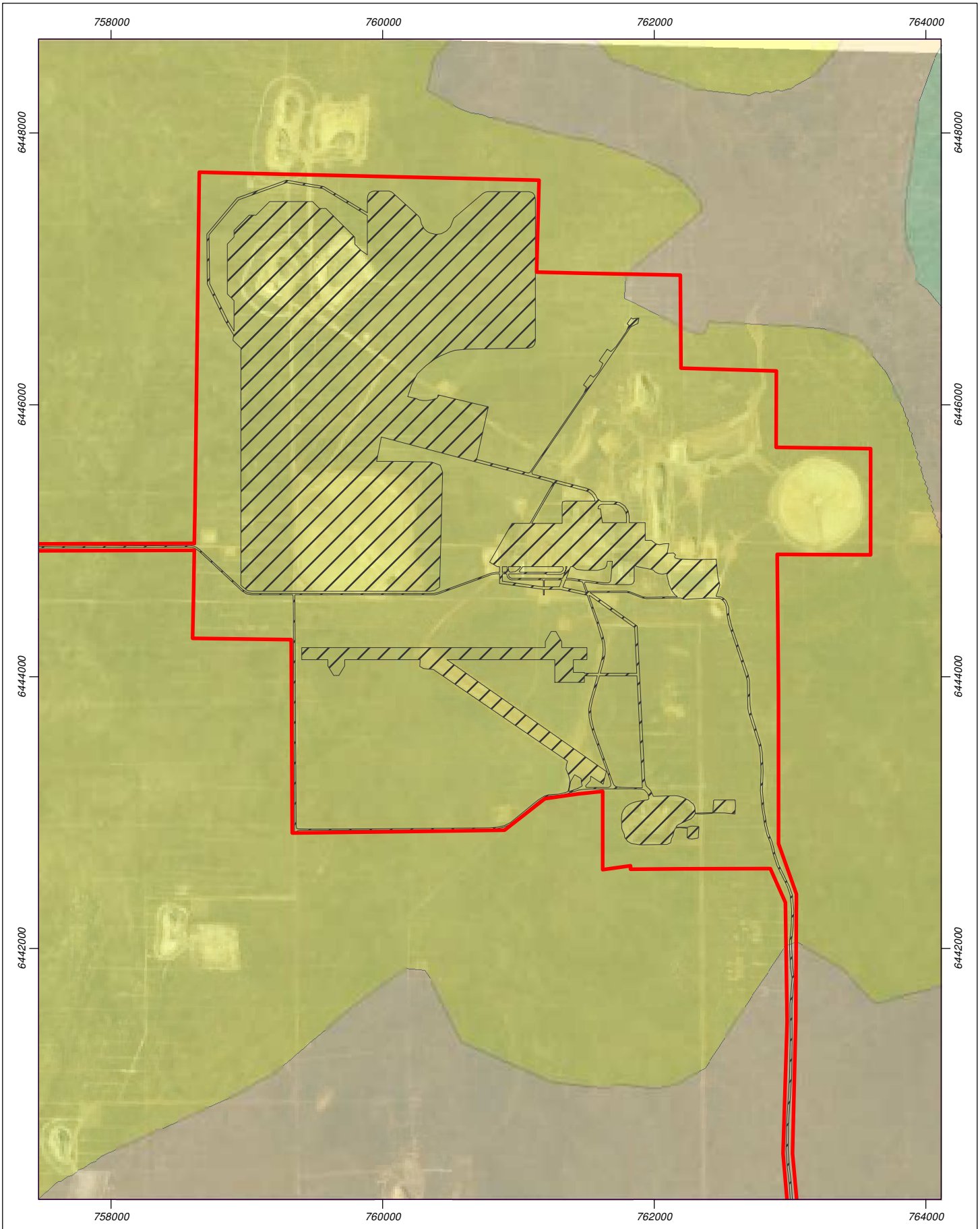

Figure 5-4: Vegetation associations

Scale 1:37,500 at A4

0 400 800 1,200 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 30/11/2018

Author: vdinh

Source: SQM: Aerial imagery - 2017, Proposed footprint, Development Envelope, Vegetation code - 17/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G040_RevA.mxd

Legend

- Development Envelope
- Indicative proposed footprint

Beards vegetation - system association

- Forrestania - 1413
- Forrestania - 511
- Skeleton Rock - 519

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Local Vegetation Communities

The majority of the Proposal is situated on sandy, sandy clay or clay loam flats and gentle slopes supporting Eucalyptus mallee woodlands over Melaleuca shrublands.

Twenty-six local vegetation communities were defined by Mattiske (2017) in the 2016 and 2017 surveys in the vicinity of the Proposal, including a buffer which extended 1 km beyond the boundary of the Development Envelope area and 200 m either side of the centre line of the access routes, as listed in Table 5-5 and shown in Figure 5-5. Of these, twenty-three communities were identified within the Development Envelope.

Table 5-5: Vegetation communities within the Proposal Survey Area

Code	Area (ha)	Description
Woodlands		
W4	235.8	*Eucalyptus flocktoniae* subsp. *flocktoniae*, *Eucalyptus eremophila* low open mallee woodland over *Melaleuca depauperata*, *Callitris canescens*, *Melaleuca phoidophylla* mid-tall sparse shrubland over *Acacia tetraptera*, *Grevillea acuaria* low isolated heath shrubs on orange brown sandy clay soils with ironstone or quartz pebbles on flats and slopes.
W5	138.7	*Eucalyptus rigidula*, *Eucalyptus burracoppinensis* low open mallee woodland over *Micromyrtus erichsenii*, *Persoonia helix, Hakea erecta* mid sparse heathland over *Hibbertia rostellata*, *Hibbertia stowardii* low isolated shrubs on gravelly orange brown clayey sand soils on flats and slopes.
W6	82.3	*Eucalyptus burracoppinensis, Allocasuarina acutivalvis*, *Allocasuarina spinosissima* tall open mallee woodland over *Hakea erecta*, *Petrophile stricta*, *Banksia laevigata* subsp. *fuscolutea* mid sparse heathland over *Drummondita hassellii*, *Hibbertia exasperata*, *Psammomoya choretroides* low sparse shrubland on yellow brown sandy soils on flats.
W7	85.2	Burnt *Eucalyptus* sp. (*E. cylindriflora, E. flocktoniae* subsp. *flocktoniae, E. prolixa, E. salmonophloia, E. eremophila, E. capillosa* subsp. *polyclada*) low open woodland over *Melaleuca hamata*, *Melaleuca eleuterostachya* mid sparse shrubland over *Daviesia argillacea*, *Acacia hemiteles*, *Acacia deficiens* low sparse heathland on orange brown sandy clay soils on flats.
W8	259.0	*Eucalyptus prolixa*, *Eucalyptus salmonophloia*, *Eucalyptus urna* mid mallee woodland over *Santalum acuminatum*, *Daviesia argillacea*, *Melaleuca eleuterostachya* mid sparse heathland over *Acacia merrallii*, *Daviesia argillacea*, *Microcybe multiflora* subsp. *multiflora* low sparse shrubland on red brown sandy clay flats.
W9	559.0	*Eucalyptus urna*, *Eucalyptus ravida*, *Eucalyptus prolixa* low mallee woodland over *Melaleuca pauperiflora*, *Dodonaea stenozyga*, *Daviesia argillacea* mid sparse shrubland over *Acacia merrallii*, *Grevillea acuaria*, *Microcybe multiflora* subsp. *multiflora* low sparse shrubland.
W10	49.0	*Eucalyptus* sp. (*E. urna, E. cylindrocarpa, E, rigidula, E gracilis*) low mallee woodland over *Melaleuca pauperiflora*, *Daviesia scoparia* mid sparse shrubland over *Acacia merrallii*, *Grevillea huegelii*, *Olearia muelleri* low sparse shrubland on red clay soils on flats.
W11	600.1	*Eucalyptus eremophila*, *Eucalyptus rigidula*, *Eucalyptus flocktoniae* subsp. *flocktoniae* low mallee woodland over *Melaleuca lateriflora*, *Melaleuca eleuterostachya*, *Melaleuca acuminata* subsp. *acuminata* mid sparse shrubland over *Grevillea acuaria*, *Acacia hystrix* subsp. *hystrix*, *Microcybe ambigua* low sparse shrubland on orange brown clay soils on flats.
W12	186.8	*Eucalyptus cylindriflora*, *Eucalyptus cylindrocarpa*, *Eucalyptus prolixa* low open mallee woodland over *Melaleuca eleuterostachya*, *Melaleuca lateriflora*, *Daviesia argillacea* mid sparse shrubland over *Grevillea acuaria*, *Acacia merrallii*, *Acacia camptoclada* low sparse shrubland on yellow brown to red brown sandy clay soils on flats.
W13	370.4	*Callitris canescens*, *Eucalyptus rigidula* low open mallee woodland over *Micromyrtus erichsenii*, *Persoonia helix*, *Allocasuarina spinosissima* mid tall sparse shrubland over *Beyeria sulcata*, *Drummondita hassellii* low sparse shrubland on yellow brown to orange brown clayey sands on flats and slopes.
W14	61.0	Burnt *Eucalyptus salmonophloia*, *Eucalyptus eremophila* mid open woodland over *Santalum acuminatum, Senna artemisioides* subsp. *filifolia* mid sparse shrubland over *Acacia hemiteles*, *Olearia muelleri* low sparse shrubland on orange brown clay spoils on flats.
W15	174.3	Burnt *Allocasuarina acutivalvis*, *Eucalyptus* sp. (*E. cylindriflora, E. eremophila, E, gracilis, E. rigidula, E. burracoppinensis*) low open mallee woodland over *Hakea minyma*, *Melaleuca cordata*, *Melaleuca hamata* mid sparse shrubland over *Dampiera sacculata, Pimelea sulfurea*, *Hybanthus floribundus* subsp. *floribundus* low sparse forbland.

Code	Area (ha)	Description
W16	113.7	Burnt *Eucalyptus* sp. (*E. cylindriflora, E. tenuis, E. burracoppinensis, E. eremophila*) low open mallee woodland over *Persoonia helix, Gastrolobium spinosum*, *Acacia assimilis* mid sparse shrubland over *Dampiera tenuicaulis* subsp. *curvula*, *Glischrocaryon aureum*, *Dampiera eriocephala* low sparse forbland on orange red gravelly sandy loam soils on flats.
W17	2.8	Burnt *Eucalyptus* sp. (*E. cylindriflora, E. tenuis, E. burracoppinensis, E. eremophila*) low open mallee woodland over *Persoonia helix, Gastrolobium spinosum*, *Acacia assimilis* mid sparse shrubland over *Dampiera tenuicaulis* subsp. *curvula*, *Glischrocaryon aureum*, *Dampiera eriocephala* low sparse forbland on orange red gravelly sandy loam soils on flats.
W18	69.3	*Eucalyptus rigidula. Eucalyptus platycorys*, *Callitris canescens* low open mallee woodland over *Melaleuca hamata*, *Allocasuarina spinosissima*, *Hakea erecta* mid sparse shrubland over *Hibbertia gracilipes*, *Phebalium obovatum*, *Cyathostemon heterantherus* low sparse shrubland on yellow brown sandy soils on flats.
W19	68.6	*Eucalyptus prolixa* low open mallee woodland over *Daviesia argillacea*, *Santalum acuminatum* mid sparse shrubland over *Acacia merrallii*, *Microcybe ambigua*, *Grevillea acuaria* low sparse shrubland on orange-red brown sandy clay soils on flats.
W20	48.3	Burnt *Eucalyptus urna*, *Eucalyptus salmonophloia*, *Eucalyptus tenuis* mid open mallee woodland over *Melaleuca pauperiflora* mid sparse shrubland over *Acacia deficiens*, *Daviesia argillacea*, *Daviesia grahamii* low sparse shrubland on red brown clay soils on flats.
W21	21.3	*Eucalyptus eremophila*, *Eucalyptus flocktoniae* subsp. *flocktoniae* low open mallee woodland over *Melaleuca hamata* over *Acacia acanthoclada* subsp. *acanthoclada*, *Dampiera sacculata*, *Westringia cephalantha* subsp. *cephalantha* low sparse shrubland on grey brown clayey sand soils on flats and slopes.
W22	66.0	*Eucalyptus eremophila* low open mallee woodland over *Melaleuca hamata*, *Melaleuca eleuterostachya*, *Melaleuca laxiflora* mid sparse shrubland over *Hibbertia exasperata*, *Cyathostemon heterantherus*, *Acacia sphacelata* subsp. *sphacelata* low sparse shrubland on slightly gravelly yellow-orange brown clay soils on flats and slopes.
Mallee Woodlands		
MW6	112.0	*Eucalyptus burracoppinensis, Eucalyptus eremophila mid open mallee woodland over Thryptomene kochii, Melaleuca laxiflora, Acacia acuminata mid open shrubland over Drummondita hasseli, Microcybe ambigua low sparse heathland on grey–brown to orange–brown clay to clay sand, often with scattered ironstone pebbles on flats.*
MW7	63.1	*Eucalyptus capillosa* subsp. *polyclada* mid open mallee woodland over *Allocasuarina spinosissima*, *Callitris canescens*, *Hakea minyma* mid tall sparse shrubland over *Phebalium megaphyllum* low sparse shrubland on orange brown clay soils on flats and slopes.
MW8	2.5	*Eucalyptus eremophila* low open mallee woodland over *Melaleuca hamata*, *Leptospermum erubescens*, *Melaleuca lateriflora* mid sparse shrubland over *Thomasia* sp. Salmon Gums (C.A. Gardner s.n. PERTH 02708639), *Darwinia* sp. Karonie (K. Newbey 8503) low sparse shrubland on orange brown clay in minor drainage channel.
Shrubland		
S1	65.0	*Allocasuarina acutivalvis, Allocasuarina spinosissima* tall closed shrubland over *Hakea subsulcata, Melaleuca cordata, Micromyrtus erichsenii* mid sparse heathland on lateritic orange-red clay soils on flats and lower slopes.
S2	228.2	*Allocasuarina acutivalvis, Allocasuarina spinosissima, Eucalyptus burracoppinensis* tall open shrubland over *Thryptomene kochii, Persoonia helix, Micromyrtus erichsenii* mid sparse heathland over *Cyathostemon heterantherus, Hibbertia exasperata, Drummondita hassellii* low sparse shrubland on orange brown clayey sand soils on flats.
S3	106.0	*Allocasuarina acutivalvis*, *Eucalyptus burracoppinensis* tall sparse shrubland over *Banksia purdieana*, *Hakea subsulcata*, *Melaleuca cordata* mid sparse shrubland over *Micromyrtus erichsenii*, *Persoonia helix* low isolated shrubs on gravelly yellow brown to orange brown clay to clayey sand soils on flats.
Heathland		
H1	2.0	*Melaleuca cliffortioides*, *Allocasuarina campestris*, *Dodonaea adenophora* mid open heathland over *Grevillea lissopleura* (P1), *Trymalium myrtillus* subsp. *myrtillus* low sparse shrubland on rocky red-brown sandy clay soils on slopes.
Cleared or Degraded		
CL	647.4	Cleared land, includes isolated small patches of degraded ruderal vegetation.

Overall, the vegetation communities mapped and species recorded in the survey area were consistent with the historical mapping of Beard (1972, 1990) and the more recent localised surveys (Craig 2006, Native Vegetation Solutions 2014, Convergent Minerals Limited 2014, Native Vegetation Solutions 2016). The majority of the Proposal is situated on sandy, sandy clay or clay loam flats and gentle slopes supporting *Eucalyptus* mallee woodlands over *Melaleuca* shrublands, interspersed with dense *Allocasuarina* scrub. No banded ironstone formations or vegetation associated with such formations was identified during surveys of the Development Envelope and surrounding areas.

Within the area mapped as cleared are smaller patches of highly degraded vegetation. While still comprised of native species, these areas were deemed functionally cleared given the size of the vegetation patches and spatial context within existing cleared areas. Overall, the species recorded during the field survey, and the vegetation communities subsequently defined, are typical of the flora and vegetation which has been previously reported in the Forrestania region by Beard (1972, 1990), and in the more recent surveys in the vicinity of the Project.

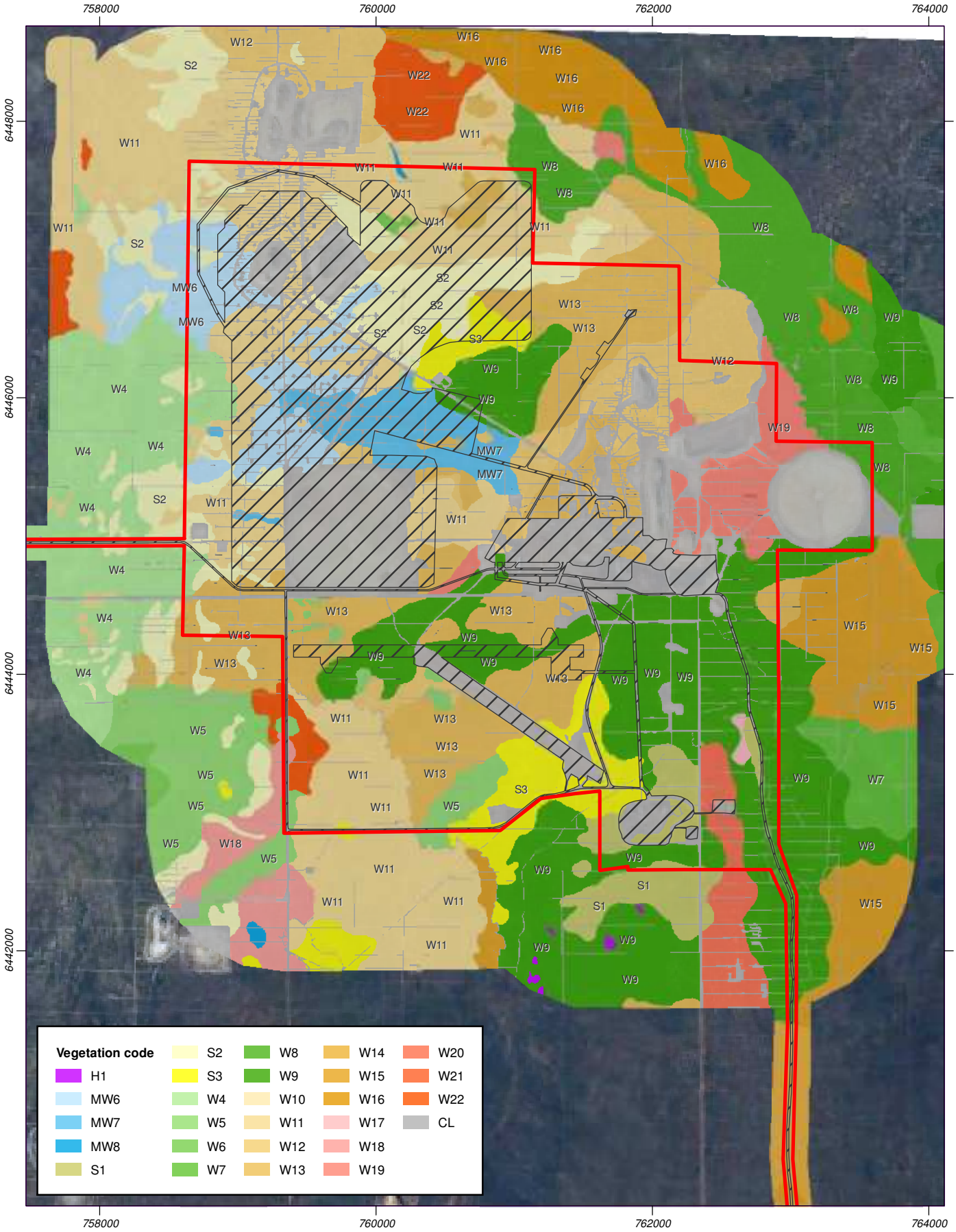

Figure 5-5: Vegetation mapping

Scale 1:37,500 at A4

0 400 800 1,200 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 30/11/2018

Author: vdinh

Source: SQM: Aerial imagery - 2017, Proposed footprint, Development Envelope, Vegetation code - 17/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G021_RevC.mxd

Legend

- Development Envelope
- Indicative proposed footprint

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Significant vegetation communities

One PEC, as listed by DBCA (2017a) currently intersects the Proposal. The Development Envelope is situated within the designated area and buffer for Ironcap Hills Vegetation Complexes (Mt Holland, Middle, North and South Ironcap Hills, Digger Rock and Hatter Hill) (banded ironstone), a Priority 3 ecological community, as shown in Figure 5-6. The principal threat to this PEC is mining (DBCA 2017a).

5.2.3 Significant Flora

A total of 450 plant taxa were identified in the desktop assessment as having the potential to occur within the Proposal Development Envelope (Mattiske 2017). These 450 taxa are representative of 54 families and 160 genera. The most commonly represented families were the Myrtaceae (115 taxa), Fabaceae (72 taxa), Proteaceae (40 taxa), Asteraceae (20 taxa), and Scrophulariaceae (13 taxa). The most commonly represented genera were Eucalyptus (50 taxa), Acacia (40 taxa), and Melaleuca (29 taxa).

A total of 369 vascular plant taxa which are representative of 140 genera and 49 families were recorded within the Development Envelope and surrounding vicinity. The majority of taxa recorded were representative of the Myrtaceae (73 taxa), Fabaceae (48 taxa), Proteaceae (42 taxa), Asteraceae (19 taxa), Rutaceae (17 taxa), and Ericaceae (11 taxa) families. The majority of the taxa recorded were widespread both locally and more broadly within the associated biogeographical subregion.

A number of conservation significant taxa have been recorded within the Development Envelope (Mattiske 2018a, Blueprint 2017). Table 5-6 lists all conservation significant flora identified within and outside of the Development Envelope during historical surveys. This list provides the basis for the species included in the targeted flora surveys based on conservation significance and likelihood of occurrence. These species are listed in Table 5-7 and shown in Figure 5-10 (*Banksia sphaerocarpa* var. *dolichostyla*) and Figure 5-11 (Priority flora and range extensions). Conservation significant flora found within the proposed layout and their regional distributions are included in Figure 5-7 and Table 5-6. Flora that were found within the proposed layout are discussed in more detail in the following sections.

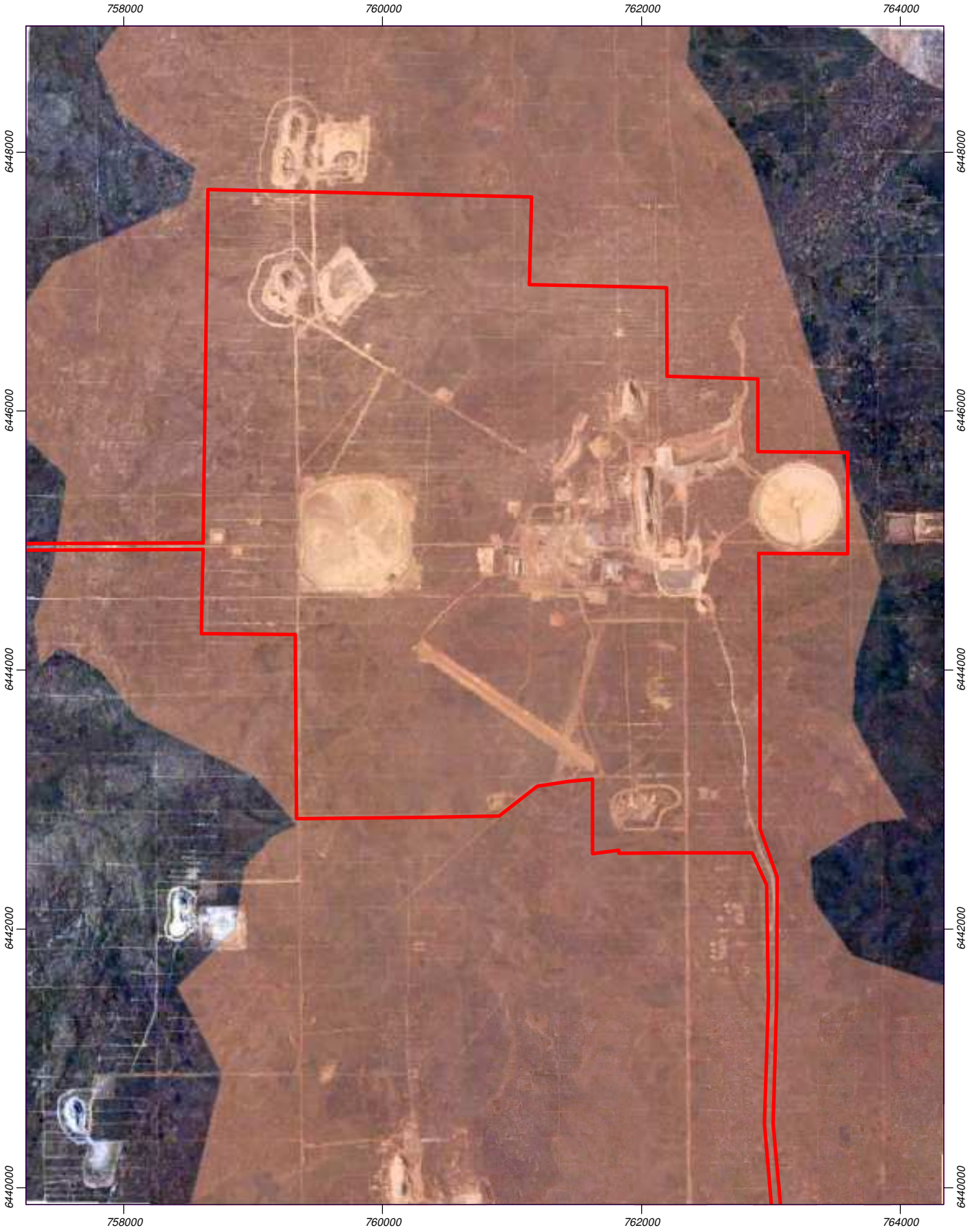

Figure 5-6: PECs in the Development Envelope

Scale 1:40,000 at A4

0 400 800 1,200 m

N

Legend

Development Envelope

PEC name

Ironcap Hills vegetation complexes (Mt Holland, Middle, North and South Ironcap Hills, Digger Rock and Hatter Hill) (banded ironstone formation)

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 30/11/2018
Author: vdinh
Source: SQM: Aerial imagery - 2017,
Development Envelope - 17/11/2017. DWER: PEC - 09/11/2016.
Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G022_RevA.mxd

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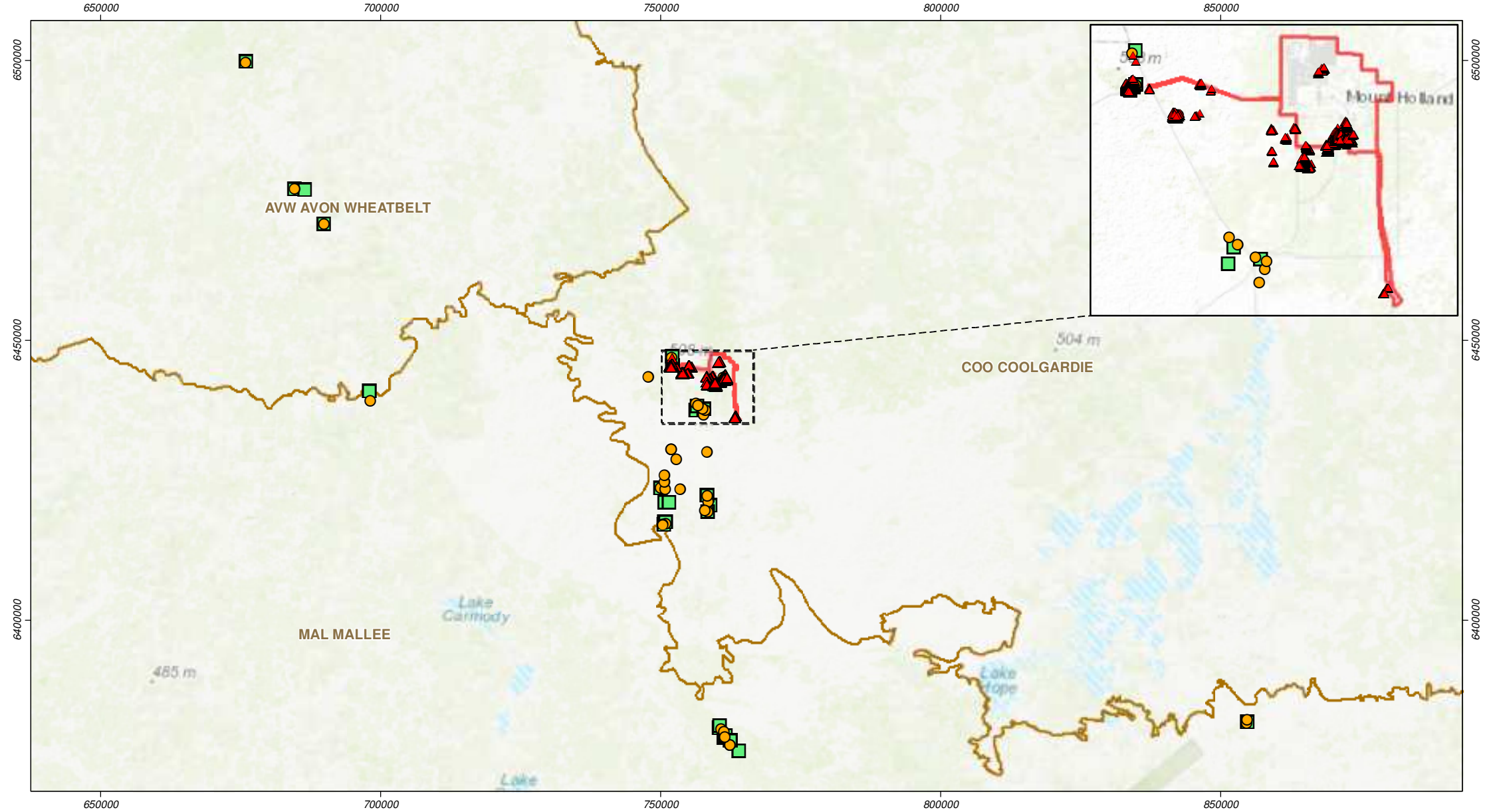

Figure 5-7: Regional *Banksia sphaerocarpa* var. *dolichostyla* populations

N

Scale 1:898,715 at A4

0 10 20 km

Coordinate System: GDA 1994 MGA Zone 50

Date: 12/01/2019

Legend

- Development Envelope
- Proposed clearing (392ha)
- TPFL - *Banksia sphaerocarpa* var. *dolichostyla*
- MCPL - *Banksia sphaerocarpa* var. *dolichostyla*
- WA Herb - *Banksia sphaerocarpa* var. *dolichostyla*

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Table 5-6: Description of Conservation Significant Flora Species Potentially occurring in the Development Envelope

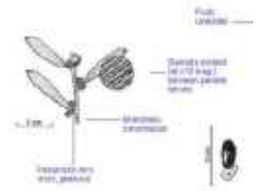
	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Banksia sphaerocarpa var. *dolichostyla*	Threatened (Vulnerable)	Vulnerable	7 records (24,636 estimated plants as per Section 5.2.1) (Mattiske 2018b)	16,503	5,220	92	Easily identified shrub 2 to 4 m tall, with bluish green leaves and golden inflorescences.	Iron–capped rises on ironstone profiles. It is found in low woodlands to low shrublands with associates which include Dryandra and Allocasuarina species.	Refer to Figure 5-7.	Refer to Figure 5-8
Eremophila verticillata[1]	Threatened (Critically Endangered)	Endangered	0	138	0	0	Low spreading shrub, up to 0.8 m high, to 1 m wide. Fl. purple-violet, Nov to Dec.	Clay loam, loam over limestone.		
Acacia sp. Mt Holland (B. Ellery BE1147)	Priority 1	NA	0	2,343	0	0	Up to 100cm high 80cm wide Branchlets terete, densely woolly when young, becoming glabrous, ultimately bare with raised projections from remnant leaf and branchlet bases.	W4, S2 (Mattiske 2018d).		

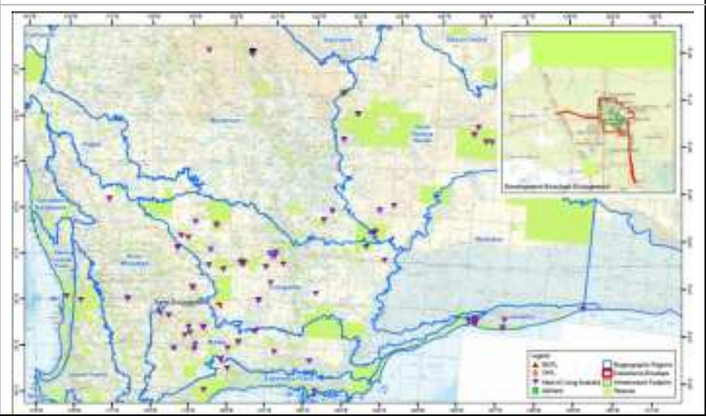
[1] Previously recorded as *Eremophila* sp. aff. *Verticillata.*

	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Brachyloma stenolobum	Priority 1	NA	4 records (601 estimated plants)	1	1	0	The only Western Australian species of *Brachyloma*. White flowers and narrowly triangular, adaxially keeled corolla lobes.	The plant grows on yellow sandplain as a component of heath. First collected in 2002, the species is assumed to not have a wide distribution, but was anecdotally observed to be "moderately common" at the originally identified locations (Hislop and Cranfield 2014).		 Photo from Hislop and Cranfield (2014)
Grevillea lissopleura	Priority 1	NA	7 records (8 estimated plants)	1,277	0	0	A 0.5-1.5 m high shrub; branchlets hairy, not glaucous. Leaves alternate, Flowers in August.	Grows in open scrub in rocky loam.		
Grevillea marriottii	Priority 1	NA	8 records (2,404 estimated plants)	1	0	0	*Grevillea marriottii* blooms from July to October and produces a terminal raceme irregular inflorescence with green, white or green flowers. Later it forms ribbed ellispoidal glabrous fruit that is 10 to 14 mm.	The species is known from Yellow or white sand over laterite. On rises or on tops of lateritic cappings.		

	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Labichea rossii	Priority 1	NA	2 records (101 estimated plants)	212	210	0	Flowers in late September and early October.	Grows out of cracks in the massive outcropping banded ironstone, often in the shade of larger shrubs.		
Microcorys sp. Mt Holland (D. Angus DA 2397)	Priority 1	NA	5 records (0 estimated plants)	8,353	5,692	1,799	Dense to open erect, multi-stemmed woody perennial shrub to 120 cm high; leaves terete to sub-terete, without a pungent tip, often arranged in whorls of 3 along the stem.	Clayey sands to lateritic clay soils; plains and lateritic slopes.		 Photo from Mattiske 2016
Daviesia sarissa subsp. *redacta*	Priority 2	NA	5 records (5 estimated plants)	4	4	0	Spreading or sprawling, glaucous shrub, to 0.6 m high. Fl. yellow & red/brown, Sep.	Yellow sand. Plains.		

	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Eutaxia lasiocalyx	Priority 2	NA	5 records (9 estimated plants)	1	1	1	Low, spreading, multi–stemmed shrub which grows to 15 cm high. It flowers in November with yellow flowers.	Grows on red sandy loam and laterite and quartz gravel on gentle lower slopes.		 Photo from Mattiske 2018d
Olearia laciniifolia	Priority 2	NA	17 records (18 estimated plants)	2	0	0	Erect, few-stemmed shrub, 0.6-1.2 m high. Fl. blue/purple & white/yellow, May to Sep.	White sand. Around playa lakes.		
Orianthera exilis	Priority 2	NA	9 records (46 estimated plants)	1	1	0	Low shrub, branches 1.1-1.5mm diameter. Stipule 0.3mm long.	Not defined.		 Photo from Mattiske (2018d)

	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Acacia undosa	Priority 3	NA	21 records (75 estimated plants)	21	6	4	Dense, spreading shrub 30 cm to 1.5 m tall. It flowers yellow from July to September.	Sandy clay loam, clayey sand. Undulating plains, low-lying area.		 Source: WorldWideWattle ver. 2.
Hakea pendens	Priority 3	NA	23 records (27 estimated plants)	225	216	1	Shrub that grows between 2 to 3m high, and 2.5 to 3.1m wide. It produces pink-white flowers in September.	Grows in stony loam and is found on ironstone ridges.		
Chorizema circinale	Priority 3	NA	15 records (172 estimated plants)	2	0	0	Prostrate, scrambling, wiry shrub, to 0.4 m high. Fl. yellow & orange & red, Sep to Dec.	Yellow sand, sandy clay with gravel. Flats, margin of gravel pit.		

	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Acacia sp.1	NA	NA	0	6,207	0	0	Up to 20cm high 20cm wide Branchlets terete, glabrous; often lightly pruinose especially on new growth; ultimately spinescent.	W9, S1, H1 (Mattiske 2018d).		
Hibbertia aff. *Oligantha.*	NA	NA	0	4,501	0	0	Shrub, to 0.5 m high. Fl. yellow, Sep to Nov.	Yellow sand, clayey grey sand, red clay, light brown loamy clay. Disturbed ground, utility reserves.		
Callitris verrucosa	NA	NA	21 records (46 estimated plants)	0[2]	0	0	Tree or shrub, to 6 m high.	Red to yellow sand. Sand dunes and ridges, edges of springs and creeks.		

[2] Previously identified individuals were misidentified. A review of these collections by the WA Herbarium has determined them to be *Callitris preissii.*

	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Centrolepis strigosa subsp. rupestris	NA	NA	6 records (6 estimated plants)	2	1	0	Tufted annual, herb, 0.01-0.04 m high. Fl. green & purple, Aug to Oct.	Moist sand. Granite outcrops.		
Dicrastylis capitellata	Priority 1	NA	8 records (57 estimated plants)	0	0	0	Low spreading shrub, 0.2-0.25 m high. Fl. blue-purple, May.	Loamy sand, sandy loam.		
Daviesia newbeyi	Priority 3	NA	15 records (47 estimated plants)	0	0	0	Bushy, multi-stemmed, broom-like shrub, 0.25- 1.5 m high. Fl. orange/yellow & red, Aug to Oct.	Sand or sandy clay over granite. Rocky slopes.		

	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Stenanthemum bremerense	Priority 4	NA	33 records (5,111 estimated plants)	0	0	0	Erect or low and spreading shrub, (0.2-) 0.3- 0.6 (-1.4) m high.	Orange-brown sandy loam, orange-red gravelly loam, skeletal red loam, laterite, ironstone. Top or sides of outcrops and breakaways.		
Teucrium sp. Dwarf (R. Dave 8813)	Priority 3	NA	14 records (23,954 estimated plants)	13	0	0	A compact, dwarf shrub, 0.1 m high, 0.1 m wide, producing white flowers in April.	Recorded on hills and road verges.		

	Conservation Status		Florabase Regional Records (estimated plants)	Individuals recorded (Mattiske 2018a, 2018d)			Description	Habitat	Range	Photo
	BC Act/DBCA Priority List	EPBC Act		Vegetation Survey Area	Development Envelope	Proposed Layout				
Verticordia stenopetala	Priority 3	NA	22 records (23 estimated plants)	2	1	0	Shrub to 0.6 m high, producing pink-purple-red flowers between October and January.	Recorded growing on yellow sands on undulating plains.		 Source: WAH (2007-)

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Table 5-7: Conservation Significant Flora Species Recorded in the Development Envelope

Species	Conservation Status		Records in 2014–2018 Surveys
	BC Act/DBCA Priority List	EPBC Act	
Banksia sphaerocarpa var. *dolichostyla*	Threatened (Vulnerable)	Vulnerable	16,503 records from targeted surveys. 5,220 plants recorded within the Development Envelope, 92 of these occur within the Proposed Layout (Mattiske 2018b). Infrastructure has been located to avoid this species to the maximum extent practicable.
Brachyloma stenolobum	Priority 1	NA	One individual recorded within the Development Envelope, but outside of the Proposed Layout.
Labichea rossii	Priority 1	NA	212 records from targeted surveys. 210 plants recorded within the Development Envelope, but outside of the Proposed Layout (Mattiske 2018d).
Microcorys sp. Mt Holland (D. Angus DA 2397)	Priority 1	NA	8,353 records from targeted surveys. 5,692 plants recorded within the Development Envelope, 1,799 of these occur within the Proposed Layout (Mattiske 2018d).
Daviesia sarissa subsp. *redacta*	Priority 2	NA	Four records from targeted surveys. Four plants recorded within the Development Envelope, but outside of the Proposed Layout (Mattiske 2018d).
Eutaxia lasiocalyx	Priority 2	NA	One record. One plant recorded within the Proposed Layout (Mattiske 2018d).
Orianthera exilis	Priority 2	NA	One plant recorded within the Development Envelope, but outside of the Proposed Layout.
Acacia undosa	Priority 3	NA	21 records from targeted surveys. Six plants recorded within the Development Envelope, four of these occur within Proposed Layout (Mattiske 2018d).
Hakea pendens	Priority 3	NA	225 plants recorded from targeted surveys. 216 occur within the Development Envelope and one within the Proposed Layout. (Mattiske 2018d).
Centrolepis strigosa subsp. *rupestris*	Range Extension	NA	Two plants recorded from targeted surveys. One occurs within the development envelope but outside the Proposed Layout.
Verticordia stenopetala	Priority 3	NA	Two plants recorded from targeted surveys. One occurs within the development envelope but outside the Proposed Layout.

Threatened Flora

***Banksia sphaerocarpa* var. *dolichostyla* (Threatened)** is an easily identified shrub 2 to 4 m tall, with bluish green leaves and golden inflorescences. It is confined to an area east of the cleared wheatbelt within the Narrogin and Merredin Districts. It occurs on Vacant Crown Land north from Digger Rocks through Forrestania to Mt Holland. This species prefers iron–capped rises on ironstone profiles. It is found in low woodlands to low shrublands with associates which include *Dryandra* and *Allocasuarina* species.

Banksia sphaerocarpa var. *dolichostyla* is currently known to be distributed between Mt Holland and South Ironcap, east of Hyden, Western Australia. Its preferred habitat is lateritic gravel on hills and rises. It commonly grows in association with *Banksia* spp., *Allocasuarina* spp., and *Hakea* spp. (Brown et al.1998, Collins et al. 2008, WAH 1998-). *Banksia sphaerocarpa* var. *dolichostyla* is currently listed as a threatened species under the BC Act and is listed as Vulnerable under EPBC Act.

The regional distribution of *Banksia sphaerocarpa* var. *dolichostyla* is shown Figure 5-7. Regionally, records of *Banksia sphaerocarpa* var. *dolichostyla* exist in the Avon Wheatbelt, Southern Cross, and Western Mallee IBRA sub-regions. Data available from the DoEE (2019) demonstrates that large populations (a minimum of 2,400 individuals) of *Banksia sphaerocarpa* var. *dolichostyla* have been recorded as shown in Table 5-8 and Figure 5-7. If the populations for the Mt Holland and Forrestania areas and associated records (a minimum of 350 individuals) are excluded, as the Proposal surveys have covered this area, the minimum regional population (excluding the Mt Holland local population) is 2,050 individuals.

Table 5-8: *Banksia sphaerocarpa* var. *dolichostyla* regional populations

Regional population	Location	Survey Year	Individuals recorded
1	Mt Holland	1990	300
2	North of Lake Cronin	1989	50+
3	South of Lake Cronin	1989	400+
4	North Ironcap	1989	100+
5	Forrestania	1990	50+
6	South Ironcap	1990	1000+
7	South east of South Ironcap	1989	500+
		Total	2400+

Targeted surveys in 2018 (Mattiske 2018b) recorded 16,503 individuals in the Proposal survey area occurring within 18 distinct local populations, nine of which occur outside of the Development Envelope. The surveys associated with the Proposal have recorded 16,503 individuals and estimated 22,586 individuals in the local population (which includes the 18 distinct local populations). This results in the estimated Regional population of individuals for *Banksia sphaerocarpa* var. *dolichostyla* as 24,636 individuals.

Table 5-9: *Banksia sphaerocarpa* var. *dolichostyla* surveyed within the Development Envelope, and the local vicinity of the Proposal

Location	Individual Plants	Distinct Local Populations	Notes
Within the Development Envelope	5,220	7	Based on targeted surveys for *Banksia sphaerocarpa* var. *dolichostyla* across the entire Development Envelope in 2018, (Mattiske 2018b).
Local population	16,503	8	Targeted survey records. Mattiske (2018b) estimated 22,586 individuals in the vicinity of the Development Envelope

The condition of *Banksia sphaerocarpa* var. *dolichostyla* plants encountered during the survey was generally excellent (Figure 5-8). This included plants growing in fire burnt areas (Figure 5-9). Plants ranged from recruiting juveniles though to large mature adult plants, often 2.5 to 3 m in height, with a similar spread. Based on field observations it is likely the *Banksia sphaerocarpa* var. *dolichostyla* is a good candidate for seeding in rehabilitation areas with suitable soils.

Figure 5-8: *Banksia sphaerocarpa* var. *dolichostyla* habit and inflorescence (photographs by D. Angus and H. Gooding)

Figure 5-9: *Banksia sphaerocarpa* var. *dolichostyla* regrowth in fire burnt areas: arrows indicate position of *Banksia sphaerocarpa* var. *dolichostyla* plants. (photograph by D. Angus)

Figure 5-10: *Banksia sphaerocarpa* var. *dolichostyla* in the Development Envelope

Other conservation significant flora

The survey results and individuals estimated are provided in Table 5-11 for other conservation significant flora. The recorded locations and regional distribution is detailed below.

Eremophila verticillata had two individuals and 136 individuals recorded by the surveys in 2017 and 2018 respectively (Mattiske 2018a and 2018d) outside of the Development Envelope in the W9 vegetation community.

All specimens recorded during the 2018 survey were located on a hill top area with a very friable and soft (low bulk density) clay loam soil. This type of soft soil was not encountered elsewhere within the Development Envelope. Whilst it is not possible to state absolutely that this soil is restricted to this particular area, given that the recording of this taxon is restricted to an area outside of the Development Envelope, no impacts to *Eremophila verticillata* are expected to result from the Proposal.

Note: This taxon has previously been referred to as *Eremophila sp. aff. verticillata.*

***Acacia* sp. Mt Holland (B. Ellery BE1147)** had five individuals and 2,338 individuals recorded by the surveys in 2017 and 2018 respectively (Mattiske 2018a and 2018d) outside of the Development Envelope in the W4 vegetation community. *Acacia* sp. Mt Holland (B. Ellery BE1147) (P1) was not recorded in any other vegetation community. However, based on local population estimates, the currently known local population has been estimated as 109,426 individuals with an estimated 458 individuals potentially occurring within the Proposed Layout.

Observations made during the present survey indicate that this taxon has a preference for the more open areas within the W4 woodland, often within grey clay-loam soils, with quartzite rocks present. The W4 vegetation community intersects an area on the western edge of the Development Envelope (0.42% of the W4 community).

The local population is the only known occurrences of this species and no regional records are known.

Note: This taxon has previously been referred to as Acacia sp. 2.

Brachyloma stenolobum was recorded from one location (one individual) across the surveys completed by Mattiske Consulting (2018a and 2018d). The individual was recorded outside the Development Envelope. The present regional distribution of this taxon is at the southern edge of the Southern Cross sub-region.

Regionally, *Brachyloma stenolobum* is presently only known to occur within the Coolgardie bioregion (Table 5-6) with 4 records and an estimated 601 individuals. Given the single individual recorded across multiple surveys, there is a low probability of further specimens of this taxon being recorded within the Development Envelope. Regionally, the majority of the recorded locations for this taxon are within the Forrestania area, on yellow sandy loam soils. This soil type is present in the vegetation along sections of the main access route from the Forrestania Rd to the Development Envelope. This access road is a wide access road and there may be little need to engage in further roadworks which would require further clearing of native vegetation (Figure 5-11).

Grevillea lissopleura had two individuals and a further 1,275 individuals recorded by the surveys in 2017 and 2018 respectively (Mattiske 2018a and 2018d). All records were outside the Development Envelope. The individuals recorded in 2018 were located in the H1 and W9 vegetation communities, situated outside, and to the south of the Development Envelope. Whilst some individuals were recorded within the W9 vegetation community, these specimens were on the ecotone which forms the boundary between W9 and H1 vegetation communities (Figure 5-11).

Regionally, records of *Grevillea lissopleura* are situated principally to the north of the Development Envelope (Table 5-6) with 7 records and estimated 8 individuals. A single record exists south of the Development Envelope in the Western Mallee subregion. The known habitat of Grevillea lissopleura is stony loams on banded ironstone, on ridges. This soil type and landform is not represented within the Development Envelope. This taxon would not be impacted as a result of the Proposal, therefore the probability of impacts to the species is nil.

Grevillea marriottii (P1) had one individual recorded by the survey in 2017 (Mattiske 2018a), however no recordings in 2018 (Mattiske 2018d). The individual recorded was outside the Development Envelope.

Regionally, records of *Grevillea marriottii* exist in the Southern Cross sub region, in the vicinity of the Development Envelope (Table 5-6) with 8 records and 2.404 estimated individuals. The known habitat is described as yellow or white sand over laterite on rises and tops of lateritic cappings. This habitat type was not noted within the Development Envelope. Whilst this taxon is restricted to areas near the Development Envelope, the absence of both recordings of this taxon and suitable habitat within the Development Envelope indicate that there is a low likelihood of this taxon being impacted as a result of the Proposal.

Labichea rossii had four individuals and a further 208 individuals recorded by the surveys in 2017 and 2018 respectively (Mattiske 2018a and 2018d). The individuals recorded were within the Development Envelope but outside the Proposed Layout. However, based on local population estimates, the currently known local population has been estimated as 2,153 individuals with 189 estimated to potentially occur within the Proposed Layout.

The records were located within the S3 and W9 vegetation communities. The S3 vegetation community is also the main vegetation community in which *Banksia sphaerocarpa* var. *dolichostyla* is located. Impacts to *Labichea rossii* are likely to be minimal as the Proponent recognises the need to avoid disturbances to this vegetation community. Twenty-five recordings of *Labichea rossii* were made in the W9 vegetation community, located to the south of the S3 vegetation community, and external to the Development Envelope. The potential impact to this taxon has been calculated as 1.49% of its currently known local population. The species was present on a slope comprising rocky clay soils which was situated downslope from the adjacent S3 vegetation community. Hence it is likely that this area may represent an ecotone between the S3 and W3 vegetation communities in this area.

Regionally, records of *Labichea rossii* exist in the Southern Cross sub region, in the vicinity of the Development Envelope (Table 5-6) with two records of an estimated 101 individuals.

Consequently, impacts to *Labichea rossii* would be minimal in this vegetation community.

***Microcorys* sp. Mt Holland (D. Angus DA2397)** was first recorded by Mattiske Consulting during a reconnaissance survey of the Earl Grey prospect in 2016 (Mattiske 2017). A total of 8,353 individual *Microcorys* sp. Mt Holland (D. Angus DA2397) have been recorded across a range of areas both within and external to the Development Envelope. Within the Development Envelope, 5,692 individuals have been recorded, of which 1,799 individuals have been recorded within the Proposed Layout. However, based on local population estimates, the currently known local population has been estimated as 41,492 individuals with 7,498 potentially occurring within the Proposed Layout.

Within the Development Envelope, *Microcorys* sp. Mt Holland (D. Angus DA2397) was principally recorded within the S3 vegetation community. This species was also recorded within the MW7 vegetation community immediately downslope from the adjacent S3 community, but was not recorded elsewhere within the MW7 vegetation community. The S3 vegetation community is also the vegetation community which is the principal habitat of *Banksia sphaerocarpa* var. *dolichostyla*. *Microcorys* sp. Mt Holland (D. Angus DA2397) was recorded growing on disturbed track edges in parts of the proposed accommodation village and externally in vegetation inferred to correspond to the W6 vegetation community. Therefore, the *Microcorys* sp. Mt Holland (D. Angus DA2397) tends to be highly associated with areas where *Banksia sphaerocarpa* var. *dolichostyla* is growing.

Microcorys sp. Mt Holland (D. Angus DA2397) was recorded within the Jilbadji Nature Reserve, as well as S3 type vegetation external to the Development Envelope where *Banksia sphaerocarpa* var. *dolichostyla* is known to be present. *Microcorys* sp. Mt Holland (D. Angus DA2397) was recorded growing on sandplain areas within the Jilbadji Nature Reserve.

The Proposed Layout within the Development Envelope has a direct impact on this vegetation community, calculated as 18.07%. The potential impacts to *Microcorys* sp. Mt Holland (D. Angus DA2397) will be more restricted to the boundaries associated with the former taxon's distribution. The majority of potential impacts to the S3 vegetation community are associated with the waste rock dump on the eastern side of the mine pit.

Daviesia sarissa subsp. redacta had one individual and three individuals recorded by the surveys in 2017 and 2018 respectively (Mattiske 2018a and 2018d). The individuals recorded were within the Development Envelope but outside the Proposed Layout. The individuals have been recorded in the W13 and S3 vegetation communities. The Proposed Layout has the potential to result in 11.23% of the W13 vegetation community being impacted.

Regionally, records of *Daviesia sarissa subsp. redacta* exist within the Southern Cross IBRA sub region, to the north of the Development Envelope (Table 5-6) with 5 records and 5 estimated individuals.

Given that this taxon is present in low numbers and impacts to the vegetation communities in which it has been recorded a relatively low, impacts to this taxon are likely to be low.

Eutaxia lasiocalyx had one individual recorded by the surveys in 2017 (Mattiske 2018a and 2018d). The individual recorded was within the Development Envelope and the Proposed Layout.

Regionally, records of *Eutaxia lasiocalyx* exist both to the north and south of the Development Envelope, principally within the Coolgardie and Avon Wheatbelt IBRA regions (Table 5-6) with 5 records and an estimated 9 individuals. The preferred habitat for this species is described as red sandy loam, laterite and quartz gravel on gentle slopes (WAH 1998-). This soil type and landform has not been observed within the Development Envelope. Given the lack of records of this taxon being made during the present survey, it is likely that if it is present it may be so in very low numbers and on an occasional basis.

Olearia laciniifolia had two individuals recorded were recorded by the survey in 2017 (Mattiske 2018a and 2018d) outside of the of the Development Envelope.

Regionally, records of *Olearia laciniifolia* is spread over a 500 km range in the Mallee bioregion, generally to the south of the Development Envelope (Table 5-6) with 17 records and an estimated 18 individuals. The known habitat for this taxon is described as white sand around playa lakes (WAH 1998-). This soil and landform is not present within the Development Envelope. Given the relatively wide distribution of this taxon, and the absence of recordings of this taxon in the present survey, there is a low likelihood of this taxon being recorded within the Development Envelope.

Orianthera exilis had one individual recorded by the survey in 2017 (Mattiske 2018a and 2018d) within the Development Envelope, however outside the Proposed Layout.

Regionally, scattered records of *Orianthera exilis* occur within 72 km to the north, east and south of the Development Envelope, within the Coolgardie and Mallee bioregions (Table 5-6) with 9 records and an estimated 46 individuals. The individual recorded within the Development Envelope was located within the W15 vegetation community in the southern section of the Development Envelope. W15 is calculated to have potentially 0.32% of its current extent impacted by Proposal. Given the isolated record of Orianthera exilis, in the vicinity of the borefields access route in a vegetation community which will be minimally impacted by the Proposal, there is a low likelihood of this taxon being impacted.

Acacia undosa had 21 individuals recorded by the survey in 2017 (Mattiske 2018a) within the MW6, MW8, S2, W7, and W8 vegetation communities. Six individuals recorded were within the Development Envelope with four inside the Proposed Layout. However, based on local population estimates, the currently known local population has been estimated as 265 individuals with 30 potentially occurring within the Proposed Layout.

The MW8, W7, and W8 vegetation communities are calculated to have potential clearing impacts of between 0% and 0.12%. Both the MW6 and S2 vegetation communities are calculated to have 47.85% and 30.26% respectively of their present extent potentially cleared.

Regionally, records of *Acacia undosa* exist in both the Avon Wheatbelt and Mallee bioregions up to 230 km from the Development Envelope (Table 5-6) with 21 records and an estimated 75 individuals.

Hakea pendens had 225 individuals recorded by the survey in 2017 (Mattiske 2018a with 215 individuals recorded within the Development Envelope and one individual within the Proposed Layout. A single, large population of *Hakea pendens*, comprising 214 plants was located within the W17 vegetation community on the eastern boundary of the Development Envelope (Figure 5-11).

Regionally, 74 records of *Hakea pendens* exist scattered through the Coolgardie IBRA region, with the majority of the known locations being situated to the north of the Development Envelope (Table 5-6). The large population of *Hakea pendens* associated with the W17 vegetation community represents the single largest recording of this taxon.

The known habitat for *Hakea pendens* is stony loam soils and ironstone ridges (WAH 1998-), the former of which corresponds to the soils in the W17 vegetation community.

Chorizema circinale had two individuals recorded by the survey in 2017 (Mattiske 2018a) outside of the Development Envelope.

Regionally, records of *Chorizema circinale* exist in the Mallee, Coolgardie, and Esperance Sandplains IBRA regions (Table 5-6) with 15 records. The known habitats for Chorizema circinale (P3) are yellow sands and gravelly sandy clay flats (WAH 1998-). Whilst these soil types are likely to exist, either within or near the Development Envelope, both the small numbers of this taxon recorded in 2017, coupled with the absence of recording during the 2018 survey indicate that this taxon is unlikely to be recorded within the vegetation communities searched. Given its relatively widespread regional distribution, potential impacts to this taxon are considered to be low.

***Acacia* sp.1** had one individual and 6,206 individuals recorded by the surveys in 2017 and 2018 respectively (Mattiske 2018a and 2018d) outside of the Development Envelope.

Acacia sp. 1 is a new taxon, recorded for the first time during the 2017 survey. Its current known distribution is to the south of the Development Envelope in vegetation currently defined as a mixture of the S1 and W9 vegetation communities. It is likely, based on observations made during the 2018 survey, that the vegetation in which *Acacia* sp.1 is situated is likely to warrant being classified as a separate vegetation community, as the species assemblage differs from the S1 vegetation. This distinction was not identified during the 2017 vegetation mapping survey due to its similar appearance on aerial maps to the S1 vegetation. Given that *Acacia* sp. 1 was not recorded at any location within the Development Envelope, it would not be impacted by the Proposal.

Hibbertia aff. oligantha had one individual and 4,500 individuals recorded by the surveys in 2017 and 2018 respectively (Mattiske 2018a and 2018d) outside of the Development Envelope.

Hibbertia aff. oligantha is a potentially new taxon, recorded for the first time during the 2017 survey. Its current known distribution is to the south of the Development Envelope in the H1 and W9 vegetation communities. Whilst some specimens of *Hibbertia aff. oligantha* were recorded within the W9 vegetation community, these specimens were on the ecotone which forms the boundary between W9 and H1 vegetation communities. Given that this taxon has only been recorded in and on the margins of the H1 vegetation community, which is situated externally and to the south of the Development Envelope, it would not be impacted by the Proposal.

Callitris verrucosa had ten individuals recorded by the survey in 2017 (Mattiske 2018a) outside of the Development Envelope.

The recording of *Callitris verrucosa* within the Development Envelope had previously been noted as a range extension. A number of collections of *Callitris* sp. suspected to be *Callitris verrucosa* were made during the 2018 survey and submitted to the Western Australian Herbarium for formal identification, together with specimens identified as *Callitris verrucosa* collected during previous surveys of the Development Envelope. In all cases the specimens were identified as *Callitris preissii*.

It is more likely that specimens previously identified by Mattiske Consulting as *Callitris verrucosa*, are in fact *Callitris preissii*. In addition, the presence of *Callitris verrucosa* within the Development Envelope would not represent a range extension, as was initially suspected. A review of the distribution of this taxon (Table 5-6) indicates that *Callitris verrucosa* is widely distributed through southern Western Australia across several IBRA regions. Based on this additional information, neither *Callitris preissii* nor *Callitris verrucosa* are considered to be significant flora species in the context of the Proposal. Therefore, the potential impact to these species is considered low.

Centrolepis strigosa subsp. rupestris had two individuals recorded by the survey in 2017 (Mattiske 2018a) inside of the Development Envelope, however outside the Proposed Layout, within the MW8 vegetation community. MW8 will not be impacted as part of the Proposal.

The recording of *Centrolepis strigosa* subsp. *rupestris* represents an approximately 200 km southerly extension to the known range of this taxon (Table 5-6).

Given MW8 is described as a drainage area and damper, it is possible other winter wet areas may provide a habitat for *Centrolepis strigosa* subsp. *Rupestris*. However, based on current results, it is unlikely that there would be impacts to this taxon. Notwithstanding this, given its widespread distribution across the Coolgardie, Avon Wheatbelt ad Murchison IBRA regions, impacts to this taxon regionally would be low. Six regional records are available for this species with an estimated six individuals.

Dicrastylis capitellata was identified as having a medium potential to be recorded within the Development Envelope on the basis of its preferred soil type and proximity to a known record of this taxon. *Dicrastylis capitellata* was not recorded during surveys (Mattiske 2018a and 2018d).

Regionally, records of *Dicrastylis capitellata* exist in the Coolgardie and Mallee IBRA regions (Table 5-6). The nearest record is approximately 13 km from the Development Envelope. Whilst *Dicrastylis capitellata* has not been recorded within the Development Envelope, it has a relatively widespread current distribution, with there being 350 km between its western and eastern record locations. *Dicrastylis capitellata* is unlikely to be impacted by the Proposal.

Daviesia newbeyi was identified as having a low potential to be recorded within the Development Envelope on the basis of its preferred soil type and proximity to a known record of this taxon. *Daviesia newbeyi* was not recorded during surveys (Mattiske 2018a and 2018d).

Regionally, records of *Daviesia newbeyi* exist in the Coolgardie, Mallee, and Esperance Sandplain bioregions (Table 5-6) with 8 records and 57 estimated individuals. *Daviesia newbeyi* is described as having a preference for sand or sandy clay soils over granite on rocky slopes (WAH 1998-). Surveys by Mattiske Consulting (2018a and 2018d) did not noted the presence of such soils within the Development Envelope. Consequently, it is unlikely that *Daviesia newbeyi* is present within the Development Envelope. Therefore, the potential impact to this species is considered low.

Stenanthemum bremerense was identified as having a medium potential to be recorded within the Development Envelope on the basis of its preferred soil type and proximity to a known record of this taxon. *Stenanthemum bremerense* was not recorded during surveys (Mattiske 2018a and 2018d.

Regionally, records of *Stenanthemum bremerense* are restricted to the Coolgardie IBRA region (Table 5-6), with one record occurring approximately 13 km from the Development Envelope (WAH 1998-) and 33 records in total with an estimated 5,111 individuals. *Stenanthemum bremerense* is described as having a preferred habitat of sandy or gravelly loams associated with outcrops and breakaway (WAH 1998-). This combination of soils and topographic conditions has not been encountered to date during surveys of the Development Envelope. Consequently, there is a low likelihood of this taxon being impacted by the Proposal.

***Teucrium* sp. dwarf (R. Davis 8813)** was recorded opportunistically in the 2018 survey (Mattiske 2018d) outside the Development Envelope in vegetation community W9. The current distribution of this taxon is within the Southern Cross IBRA sub region (Table 5-6) with 14 records and 23,954 estimated individuals. Given that this taxon has not been recorded within the Development Envelope and its wide geographical distribution, this taxon will not be impacted by the Proposal.

Verticordia stenopetala was recorded opportunistically in the 2018 survey (Mattiske 2018d) outside the Development Envelope in the W6 vegetation community. A second recording of this taxon was made on the boundary of the S3 vegetation community on the south of the planned waste rock dump area within the Proposed Layout. The current distribution of this taxon (Table 5-6) is within the Coolgardie, Avon Wheatbelt and Mallee IBRA regions with 22 records and 23 estimated individuals.

Table 5-10: Conservation significant flora regional and local population records and estimates

		Individuals records		
Species	BC Act/DBCA Priority List	Regional Individuals	Local Population Individual Records	Within Proposed Layout
Eremophila Verticillate	Threatened	138	138	0
Acacia sp. Mt Holland (B. Ellery BE1147)	Priority 1	109,426	109,426	458
Brachyloma stenolobum	Priority 1	602	1	0
Grevillea lissopleura	Priority 1	1,285	1277	0
Grevillea marriottii	Priority 1	2405	1	0
Labichea rossii	Priority 1	2254	2153	189
Microcorys sp. Mt Holland (D. Angus DA 2397*)*	Priority 1	41,492	41,492	7,498
Daviesia sarissa subsp. *redacta*	Priority 2	9	4	0
Eutaxia lasiocalyx	Priority 2	10	1	1
Olearia laciniifolia	Priority 2	20	2	0
Orianthera exilis	Priority 2	47	1	0
Acacia undosa	Priority 3	340	265	30
Hakea pendens	Priority 3	252	225	1
Chorizema circinale	Priority 3	174	2	0
Acacia sp.1	NA	6,207	6207	0
Hibbertia aff. *Oligantha.*	NA	4,501	4501	0
Callitris verrucosa	Range extension	46	0[3]	0
Centrolepis strigosa subsp. rupestris	Range extension	8	2	0
Dicrastylis capitellata	Priority 1	57	0	0
Daviesia newbeyi	Priority 3	47	0	0
Stenanthemum bremerense	Priority 4	5111	0	0
Teucrium sp. Dwarf (R. Dave 8813)	Priority 3	23,967	13	0
Verticordia stenopetala	Priority 3	25	2	0

[3] Species originally identified as *Callitris verrucosa* were misidentified. A review of these collections by the WA Herbairum has determined them to be *Callitris preissii*.

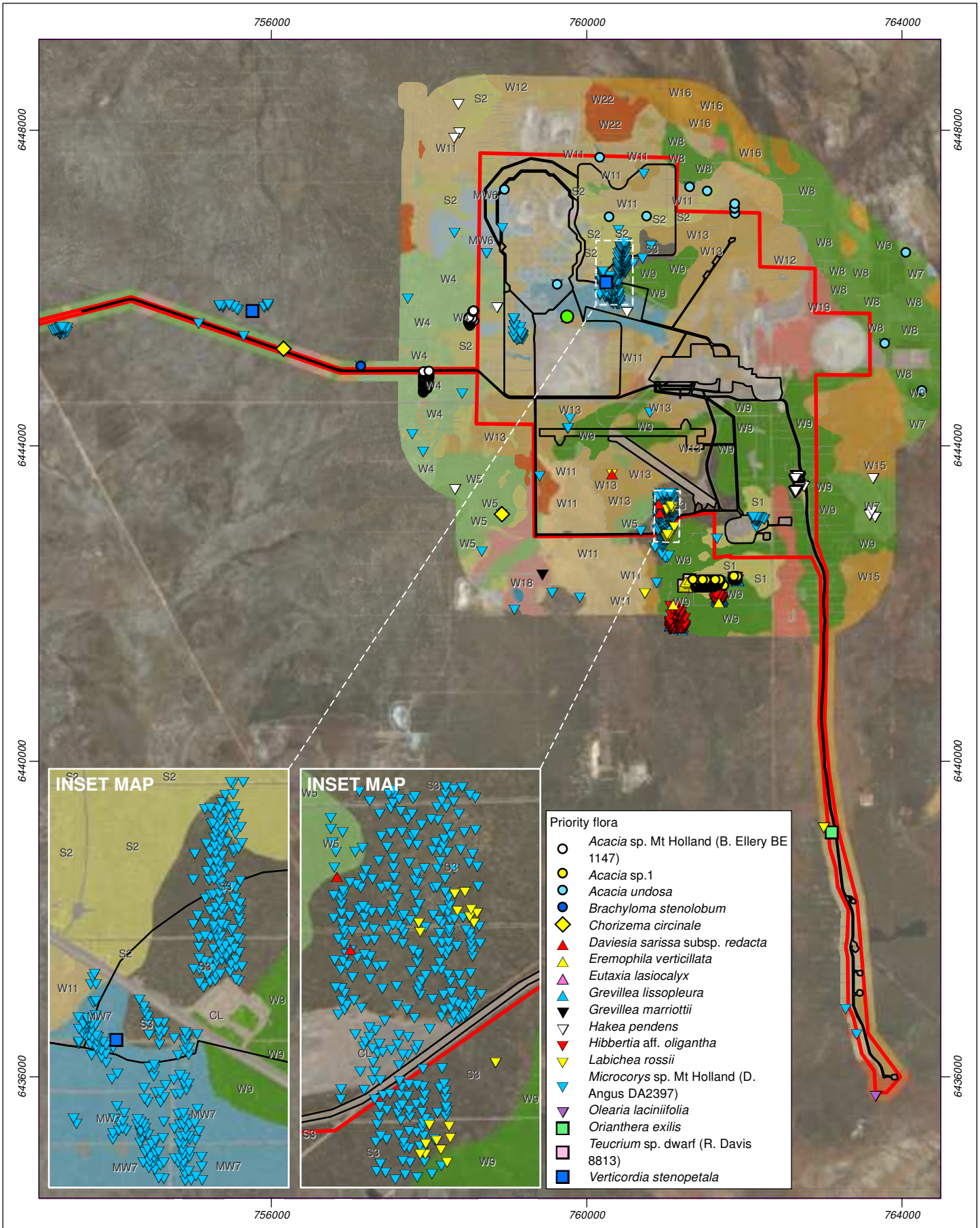

Figure 5-11: Conservation Significant flora in the Survey Area

Scale 1:65,000 at A4

km 0 0.5 1 1.5

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 18/01/2019

Author: Cthatcher

Source: SQM: Aerial imagery - ESRI 2015-2017
Development Envelope, Banksia species - 17/11/2017 & 3/10/2018.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G038_RevC.mxd

Legend

Development Envelope
Indicative Site Layout

Vegetation code
H1, MW6, MW7, MW8, S1, S2, W4, W5, W6, W7, W8, W9, W10, W11, W12, W13, W14, W15, W16, W17, W18, W19, W20, W21, W22, CL

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5.2.4 Introduced Species

Within the context of a site with a long history of clearing and development, the observed incidence of invasive weeds within the Development Envelope is very low. Only one introduced (exotic) plant taxon, *Centaurium tenuiflorum*, was recorded in the Development Envelope by Mattiske (2018a) at –32.077429, 119.756233. This taxon is listed as Permitted (s11) pursuant to the *Biosecurity and Agriculture Management Act 2007* (Department of Agriculture and Food Western Australia [DAFWA] 2017).

Centaurium tenuiflorum (*Gentianaceae*) is an erect hairless herb that can grow to 50 cm high. It produces pink flowers from the months of August to December and is known to occur along drainage lines, in swamp, and disturbed areas (Mattiske 2018a). The record within the Development Envelope is at the very northern boundary of the site within existing vegetation and is not clearly associated with the developed footprint of the previous mine. The location of the observed *Centaurium tenuiflorum* is also outside of proposed site layout.

5.2.5 Design considerations to avoid impacts

The Proposal has been designed to avoid impacts to significant taxa to the maximum extent practicable and includes consideration of buffers to ensure indirect impacts from operation of the mine are minimised. A targeted survey for *Banksia sphaerocarpa* var. *dolichostyla* has occurred within the Development Envelope during October 2017 surveys. As currently designed, the Proposal involves direct impacts to 92 *Banksia sphaerocarpa* var. *dolichostyla* individuals. As part of future detailed designs of the Proposal, the Proponent shall attempt to minimise direct impacts to the 92 *Banksia sphaerocarpa* var. *dolichostyla* individuals through infrastructure placement and design.

5.3 Assessment of impacts

5.3.1 Direct Loss of flora and native vegetation

Banksia sphaerocarpa var. dolichostyla

Table 5-11 details the direct impacts to the *Banksia sphaerocarpa* var. *dolichostyla* populations within the Development Envelope, currently known local population and regional populations.

Of the 16,503 individual plants identified during flora surveys (5,220 individual plants occurring within the Development Envelope), 92 *Banksia sphaerocarpa* var. *dolichostyla* are located within the Proposed Layout and therefore have the potential to be directly impacted through clearing as shown in Figure 5-10. This equates to 0.56% of the currently known local population and 0.37% of the currently estimated regional populations. Two discrete populations occur within the Development Envelope that will be directly impacted, with the majority of impact (91 individuals) occurring to the population around the existing airstrip. However, this population currently has 7,085 individuals recorded and therefore the direct impact would be 1.28% of the population.

Table 5-11: Direct impacts to *Banksia sphaerocarpa* var. *dolichostyla* within the Proposed Layout, Development Envelope, and the local vicinity of the Proposal

Location	Individual Plants	Populations	% direct impacts	Notes
Region	24,636	7 recorded populations	0.37%	Estimated based on Table 5-8.
Locally occurring	22,586	18 (local population)	0.41%	During targeted surveys, an additional 6,083 plants were estimated (using methodology detailed in Section 5.2.1) to be present in areas outside of the Development Envelope that could not be completely surveyed during the targeted survey program.
Within Targeted Survey Area	16,503	18 (local population)	0.56%	Based on targeted surveys for *Banksia sphaerocarpa* var. *dolichostyla* in 2018 (Mattiske 2018b).
Within the Development Envelope	5,220	7 (local population)	1.76%	Based on targeted surveys for *Banksia sphaerocarpa* var. *dolichostyla* across the entire Development Envelope in 2018 (Mattiske 2018b).
Within the Proposed Layout (direct impacts)	92	2 (local population)	Not applicable	Individuals are located within Proposed Layout within accommodation village, former airstrip being used for soil stockpiling and access road. Further opportunities to avoid the 92 individuals still exist during final project design and attempts to minimise direct loss shall occur.

Other conservation significant flora

Nine priority flora taxa and one additional flora species of significance were recorded within the Development Envelope (Figure 5-11). The conservation significant flora species identified as occurring within the Proposed Layout (excluding *Banksia sphaerocarpa* var. *dolichostyla)* are listed in Table 5-12 with potential direct impacts to local and regional populations shown. Impacted individuals are shown in Figure 5-12.

The local and regional individual plants have been determined for conservation significant flora, however limited data is available for regional populations. The number of regional populations is difficult to determine based on WA Herbarium information available. Section 5.2.3 includes the regional records, estimated regional individuals and distributions which provide an indication of the regional population. Regional records in Table 5-12 identifies the number of regional records and where available, individual plant numbers have been used to determine total regional individuals, to provide a quantifiable impact to populations numbers.

The only conservation significant flora species with limited regional distributions (as per Section 5.2.3 are *Acacia* sp. Mt Holland (B. Ellery BE1147), *Labichea rossii* and *Microcorys* sp. Mt Holland (D. Angus DA 2397*).* These species are not widely distributed across the region and therefore the local population is also considered the regional population.

Table 5-12: Direct impacts to conservation significant flora identified within Development Envelope

Species	Total Regional Individuals	Regional Records	Individuals		% Direct Impacts	
			Local population	Within Proposed Layout	Local Population	Regional Populations
Acacia sp. Mt Holland (B. Ellery BE1147)	109,426	0	109,426	458	0.42%	0.42%
Labichea rossii	2,254	2	2,153	189	8.79%	8.39%
Microcorys sp. Mt Holland (D. Angus DA 2397*)*	41,492	5	41,492	7,498	18.07%	18.07%
Eutaxia lasiocalyx	10	5	1	1	100.00%	10.00%
Orianthera exilis	47	9	1	0	0.00%	0.00%
Acacia undosa	340	21	265	30	11.32%	8.82%
Hakea pendens	252	23	225	1	0.44%	0.40%
Chorizema circinale	174	15	2	0	0.00%	0.00%
Verticordia stenopetala	25	22	2	1	25.00%	4.00%

The locations of potentially impacted individuals and the local and regional populations are discussed in Section 5.2.3 If the conservation significant flora species is located within the Proposed Layout, or has potential to be located within the Proposal Layout (based on presence within the Development Envelope), the potential direct loss through direct impact (clearing) is summarised below.

***Acacia* sp. Mt Holland (B. Ellery BE1147)** is restricted to the W4 vegetation community and is localised in more open areas within the woodland (Mattiske 2018d). The W4 vegetation community has 0.42% of its mapped extent intersecting the western edge of the Development Envelope, in an area currently proposed as an integrated waste landform. Consequently, clearing has the potential to impact up to 0.42% of the known local and regional population of this taxon. These impacts are based on estimates, with all current individuals recorded located outside the Development Envelope. Therefore, this impact is not considered significant.

Eutaxia lasiocalyx was recorded at a single location within the Proposed Layout. The direct impact to this individual would directly impact 100% of the known population within the Development Envelope and a maximum 10% of the currently known regional population. At the regional level, records of this taxon exist in both the Avon Wheatbelt and Coolgardie bioregions. Given that some records of this taxon exist externally and to the north of the Development Envelope, it is likely that this taxon exists scattered locally. Therefore, the direct impact is not considered significant.

***Microcorys* sp. Mt Holland (D. Angus DA2397)** was recorded in association with the S3 vegetation community and also recorded to the north of the Development Envelope at three different locations in the Jilbadji Nature Reserve. It is likely that further surveys will reveal other populations of this taxon within the Jilbadji Nature Reserve. Three other populations of *Microcorys* sp. Mt Holland (D. Angus DA2397) were located external to the Development Envelope. In both cases, *Microcorys* sp. Mt Holland (D. Angus DA2397) was recorded growing in association with *Banksia sphaerocarpa* var. *dolichostyla* on gravelly hills within the S3 vegetation community. All areas outside the Development Envelope where *Microcorys* sp. Mt Holland (D. Angus DA2397) was recorded are currently within mining or exploration tenements, including those within the Jilbadji Nature Reserve. Consequently, there is a potential for these populations to be impacted in the future should any mining take place. However, given that this taxon, based on current survey work, is present in greater numbers in vegetation and landforms which support the presence of *Banksia sphaerocarpa* var. *dolichostyla*, it is likely given the need to protect the latter, the former will also be protected.

Microcorys sp. Mt Holland (D. Angus DA2397) was commonly recorded growing on disturbed grounds associated with old tracks within the survey area, or in fire burnt areas within the Jilbadji Nature Reserve. These observations would suggest that this species is likely to readily grow from seed and could be considered as a suitable species to be used as part of any rehabilitation activities.

Whilst the proposed direct impacts to *Microcorys* sp. Mt Holland (D. Angus DA2397) amount to up to 18.07% of the currently known local and regional population, given that this taxon is present in large numbers both within and in the area surrounding existing *Banksia sphaerocarpa* var. *dolichostyla* populations, further reductions in impacts to this taxon can be achieved by the Proponents strategy of avoidance of impacts where possible.

Where large populations of *Microcorys* sp. Mt Holland (D. Angus DA2397) are identified, the site layout will be amended with the implementation of exclusion zones where possible. Large populations have been recorded adjacent to the waste rock landform and surrounding the accommodation village and former airstrip (Figure 5-11). Preclearance surveys will be undertaken to define the population boundaries of *Microcorys* sp. Mt Holland (D. Angus DA2397) to assist in the avoidance strategy. Therefore, the impact to the population is not considered significant.

Labichea rossii was recorded in association with the S3 vegetation community. The S3 vegetation community is the prime habitat for the threatened taxon *Banksia sphaerocarpa* var. *dolichostyla*. Estimated currently known local populations for *Labichea rossii* indicate a potential direct impact to 8.79% of the currently known local population and 8.39% of the currently known regional population.

However, the association with the S3 vegetation community and the avoidance strategy for *Banksia sphaerocarpa* var. *dolichostyla* discussed above would minimise any potential direct impacts to *Labichea rossii.* In addition, the taxon has a known regional population with two records and a minimum of 101 estimated individuals. Preclearance surveys will assist in determining populations and in developing an avoidance strategy. Therefore, direct impact to the taxon is not considered significant.

Acacia undosa is calculated to have 11.32% (8.82% regionally) of its currently known local population impacted by direct impacts from the Proposal. Regional distribution of this taxon shows that it is widely distributed across the Avon Wheatbelt and Mallee bioregions. Consequently, whilst local impacts are low to medium, the widespread distribution of this taxon indicates that local impacts would not affect the viability of the persistence of this species. Therefore, impacts to the species are not considered significant.

Eremophila verticillata was previously recorded as *Eremophila* sp. aff. *Verticillata*. However, it is only located outside the Development Envelope on a hill top to the south. The soils on which it occurs are unusual in that they are a powdery, low bulk density clay. This type of soil has not been encountered elsewhere within the vegetation survey area.

Eremophila verticillata is currently only known to occur within the Mallee bioregion. A review of the available data on Florabase (WAH 1998) shows nine records of this taxon and in excess of 1,000 plants spread over approximately 4 populations. A review of the Department of Environment and Energy website (DoEE 2019) does not provide additional information on populations of this taxon but shows that potential habitat for this species to be widely distributed. Given that this taxon has only been recorded on a hilltop located to the south of the Development Envelope, there are presently no impacts likely to this species.

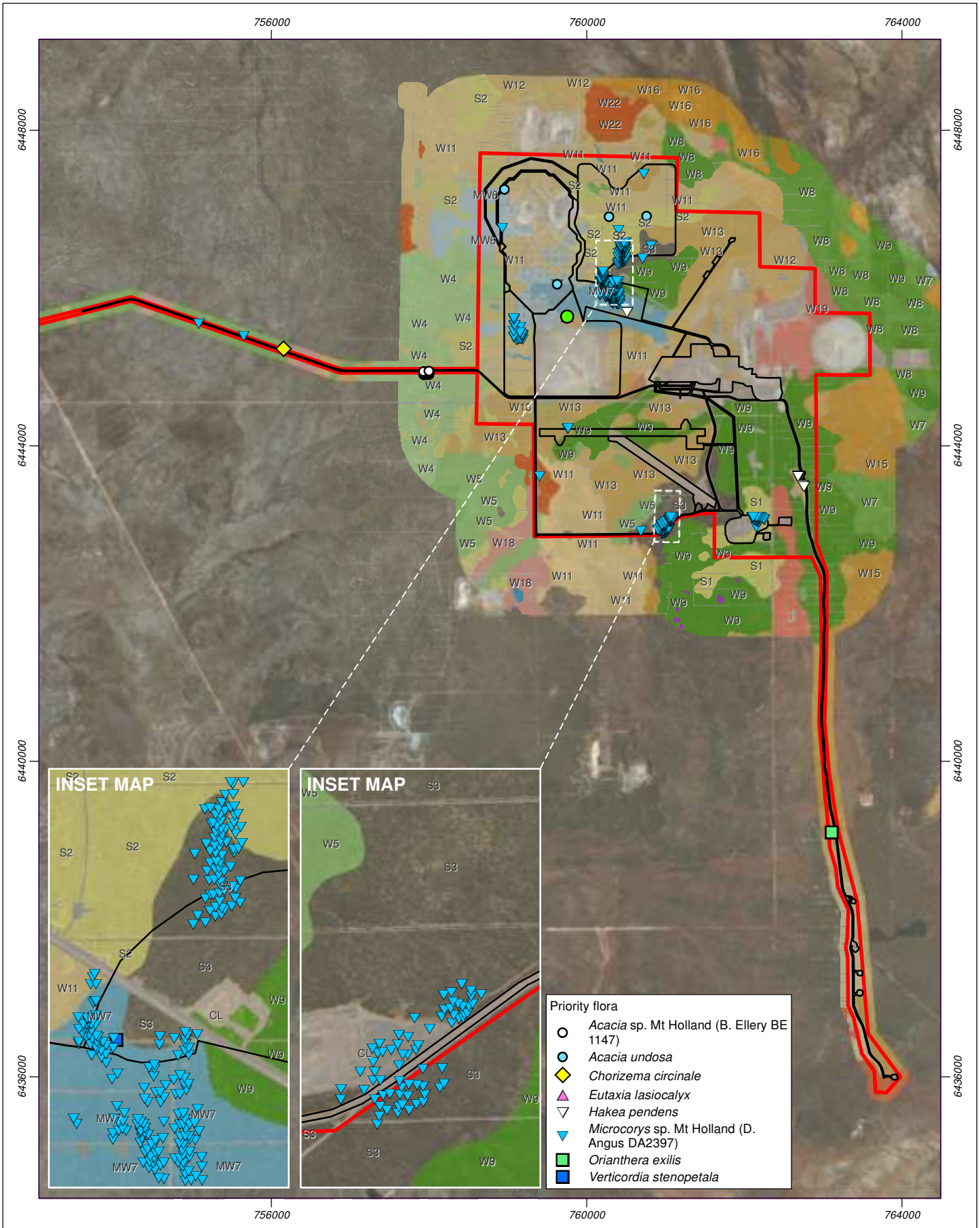

Figure 5-12: Conservation Significant Flora impacted by the Proposal

Scale 1:65,000 at A4

0 0.5 1 1.5 km

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 18/01/2019

Author: Cthatcher

Source: SQM: Aerial imagery - ESRI 2015-2017

Development Envelope, Banksia species - 17/11/2017 & 3/10/2018.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G039_RevC.mxd

Legend

Development Envelope

Indicative Site Layout

Vegetation code

H1, MW6, MW7, MW8, S1, S2, W4, W5, W6, W7, W8, W9, W10, W11, W12, W13, W14, W15, W16, W17, W18, W19, W20, W21, W22, CL

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Regional vegetation associations and local vegetation communities

Figure 5-4 identifies that of the regional vegetation associations present in the Development Envelope, less than 2% have been cleared historically within the Coolgardie bioregion or the Southern Cross Subregion, showing negligible loss of vegetation to date at a regional and local scale. This illustrates that the vegetation associations present in the Development Envelope are all well represented in the wider region. The Proposal also builds upon the existing mine Development Envelope and through reuse of existing facilities, minimising the footprint of new clearing to 392 ha. The extension of clearing at the site does not extend the development in a linear fashion that bisects or fragments existing vegetation associations. The Proposal also does not extend the development footprint to a topographic barrier that would fragment or impair habitat functions within the vegetation association.

As shown in Table 5-13, clearing proposed within the Forrestania – 511 vegetation system association (predominantly salmon gum & morrel open woodland) is 4.4 ha and has a statistically negligible impact on clearing within a regional context. Clearing within the Skeleton Rock – 519 vegetation system association (predominantly mallee scrub and shrublands) is more substantial 386.3 ha, but still only raises the total regional clearing from 1.13% to 1.82% within the Southern Cross subregion. This is in contrast to the 15,622.25 ha of the Skeleton Rock - 519 vegetation system association already protected for conservation, representing 27.89% of the vegetation associations within the Southern Cross subregion.

Table 5-13: Extent and clearing of regional vegetation system associations

Vegetation association	Total area Vegetation association within Southern Cross Subregion (ha)	% Cleared within Southern Cross Subregion	% in Conservation within Southern Cross Subregion	Cleared from the Proposal (ha)	% cleared within Southern Cross Subregion including Proposal
Forrestania (511)	153,641.65	0.42	9.68%	4.4	0.42
Skeleton Rock (519)	56,013.48	1.13	27.89%	386.3	1.82

As shown in Table 5-14, loss of open woodland constitutes less than 5% of the woodland area currently existing within the Development Envelope and is negligible within the context of the greater 7.4 million hectares of open woodland existing within the boundaries of the Great Western Woodlands. While impacts to Mallee woodland within the Development Envelope exceeds 20% of what is currently remaining, the regional impact is not significant in the context of the nearly 1.2 million hectares of Mallee woodland that exists along the south-eastern edge of the Great Western Woodlands and is well represented within the protected area of the Jilbadji Nature Reserve north of the Development Envelope. As such, the Proposal would not significantly reduce the extent of vegetated habitat types and it is considered unlikely that the additional clearing would significantly affect Flora and Vegetation values.

Table 5-14: Regional vegetated habitat loss resulting from the Proposal*

Habitat	Habitat occurring in the Development Envelope (ha)	New area to be cleared under Proposal (ha)	% of habitat in Development Envelope to be cleared under Proposal	Habitat mapped in the Great Western Woodlands (ha)	% of Great Western Woodlands to be cleared under Proposal
Mallee Woodland	138.3	95.2	69%	1,174,490.50	0.01%
Open Woodland	1,208.80	223.7	19%	7,377,876.50	0.003%
Scrub/Shrubland	130.8	73.1	56%	--	--
Cleared	503.1	--	--	--	--

* - Habitat mapped regionally for the Great Western Woodlands is per Beard (1990) and did not map scrub/shrubland.

Direct impacts to local vegetation communities from clearing are described in detail in Table 5-15. In the context of these local vegetation communities, impacts are generally less than 10% of what is found within the Development Envelope. Populations of *Banksia sphaerocarpa* var. *dolichostyla* showed a strong, but not definitive, correlation with the S3 local vegetation community Mattiske (2017). Consistent with the general approach to minimise *Banksia sphaerocarpa* var. *dolichostyla* direct impact, less than 0.56% of the currently known local population (92 individuals of a currently known local population of 16,503) would be directly impacted. The associated S3 vegetation community would be 12% of the surveyed area cleared under the Proposal and 35% of this community was mapped outside of the Development Envelope. Given the identified presence of additional *Banksia sphaerocarpa* var. *dolichostyla* populations outside of the survey area, it can be inferred that this community occurs in a greater extent regionally than has been surveyed for the Proposal.

Five local vegetation communities would be cleared in excess of 20% of what was surveyed locally, including two mallee woodland communities, two open eucalypt woodland communities, and one shrubland community. All five local vegetation communities are considered typical, both in terms of structure and species composition to those mapped in other surveys in the area (Craig 2006, Native vegetation Solutions 2014, 2016a) as well as those described historically by Beard (1972, 1990).

None of the vegetation communities defined within the Development Envelope are classified as unique or restricted in the region. There is a considerable degree of disturbance in the Development Envelope, in terms of pits, waste dumps, access tracks and drill tracks, particularly form past mining and exploration activities.

Table 5-15: Local vegetation community impacts resulting from the Proposal

Vegetation Code	Surveyed Local Vegetation (ha)	Development Envelope (ha)	Proposed site layout (ha)	% of vegetation cleared within Development Envelope	% of vegetation cleared within Survey Area
MW6	112.0	75.2	53.6	71%	48%
MW7	63.1	63.1	41.6	66%	66%
MW8	2.5	0.4	--	--	--
S1	65.0	27.0	4.1	15%	6%
S2	228.2	103.8	69	66%	30%
S3	106.0	69.1	12.7	18%	12%
W4	235.8	23.6	1	4%	--
W5	138.7	27.0	--	--	--
W6	82.3	12.7	2.4	19%	3%
W8	259.0	5.8	0.3	5%	--
W9	559.0	285.8	21.3	7%	4%
W10	49.0	26.2	1.8	7%	4%
W11	600.1	269.7	134	50%	22%
W12	186.8	87.6	6.1	7%	3%
W13	370.4	282.4	41.6	15%	11%
W14	61.0	19.4	1.1	6%	2%
W15	162.9	7.4	0.5	7%	0%
W17	2.8	2.8	--	--	--
W18	69.3	3.8	--	--	--
W19	68.6	53.5	0.3	1%	--
W20	48.3	16.7	0.2	1%	--
W21	21.3	7.0	0.2	3%	1%

Vegetation Code	Surveyed Local Vegetation (ha)	Development Envelope (ha)	Proposed site layout (ha)	% of vegetation cleared within Development Envelope	% of vegetation cleared within Survey Area
W22	66.0	11.1	--	--	--
Total*	**3558.1**	**1481.0**	**391.8**	--	--

*Totals do not include previously cleared areas.

Two local vegetation communities, H1 and W17, were identified as potentially unique or restricted in the region based on surveys. H1 was not mapped within the Development Envelope, however W17 is within the Development Envelope but not within the Proposed Layout. The population of *Hakea pendens* (P3) was found to be generally associated with the W17 vegetation community. Some of these taxa have the potential to be impacted by development of the Development Envelope. The W17 vegetation community will not be directly impacted by the Proposal and indirect impacts are considered low, as the adjacent activity is a low use access road to the borefield, therefore with low dusting potential.

The Priority 1 taxon, *Grevillea lissopleura*, which was specifically associated with the H1 community would not be impacted as it is situated externally to the south of the Development Envelope. With the exceptions of the H1 and W17 vegetation communities, none of the vegetation communities defined within the area surveyed by Mattiske represents vegetation which could be classified as unique or restricted in the region.

Significant communities

The Development Envelope is situated wholly within the designated area for Ironcap Hills Vegetation Complexes (Mt Holland, Middle, North and South Ironcap Hills, Digger Rock and Hatter Hill) (banded ironstone), a Priority 3 ecological community, as shown in Figure 5-6. As indicated in Section 5.2.2, Banded ironstone formations or any form of outcropping are not present within the Development Envelope. The terrain of the Project is gently undulating flats with occasional low rises, none of which exhibited any outcropping that would be indicative of the PEC.

Two studies of the community have been done by Gibson (2004) and Thompson and Allen (2013), with the more recent study focused on the Mt Holland area in the vicinity of the proposal. A qualitative review of species and vegetation communities observed within the Development Envelope as compared to the Ironcap Hills vegetation complexes defined by Thompson and Allen (2013) is shown in Table 5-16. The comparison reveals a poor correlation between the identified vegetation communities, dominant vegetation types and representative species associated with Ironcap Hills Vegetation Complexes in addition to the lack of comparative landforms and geology associated with the PEC. Notable in Table 5-16 as compared to surveyed dominant vegetation described in Table 5-5 for the Development Envelope is the lack of correlation between dominant groupings. Even when dominant vegetation shows some degree of correlation, such as Community types 2 and 4 in Table 5-16, the dominant species were found to correlate to dominance in disparate surveyed communities under Table 5-5, often with notable geographic separation. The most notable correlation was between Community type 4 and local vegetation community W11, which still lacks a level of significance to suggest the presence of the PEC in the Development Envelope.

Table 5-16: Comparison of Ironcap Hills vegetation complexes (Thompson and Allen 2013) to vegetation communities within the Development Envelope

Ironcap Hills PEC surveyed community	Geology/Landform	Dominant Vegetation	Representative Species found in Development Envelope
Community #1	Predominantly upland basalt/laterite sites with gentle gradients	***Allocasuarina acutivalvis*** and *Acacia yorkrakinensis* subsp. *acrita* over *Melaleuca calyptroides,* ***Thryptomene kochii,*** *Hibbertia exasperata* and ***Drummondita hassellii.***	33 of 81 Present (41%)
Community #2	Upland sites characterised by granular or banded ironstone coarse fragments	***Allocasuarina campestris*** over ***Calothamnus quadrifidus* subsp. *seminudus***, *Hakea subsulcata* and ***Melaleuca cordata*** over *Stenanthemum stipulosum* and *Stylidium sejunctum.*	25 of 63 Present (38%)
Community #3	Upland laterite and weathered ironstone sites	***Eucalyptus eremophila***, *Acacia castanostegia*, *Baeckea crispiflora*, ***Beyeria sulcata***, *Hakea multilineata*, ***Melaleuca hamata*** and *Stenanthemum stipulosum* over *Phebalium filifolium* and *Platysace maxwellii* over *Lepidosperma* sp. A2 Inland Flat.	26 of 61 Present (43%)
Community #4	Laterite and basalt sites with gentle slopes	***E. flocktoniae*** and ***Allocasuarina acutivalvis*** over *Dodonaea bursariifolia*, ***M. acuminata* subsp. *acuminata***, ***M. hamata***, ***M. lateriflora* subsp. *lateriflora*** and ***Grevillea acuaria***.	27 of 64 Present (42%)
Community #5	Coarse rock fragments predominantly basalt and undifferentiated greenstone with slight presence of exposed bedrock recorded as basalt	*E. salubris* over ***D. stenozyga***, ***Trymalium myrtillus* subsp. *myrtillus*** and ***G. acuaria*** with *Thysanotus patersonii*.	20 of 40 Present (50%)
Community #6	Footslopes and pediments with little slope	*E. calycogona* subsp. *calycogona*, *Exocarpos aphyllus* and ***Santalum acuminatum*** over ***D. stenozyga*, *G. acuaria*** over *Acacia erinacea* and *Wilsonia humilis*.	36 of 84 Present (43%)
Community #7	Most widespread distribution characterised by the presence of calcrete in the substrate and low species richness	*Eucalyptus extensa* over ***A. merrallii***, *Daviesia articulata* and ***Dodonaea stenozyga*** with *W. humilis*.	24 of 59 Present (41%)
Community #8	Plains with little or no gradient	***E. salmonophloia*** over ***Santalum acuminatum*** over ***A. merrallii***, ***Daviesia scoparia***, *Eremophila ionantha* and ***Olearia muelleri*** with *Austrostipa elegantissima*.	24 of 59 Present (41%)

* – PEC indicators found within the Development Envelope are highlighted in **bold**.

In addition to this, Mattiske Consulting (2018c; Appendix 3) conducted a statistical comparison of the vegetation in the Development Envelope and the Ironcap Hills Vegetation Complexes and determined that vegetation recorded in the Development Envelope showed significant dissimilarity with vegetation recorded at Digger Rock, Hatter Hill, Middle and South Ironcap. The dissimilarity was primarily due to the different suite of species recorded between the Development Envelope and those associated with the current dataset for the Ironcap Hills Vegetation Complexes, as well as the differences in species assemblage.

Based on the lack of a strong correlation between surveyed vegetation communities and species composition within the surveyed area to the Ironcap Hills Vegetation Complexes, in addition to a lack of associated landforms, it is considered that the Proposal is not of consequence in relation to the Ironcap Hills PEC.

5.3.2 Indirect impacts

Indirect impacts include impacts from dust deposition, hypersaline water use, spills, weeds and changes to fire regimes.

Indirect impacts could occur to individuals within 50 m of the Proposed Layout. The 50 m distance is based on the DWER Clearing Regulation Fact Sheet 24: Environmentally Sensitive Areas (August 2014), whereby a declared environmentally sensitive area is considered the area covered by vegetation within 50 metres of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located. In addition, a 50 m distance is considered sufficient to minimise any potential indirect impacts (for example, dust, hypersaline water overspray).

The potential indirect impacts presented in this Section and Sections 5.3.3 to 5.3.7 represent a conservative maximum potential impact. It is expected that the mitigation and monitoring measures discussed in Section 5.4 and 5.5 respectively will substantially minimise the potential of indirect impact within 50 m around the Proposed Layout to a small proportion of the indirect impacts.

Banksia sphaerocarpa var. dolichostyla

Table 5-17 details the potential indirect impacts to the *Banksia sphaerocarpa* var. *dolichostyla* populations within the Development Envelope, currently known local population and regional populations.

Of the 16,503 individual plants identified during flora surveys (5,220 individual plants occurring within the Development Envelope), up to 2,826 *Banksia sphaerocarpa* var. *dolichostyla* individuals occur within the 50 m buffer adjacent to proposed infrastructure and mining activities (predominantly existing disturbed areas where new infrastructure will be located) and consequently have the potential to be indirectly impacted. This equates to 17.12% of the currently known local population and 11.47% of the currently estimated regional populations. Preclearance surveys will be undertaken to define the population boundaries of *Banksia sphaerocarpa* var. *dolichostyla* to assist in the avoidance strategy.

The potential indirect impacts to *Banksia sphaerocarpa* var. *dolichostyla* are considered a conservative maximum. It is expected the mitigation and monitoring measures, discussed in Section 5.4 and 5.5 respectively, will substantially minimise the potential of indirect impact.

Table 5-17: Potential indirect impacts to *Banksia sphaerocarpa* var. *dolichostyla* within the Proposed Layout, Development Envelope, and the local vicinity of the Proposal

Location	Individual Plants	Populations	% Potential Indirect Impacts	Notes
Region	24,636	7 recorded populations	11.47%	Estimated based on Table 5-8.
Locally occurring	22,586	18	12.51%	During targeted surveys, an additional 6,083 plants were estimated (using methodology detailed in Section 5.2.1) to be present in areas outside of the Development Envelope that could not be completely surveyed during the targeted survey program.
Within Targeted Survey Area	16,503	18	17.12%	Based on targeted surveys for *Banksia sphaerocarpa* var. *dolichostyla* in 2018 (Mattiske 2018b).
Within the Development Envelope	5,220	7	54.14%	Based on targeted surveys for *Banksia sphaerocarpa* var. *dolichostyla* across the entire Development Envelope in 2018 (Mattiske 2018b).
Within 50 m buffer of Proposed Layout[4] (indirect impacts)	2,826	6	Not applica-ble	Populations adjacent to the primary access road and the existing airstrip come within 50 m of the proposed layout. Majority of plants are in lower use areas of the Development Envelope, including the accommodation village, main access road, former airstrip being used for soil stockpiling and roads to the accommodation village. Five individuals are located within the 50 m buffer adjacent to the Waste Rock Dump, which is a high use area.

Other conservation significant flora

The locations of potentially impacted individuals and the local and regional populations are discussed in Section 5.2.1. Table 5-18 details the conservation significant flora species located within the Development Envelope, that have the potential of indirect impacts (dust, hypersaline overspray, spills and changed fire regimes).

Table 5-18: Potential indirect impacts to conservation significant flora identified within Development Envelope

Species	Regional Population Individuals	Regional Records	Individuals		% Potential Indirect Impacts	
			Local population	Within 50 m buffer of Proposed Layout	Local Population	Regional Populations
Acacia sp. Mt Holland (B. Ellery BE1147)	109,426	0	109,426	309	0.28%	0.28%
Labichea rossii	2,254	2	2,153	0	0.00%	0.00%
Microcorys sp. Mt Holland (D. Angus DA 2397)	41,492	5	41,492	1,525	3.68%	3.68%
Eutaxia lasiocalyx	10	5	1	0	0.00%	0.00%
Orianthera exilis	47	9	1	1	100.00%	2.13%
Acacia undosa	340	21	265	0	0.00%	0.00%
Hakea pendens	252	23	225	15	6.67%	5.95%
Chorizema circinale	174	15	2	1	50.00%	0.57%
Verticordia stenopetala	25	22	2	1	50.00%	4.00%

[4] Excludes 92 individuals within Proposed Layout.

***Acacia* sp. Mt Holland (B. Ellery BE1147)** has one recorded population located on the main access road which could be potentially indirectly impacted, which is not expected to be heavily trafficked, which results in a 0.28% impact to the currently known local population. These potential impacts are based on estimates, with all current individuals recorded outside the Development Envelope. Therefore, this impact is not considered significant.

Labichea rossii was not recorded with 50 m of the Proposed layout, therefore potential indirect impacts are not expected to occur based on individual records.

However, the association with the S3 vegetation community and the avoidance strategy for *Banksia sphaerocarpa* var. *dolichostyla* discussed above would minimise any potential direct impacts to *Labichea rossii.* In addition, the taxon has a known regional population with two records and a minimum of 101 estimated individuals. Preclearance surveys will assist in determining populations and assist in developing an avoidance strategy.

***Microcorys* sp. Mt Holland (D. Angus DA2397)** has the potential for a 3.68% potential indirect impact to the local and regional populations. It was recorded in association with the S3 vegetation community and also recorded to the north of the Development Envelope at three different locations in the Jilbadji Nature Reserve. It is likely that further surveys will reveal other populations of this taxon within the Jilbadji Nature Reserve. Three other populations of *Microcorys* sp. Mt Holland (D. Angus DA2397) were located external to the Development Envelope. In both cases, *Microcorys* sp. Mt Holland (D. Angus DA2397) was recorded growing in association with *Banksia sphaerocarpa* var. *dolichostyla* on gravelly hills within the S3 vegetation community.

All areas outside the Development Envelope where *Microcorys* sp. Mt Holland (D. Angus DA2397) was recorded are currently within mining or exploration tenements, including those within the Jilbadji Nature Reserve. Consequently, there is a potential for these populations to be impacted in the future should any mining take place. However, given that this taxon, based on current survey work, is present in greater numbers in vegetation and landforms which support the presence of *Banksia sphaerocarpa* var. *dolichostyla*, it is likely given the need to protect the latter, the former will also be protected.

Microcorys sp. Mt Holland (D. Angus DA2397) was commonly recorded growing on disturbed grounds associated with old tracks within the survey area, or in fire burnt areas within the Jilbadji Nature Reserve. These observations would suggest that this species is likely to readily grow from seed and could be considered as a suitable species to be used as part of any rehabilitation activities.

Whilst the proposed direct impacts to *Microcorys* sp. Mt Holland (D. Angus DA2397) amount to up to 18.07% of the currently known local and regional population, given that this taxon is present in large numbers both within and in the area surrounding existing *Banksia sphaerocarpa* var. *dolichostyla* populations, further reductions in impacts to this taxon can be achieved by the Proponents strategy of avoidance of impacts where possible.

Where large populations of *Microcorys* sp. Mt Holland (D. Angus DA2397) are identified, the site layout will be amended with the implementation of exclusion zones where possible. Large populations have been recorded adjacent to the waste rock landform and surrounding the accommodation village and former airstrip (Figure 5-11). Preclearance surveys will be undertaken to define the population boundaries of *Microcorys* sp. Mt Holland (D. Angus DA2397) to assist in the avoidance strategy. Therefore, the potential indirect impact to the population is not considered significant.

Eutaxia lasiocalyx was not recorded within 50 m of the Proposed Layout, therefore, the potential indirect impact is not considered significant.

Orianthera exilis has one individual located within the 50 m buffer around the Proposed Layout, therefore is at risk of potential indirect impact. This individual represents 100% of the currently known local population and 2.13% of the regional population and the impact to the regional population is not considered significant. The individual is located on the borefield access road which will not be heavily trafficked, therefore the risk of indirect impact from dust is considered low.

Acacia undosa was not recorded with 50 m of the Proposed layout, therefore potential indirect impacts are not expected to occur based on individual records.

Hakea pendens has 15 individuals with the potential to be indirectly impacted, equating to 6.67% of the currently known local population and 5.95% of the regional populations. These individuals are located in a population along the borefield access road, which is not likely to be heavily trafficked. Therefore, the indirect impacts are not expected to significant impact this species.

Chorizema circinale has one individual located within 50 m of the Proposed Layout. Given the isolated recording, this represents 50% of the currently known local population, however given its regional distribution and population data, the impact to the species is not considered to be significant.

Verticordia stenopetala has a potential indirect impact of 25% to the currently known local population. *Verticordia stenopetala* is distributed across the Coolgardie, Avon Wheatbelt and Mallee bioregions, with a total potential impact of 4.00% to the regional population, therefore it is not expected to be significantly impacted.

The potential indirect impacts to the conservation significant flora species are considered a conservative maximum. It is expected the mitigation and monitoring measures, discussed in Section 5.4 and 5.5 respectively, will substantially minimise the potential of indirect impact.

5.3.3 Dust deposition on vegetation from mining and related activities

Deposition of mining, quarry and road dust on vegetation canopies has been observed to inhibit plant growth and reduce photosynthesis when dust burdens are dense (≥5 g/m^2) and or daily dust deposition rates are high (≥1 g/m^2/d) (Farmer 1993, Turner 2013). Indirect impacts associated with the Earl Grey Mine are likely to occur in areas where existing and new disturbance is located in proximity to conservation significant flora species.

The direct loss (mortality) associated with potential indirect impacts has been quantified in Section 5.3.2 with potential indirect impacts on local and regional populations presented in Table 5-17 for *Banksia sphaerocarpa* var. *dolichostyla* and Table 5-18 for other conservation significant flora species found within the Development Envelope.

Individuals located with 50 m of the Proposed Layout have been considered at risk of indirect dust impacts. This distance is based on the DWER Clearing Regulation Fact Sheet 24: Environmentally Sensitive Areas (August 2014), whereby a declared environmentally sensitive area is considered the area covered by vegetation within 50 metres of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located. In addition, a 50 m distance is considered sufficient to minimise any potential indirect impacts (for example, dust).

Of the currently known local population of *Banksia sphaerocarpa* var. *dolichostyla*, 17.12% are located within 50 m of the Proposed Layout. Of the currently known population within the Development Envelope, 54.14% of individuals are located within 50 m of the Proposed Layout. This is a significant portion, given the Proponent will only have direct control over management activities within the Development Envelope. There is limited control over populations outside the Development Envelope, however the management actions are expected to extend beyond the Development Envelope boundary (for example, weed management).

The majority of the potential indirect dust impacts on *Banksia sphaerocarpa* var. *dolichostyla* individuals are concentrated on the southern portion of the Development Envelope. The southern populations would be at risk from vehicle trips to and from the accommodation village and the airstrip, plus intermittent dust from aircraft landings at the airstrip. Populations located within proximity to access road could be indirectly impacted by less frequent vehicle movements.

A small portion (5 individuals) are within proximity to the Waste Rock Dump. Consequently, there is the potential for these individuals to be indirectly impacted. Mitigation actions including locating infrastructure within already disturbed areas at least 50 m from *Banksia sphaerocarpa* var. *dolichostyla* individuals will be implemented where possible.

Populations located in the northern portion of the Development Envelope could be potentially indirectly impacted by waste rock dump development. This area is expected to have a higher activity level during clearing and waste rock dump development. Dust would be expected to be intermittent and not significant within the overall context of the Proposal.

A 50 m protective buffer on the remaining *Banksia sphaerocarpa* var. *dolichostyla* individuals will be implemented to minimise indirect impacts.

The potential indirect dust impacts to conservation significant species individuals are the greatest for *Microcorys* sp. Mt Holland (D. Angus DA 2397) (1,525 individuals), *Acacia* sp. Mt Holland (B. Ellery BE1147) (309 individuals), *Orianthera exilis* (1 individual), *Chorizema circinale* (1 individual), *Verticordia stenopetala* (1 individual) and *Hakea pendens* (15 individuals). The potential impacts to currently known local populations are 3.68% (*Microcorys* sp. Mt Holland (D. Angus DA 2397)), 0.28% (*Acacia* sp. Mt Holland (B. Ellery BE1147)), 100% (*Orianthera exilis)*, 50% (*Chorizema circinale)*, 50% (*Verticordia stenopetala)* and 6.67% (*Hakea pendens*). *Microcorys* sp. Mt Holland (D. Angus DA 2397) will benefit from its association with *Banksia sphaerocarpa* var. *dolichostyla* populations due to associated mitigation measures. *Hakea pendens* and *Acacia* sp. Mt Holland (B. Ellery BE1147) population is located on the borefield access road and mine access road respectively, which are expected to be have low levels of vehicle traffic and therefore less dust emissions. The other conservation significant flora species indirectly impacted are due to isolated recordings and has a wider regional distribution, so the impact is not considered to be significant.

The potential indirect impacts to *Banksia sphaerocarpa* var. *dolichostyla* and conservation significant flora species are considered a conservative maximum. It is expected the mitigation and monitoring measures, discussed in Section 5.4 and 5.5 respectively, will substantially minimise the potential of indirect impact.

In this context of population numbers, the environmental effect of dust generated by the Proposal to *Banksia sphaerocarpa* var. *dolichostyla* and other conservation significant flora species is not expected to be environmentally significant and can be managed through controls on vehicle speeds and periodicity, and dust management actions. The EPA's objectives for the key environmental factor of Flora and Vegetation can therefore be met, noting the Proposal is not expected to result in a significant detrimental effect to the environment.

5.3.4 Impact to flora and vegetation from use of hypersaline water used for dust suppression

Included in the management measures for dust suppression under the Proposal is the use of the existing on–site water supply which would include the use of hypersaline groundwater. Salts may also be transported from roads and infrastructure into vegetation.

The local populations discussed in Section 5.3.2 for potential impacts from dust deposition are the same for those populations at risk from hypersaline water use and the associated saline run off.

Hypersaline water used in dust suppression will be managed through:

- implementation of dribble bars in roadway dust suppression and construction of earthen bunds on road sides, prioritised in existing roadway sections within 50 m of *Banksia sphaerocarpa* var. *dolichostyla*
- locating pipes transferring saline water within bunds, fitted with leak detection systems and routinely inspected
- hypersaline water shall not be used for dust suppression during rainfall events
- lining water storages potentially storing hypersaline or poor-quality water to prevent or minimise seepage. They will be operated with adequate freeboard to store inflows associated with 1 in 100 year, 72 hour rainfall event.

In this context, the environmental effect of hypersaline water overspray by the Proposal to *Banksia sphaerocarpa* var. *dolichostyla* and other conservation significant flora species is not expected to be environmentally significant and can be managed through controls on hypersaline water storage and control of dust suppression measures. The EPA objectives for the key environmental factor of Flora and Vegetation can therefore be met, noting the Proposal is not expected to result in a significant detrimental effect to the environment.

5.3.5 Impact to flora and vegetation from spillage of hypersaline water and hydrocarbons.

Spillages of hydrocarbons and hypersaline water from pipelines can potentially result in large scale vegetation death without the correct controls in place.

The proponent will implement spill control management measures across the facility to manage against accidental spill and/or contamination of native soils that could significantly harm native vegetation and plant species. Key measures in relation to flora and vegetation include:

- spill kits will be located at strategic locations throughout the project area and employees trained in their use
- chemicals and hydrocarbons will be stored and used within bunded areas
- hydrocarbon wastes will be segregated from other wastes and collected for offsite disposal by a licensed contractor
- all hydrocarbon and chemical storages will be designed and constructed in accordance with Australian Standards AS1940 and AS1692
- pipes transferring saline water or tailings will be located within bunds, fitted with leak detection systems and routinely inspected
- water storages potentially storing saline or poor quality water will be lined to prevent or minimise seepage. they will be operated with adequate freeboard to store inflows associated with 1 in 100 year, 72 hour rainfall event
- landfill and waste water treatment plants will be operated in accordance with an Environmental Licence.

Tailings will be dewatered, dry stacked and are geochemically benign with no requirement for specific management measures. In this context, the likelihood of accidental spills would not be significant and the commensurate environmental effect of spills on *Banksia sphaerocarpa* var. *dolichostyla* and other conservations significant flora species is not expected to be environmentally significant and can be managed through spill control measures. The EPA's objectives for the key environmental factor of Flora and Vegetation can therefore be met, noting the Proposal is not expected to result in a significant detrimental effect to the environment.

5.3.6 Changes to vegetation structure and composition through altered surface drainage flow patterns

Operations can result in modified hydrology (e.g. creek diversions or impoundment of flows) resulting in deterioration of plant health through either inundation or reduced water supply. Within the Project area, there are very few surface water features due to a limited total upper catchment area of less than 1,000 ha and the subdued relief. The only notable surface water feature is an ephemeral drainage line that starts at the northwest tip of the airstrip and runs northeast past the processing plant area. Apart from this drainage line, the Project area does not intersect any other identifiable drainage lines or creeks, with runoff generally occurring as sheetwash in a north-easterly direction. A small sub-catchment containing the southern end of the airstrip and accommodation village drains to the south, away from new areas of clearing and mining associated with the Proposal.

A combination of earth bunds and landforms were constructed within the ephemeral drainage during previous mining operations between 1988 and 2001. These previously constructed features form an effective drainage diversion around most of the site that would not be altered as part of the Proposal. Recent aerial imagery and site photos indicate no new watercourses or significant erosion gullies have formed as a result of flow concentration by these structures in the 20 years or more they have been in place. As such, future changes to surface hydrology resulting from the Proposal would be negligible and not be anticipated to have significant effects on local hydrology or associated vegetation communities in the Development Envelope.

5.3.7 Spread of weeds and alteration of fire regimes

Vehicle or earth movements have the potential to spread existing weed species and to introduce new weed species, particularly if equipment is not adequately inspected and cleaned prior to arrival or departure from site. Activities that disturb native vegetation (such as clearing) can create favourable conditions for weeds to establish. If appropriate management measures are not implemented, weed infestations can outcompete native vegetation and result in alterations to existing ecosystems.

One introduced (exotic) plant taxon, *Centaurium tenuiflorum*, was recorded during the survey of the Development Envelope This taxon is listed as Permitted (s11) pursuant to the *Biosecurity and Agriculture Management Act 2007* according to the DAFWA (2017).

Introduced flora can be effectively managed through standard mine hygiene processes, which can commonly include weed spraying, and procedures to control vehicle and personnel movements within weed infested areas. In this context, the environmental effect of the Proposal to introduced flora taxa is not expected to be environmentally significant. The EPA's objectives for the key environmental factor of Flora and Vegetation can therefore be met, noting the Proposal is not expected to result in a significant detrimental effect to the environment from introduced flora.

Mining activities can cause accidental fires, though the risk is low, unplanned fires can also be caused by road accidents, lightning or arson. While fire is a positive contributor to a mosaic of vegetation structures and understory/overstory composition, high intensity unplanned bushfires are undesirable as they substantially change fauna habitats on a large scale contributing to reduced diversity. Fauna can be negatively impacted by fire with direct mortality experienced as well as a reduction required habitat such the loss of leaf–litter essential for building Malleefowl mounds. With the inclusion of fire management measures, unintentional burning and/or unplanned fire would be managed to not significantly affect Flora and Vegetation values.

5.3.8 Total impacts

Section 5.3.1 and 5.3.2 address the direct and potential indirect impacts associated with the Proposal. The total impacts to local and regional populations are presented in Table 5-19.

The total potential impact to local and regional populations does not significantly differ from the assessment of direct and potential indirect impacts.

As a result of the surveys associated with the Proposal, the known individuals and population data has increased for *Banksia sphaerocarpa var. dolichostyla*. Previous individual estimates were a minimum of 2,400 individuals. The current estimated regional individuals is 24,636 individuals. Therefore, the total potential impact to *Banksia sphaerocarpa var. dolichostyla* is 17.68% to the currently known local population and 11.84% to the regional population.

The largest total potential impact to conservation significant flora local populations is associated with isolated individuals having been identified within the Development Envelope (*Eutaxia lasiocalyx, Orianthera exilis, Chorizema circinale* and *Verticordia stenopetala).* In these circumstances, as discussed in Section 5.3.1 and 5.3.2, these isolated occurrences are part of a wider distribution of regional populations and the resulting regional potential impacts range from 0.57% *(Chorizema circinale)* to 10% *(Eutaxia lasiocalyx).* Therefore, the impact to the species is not considered significant.

The only conservation significant flora species with limited regional distributions (as per Section 5.2.1) are *Acacia* sp. Mt Holland (B. Ellery BE1147) (0.70% total potential impact to local population), *Labichea rossii* (8.78% total potential impact to local population), and *Microcorys* sp. Mt Holland (D. Angus DA 2397*)* (21.75% total potential impact to local population). These species are not widely distributed across the region and therefore the local population is also considered the regional population. The total potential impact to *Acacia* sp. Mt Holland (B. Ellery BE1147) and *Labichea rossii* are not considered significant due to the scale of potential impact. The remaining conservation significant species have numerous regional records and estimated individuals are widely distributed, therefore the total impacts to these regional populations is not considered to be significant.

The largest total potential impacts to regional population individuals is for the *Banksia sphaerocarpa var. dolichostyla* (11.84%) and *Microcorys* sp. Mt Holland (D. Angus DA 2397) (21.75%). Specific mitigation measures for these species are included in 5.4.1 and the Flora Management Plan (Appendix 4). When these management measures are taken into account, the impact to the species is not considered significant.

Table 5-19: Total potential impacts of Conservation Significant Flora species

Species	Total Regional Individuals	Individuals			Local Population Impacts			Regional Population Impacts		
		Local population	Within Proposed Layout	Within 50 m buffer of Proposed Layout	% Direct Impacts	% Potential Indirect Impacts	% Total Potential Impacts	% Direct Impacts	% Potential Indirect Impacts	% Total Potential Impacts
Banksia sphaerocarpa var. dolichostyla	24636	16503	92	2826	0.56%	17.12%	17.68%	0.37%	11.47%	11.84%
Acacia sp. Mt Holland (B. Ellery BE1147)	109426	109426	458	309	0.42%	0.28%	0.70%	0.42%	0.28%	0.70%
Labichea rossii	2254	2153	189	0	8.78%	0.00%	8.78%	8.39%	0.00%	8.39%
Microcorys sp. Mt Holland (D. Angus DA 2397)	41492	41492	7498	1525	18.07%	3.68%	21.75%	18.07%	3.68%	21.75%
Eutaxia lasiocalyx	10	1	1	0	100.00%	0.00%	100.00%	10.00%	0.00%	10.00%
Orianthera exilis	47	1	0	1	0.00%	100.00%	100.00%	0.00%	2.13%	2.13%
Acacia undosa	340	265	30	0	11.32%	0.00%	11.32%	8.82%	0.00%	8.82%
Hakea pendens	252	225	1	15	0.44%	6.67%	7.11%	0.40%	5.95%	6.35%
Chorizema circinale	174	2	0	1	0.00%	50.00%	50.00%	0.00%	0.57%	0.57%
Verticordia stenopetala	25	2	0	1	0.00%	50.00%	50.00%	0.00%	4.00%	4.00%

5.3.9 Cumulative impacts

The Proposal would result in in 392 ha of new clearing in addition to the clearing undertaken for the existing mine. Within the 1,984 ha Development Envelope, 668 ha (33.7%) of the site is already cleared or otherwise developed. Within the context of the Development Envelope, this represents a 20% increase in clearing of the site. Overall clearing of vegetation associations at both a regional and subregional scale are less than 2% of total vegetation association cover (discussed further in Section 5.3.1) and would not be a cumulatively significant contribution at a regional scale.

In addition, the timescale for effects places more emphasis on existing disturbed areas in the early years of work, with the new mine pit and airstrip being the primary areas of clearing in the early years of the proposal. Progressive clearing is anticipated to approximately reach 270 ha by the 20-year mark of the project, as shown in Table 5-20 and Figure 2-4, and would still be below 150 ha at the 10-year mark. This slow and relatively minor clearing progression in the context of greater than 98% of regional vegetation remaining and local conservation areas such as Jilbadji Nature Reserve less than 5 km north of the Development Envelope, ensures that overall impacts are not cumulatively significant in the regional context.

Table 5-20: Approximate vegetation clearing timeline for Earl Grey Lithium Project

	Year		
	3	**10**	**20**
Area (Ha)	90	150	270

Cumulative impacts to *Banksia sphaerocarpa var. dolichostyla* and conservation significant flora species are expected to be limited due to:

- location within a range of vegetation communities and locations, indicating the species (particularly *Banksia sphaerocarpa var. dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) are not dependent on one vegetation community
- a high potential of additional unrecorded populations being identified outside the Development Envelope. This is evident as additional surveys have identified *Banksia sphaerocarpa var. dolichostyla* and conservation significant flora species outside the Development Envelope
- a small portion of clearing is required for the Proposal in the context of regional vegetation associations
- the regional vegetation associations have a low portion of clearing (less than 2%), therefore any unrecorded population occurrences outside the Development Envelop are expected to be subject to low clearing pressure
- the low portion of clearing within the Southern Cross subregion suggests a lower risk of weed spread, plant disease and grazing. The Proposal is located approximately 35 km from a significant cleared area (Wheatbelt agricultural area) which could be considered an adequate buffer from these pressures
- whilst some regional populations may be located in areas which could be considered at risk from agriculture or mining activities, no known proposals or projects with potential to impact on these population is known to the Proponent.

The cumulative impacts of climate change, including rainfall and fire regime changes, is unknown. However, based on the *Banksia sphaerocarpa var. dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) field observations of active recruitment of different ages, even within burnt areas, indicates these species are resilient to changed fire regimes.

Therefore, the cumulative impacts to *Banksia sphaerocarpa var. dolichostyla* and conservation significant flora species is expected to be low.

5.4 Mitigation

A Management Plan for the Proposal that addresses *Banksia sphaerocarpa* var. *dolichostyla* and other conservation significant flora has been prepared and is provided in Appendix 4. A summary of the key management measures is provided below. The management measures are applicable to the maintenance and protection of flora and vegetation and associated biodiversity within the Development Envelope.

Based on the current design and available survey information, the Proposal would result in direct loss of 0.56% of currently known local *Banksia sphaerocarpa* var. *dolichostyla* population. Direct loss could occur to currently known local populations of *Microcorys* sp. Mt Holland (D. Angus DA 2397) (18.07%), *Acacia* sp. Mt Holland (B. Ellery BE1147) (0.42%), *Eutaxia lasiocalyx* (100%), *Hakea pendens* (0.44%), *Acacia undosa* (11.32%), *Verticordia stenopetala* (25%) and *Labichea rossii* (8.79%). Redesign during the detailed design stage will be considered to avoid impacts where possible. Where direct impacts are unavoidable, measures intended to minimise direct loss have been proposed in Section 5.4.1.

Potential indirect impacts on an additional 2,826 individuals of *Banksia sphaerocarpa* var. *dolichostyla* are anticipated, especially in areas where existing infrastructure is in close proximity (less than 50 m) to plant individuals. Potential indirect impacts could occur to the currently known local populations of *Microcorys* sp. Mt Holland (D. Angus DA 2397) (3.68%), *Acacia* sp. Mt Holland (B. Ellery BE1147) (0.28%), *Hakea pendens* (6.67%), *Verticordia stenopetala* (25%) and *Labichea rossii* (8.79%). Potential indirect impacts will be minimised to the maximum extent practicable with best management practices to suppress dust and minimise invasive plant species as described in Section 5.4.2 through 5.4.6.

5.4.1 *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys sp. Mt Holland (D. Angus DA 2397)* specific measures

The Proposal would minimise clearing of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) to the maximum extent practicable through implementation of an internal clearing permit procedure and avoidance of the populations and associated vegetation community where possible.

Where *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) has been recorded in targeted surveys the following actions will be undertaken:

- within the Development Envelope all populations will have a 50 m buffer and development of new infrastructure within the buffer will be avoided if possible
- all populations with the 50 m buffer adjacent to a disturbed area will be demarcated and signed as Conservation Significant Flora Exclusion Zones, with physical barriers installed in areas of high risk
- minimise saline water overspray through use of dribble bars in roadway dust suppression and construction of earthen bunds on road sides
- plants will be recorded in the Significant Flora Register which will include date, observer, status (flowering, poor health etc.) and a GPS/location description
- Significant Flora Exclusion Zones will be incorporated into the mine plan
- avoid accidental disturbance by enforcing strict traffic management rules (e.g. keeping to designated tracks, reduced speed limits, prohibiting access to native vegetation areas containing *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) except for monitoring purposes, signage installation warning personnel of the presence of Conservation Significant Flora.

For up to 0.56% of currently known local populations (92 individuals) of *Banksia sphaerocarpa* var. *dolichostyla* where avoidance is not achievable, clearing will not be undertaken until:

- a permit to take Declared Rare Flora is granted by DBCA
- seed and/or cuttings collected by a suitably qualified environmental professional, in consultation with DBCA and Kings Park and Botanical Gardens and stored appropriately for rehabilitation (where seed is present). Regardless of impacts, *Banksia sphaerocarpa* var. *dolichostyla* will be considered as part of the plant mix for rehabilitation areas near existing populations. The Flora Management Plan (Appendix 4) provides further detail on rehabilitation approach.

Banksia sphaerocarpa var. *dolichostyla* has been identified as a good candidate for seeding in rehabilitation areas with suitable soils. It has been observed to be a recruiting species in previously burnt and disturbed areas. Therefore, in the event of a *Banksia sphaerocarpa* var. *dolichostyla* individual direct loss associated with the Proposal, the Proponent aims to achieve no net loss of individuals of the currently known local population (16,503 individuals) through the following rehabilitation strategy:

- undertaking rehabilitation trials and implementing research programs (in consultation with DBCA and Kings Park and Botanical Gardens) to increase translocation and rehabilitation success and investigate active propagation
- translocation of individuals to be directly impacted into an area of suitable habitat
- rehabilitation of areas to provide suitable habitat for *Banksia sphaerocarpa* var. *dolichostyla*. The previously disturbed former airstrip is a potential location for rehabilitation trials as it intersects the local population area
- seeding of areas with suitable habitat within the Development Envelope with *Banksia sphaerocarpa* var. *dolichostyla* seeds
- monitoring of translocated individuals and rehabilitated areas.

While the field observations suggest that *Banksia sphaerocarpa* var. *dolichostyla* is a good candidate for rehabilitation, there are no rehabilitation trials or research to date. Accordingly, there remains uncertainty as to the success of a rehabilitation program if required within the Development Envelope. This uncertainty would be addressed through the above mentioned research programs and rehabilitation trials, however there is no scientific evidence that the rehabilitation strategy would achieve the desired outcome of no net loss.

5.4.2 Worker Awareness Training

The Proponent will require all workers, both during construction and operation of the mine, to attend a worker awareness training covering the following topics:

- *Banksia sphaerocarpa* var. *dolichostyla* (e.g. how to identify it, conservation status, the importance of minimising impacts on the species, requirements of personnel including adherence to speed limits and staying on roads as well as locations and incidents, reporting to Environment Department
- information on weed species and the impact on *Banksia sphaerocarpa* var. *dolichostyla*
- information on the prevention and management of fires.

5.4.3 Dust suppression

Dust suppression measures will be implemented during construction and operation of the proposed mine to minimise potential indirect impacts on native vegetation adjacent to facilities and roads at the mine site. Dust will be minimised on site through implementation of the following measures:

- maximise efficiency of loads when transporting ore or concentrate (including haul trucks and conveyers)
- maintain at least 0.5 m of freeboard in hauling trucks or cover loads
- use dust covers on machinery and water suppressants on exposed areas wherever required

- minimise open area footprint and rehabilitate or cover (using vegetation, rock, water and/or dust suppressant) exposed areas as soon as practicable
- implement management practices including ensuring that product spills are cleaned up as soon as possible, and water sprays and emissions control equipment is properly maintained
- minimise saline water overspray through use of dribble bars in roadway dust suppression and construction of earthen bunds on road sides
- reduce vehicle traffic on unsealed roads and other exposed areas, where practicable, and limit traffic speeds on unsealed roads to 25 km/h.

5.4.4 Spill Prevention

Spill prevention measures will be implemented during construction and operation of the proposed mine to minimise potential indirect impacts on native vegetation adjacent to facilities and roads at the mine site. Spills and overspray will be minimised on site through implementation of the following measures:

- spill kits will be located at strategic locations throughout the project area and employees trained in their use
- hydrocarbon wastes will be segregated from other wastes and collected for offsite disposal by a licensed contractor
- all hydrocarbon and chemical storages will be designed and constructed in accordance with Australian Standards AS1940 and as1692
- pipes transferring saline water or tailings will be located within bunds, fitted with leak detection systems and routinely inspected
- water storages potentially storing saline or poor quality water will be lined to prevent or minimise seepage. They will be operated with adequate freeboard to store inflows associated with 1 in 100 year, 72 hour rainfall event
- landfill and waste water treatment plants will be operated in accordance with an Environmental Licence.

5.4.5 Fire Management

To avoid or minimise increases in fire frequency, the Proponent will contribute to fire management at the mine site and in the region through the following measures:

- implementation of fire management procedures (e.g. maintenance of fire breaks, Hot Work Permit system, firefighting training, Emergency Response Plan)
- firefighting equipment will be located on site and in vehicles
- lightning protection equipment will be installed as part of Project design where necessary
- vehicles will not be permitted to leave access tracks or cleared areas
- coordination with DBCA and Department of Fire and Emergency Services (DFES) to undertake prescribed burns.

5.4.6 Weed control

To avoid or minimise the introduction or spread of invasive weeds, the Proponent will implement the following measures during construction and operation of the mine:

- minimise the risk of introduction of invasive species through implementation of a vehicle hygiene procedure and weed control
- will be required to stockpile excavated topsoil so it can be reused for revegetation on the Proposed Project site as needed. To ensure maximum topsoil recovery, topsoil will be stockpiled separately from other excavated materials
- Development Envelope will be surveyed for weeds periodically, so that any infestations of invasive species that establish can be eradicated before the plants can flower and set seed.

5.5 Monitoring

Banksia sphaerocarpa var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) populations will be monitored prior to commencement of operations, during operations, and post–closure to enable early detection of indirect impacts on individuals within 50 m of construction and mining activities.

5.5.1 Prior to commencement

Prior to commencement the following monitoring will be undertaken:

- Pre–clearance survey: A targeted site pre–clearance survey will be undertaken across the site footprint to accurately delineate Conservation Significant Flora (*Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397)) population boundaries
- Transects: Establish permanent 100 m transects for annual plant health monitoring
- Baseline Monitoring: Undertake a pre–operation baseline monitoring assessment of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys sp.* Mt Holland (D. Angus DA 2397) population health on transects. Plant condition for each individual that intersects the transect will be assessed using a rating method that assigns a score based on species health/vigour (e.g. 0 = dead, 1 = poor health (i.e. extensive crown decline), 2 = moderate health (i.e. some evidence of crown decline) and 3 = very healthy (i.e. no evidence of crown decline). Presence of invasive weeds will also be recorded if present. Analogue transects, outside of the Development Envelope will be established and monitored concurrently to provide a control for climatic conditions outside of the Proponent's control. Statistical analysis will be undertaken to determine if a significant difference between populations within the Development Envelope and those outside exists.

5.5.2 During construction and operation phases

During construction and operation, the following monitoring will be undertaken:

- Clearing survey: Survey and recording of all areas cleared, to be submitted on an annual basis
- Quarterly Observations: Undertake quarterly visual observations of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys sp.* Mt Holland (D. Angus DA 2397) populations in close proximity to the access roads and operations. Written and photographic records will be kept of the visual inspections of plant conditions. Presence of invasive weeds will also be recorded if present
- Baseline Monitoring: Undertake a pre–operation baseline monitoring assessment of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) population health on transects. Plant condition for each individual that intersects the transect will be assessed using a rating method that assigns a score based on species health/vigour (e.g. 0 = dead, 1 = poor health (i.e. extensive crown decline), 2 = moderate health (i.e. some evidence of crown decline) and 3 = very healthy (i.e. no evidence of crown decline). Presence of invasive weeds will also be recorded if present. Analogue transects, outside of the Development Envelope will be established and monitored concurrently to provide a control for climatic conditions outside of the Proponent's control. Statistical analysis will be undertaken to determine if a significant difference between populations within the Development Envelope and those outside exists.

5.5.3 Post closure monitoring

Post-closure the following monitoring will be undertaken:

- Annual Monitoring: Monitoring will continue until completion of rehabilitation activities. Annual monitoring will summarise data collected during the year on *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) transects and additional data as follows:
    - monitoring of incident reports impacting *Banksia sphaerocarpa* var. *dolichostyla* relating to damage, death, unauthorised clearing and fire
    - monitoring of increases in herbivore species through feral control reports
    - internal audit and inspection of areas of clearing
    - monitoring of clearing through the clearing register, survey data and aerial photography.

The Flora Management Plan (Appendix 4) details management actions and targets (and associated early response triggers) and environmental criteria (and associated triggers and thresholds) for managing impacts to *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397). Where an early response action, management target, trigger or threshold is breached, the Flora Management Plan identifies the resulting actions to be initiated.

5.6 Predicted outcome

The EPA objective for the environmental factor Flora and Vegetation is "To protect flora and vegetation so that biological diversity and ecological integrity are maintained." The EPA's Environmental Factor Guideline for Flora and Vegetation indicates that in the context of this objective, ecological integrity is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements; and that vegetation can be an effective surrogate for ecological processes and the diversity of interactions in terrestrial ecosystems.

At a regional level, the Proposal would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations that are currently less than 1% cleared and have 17% of the regional vegetation association protected for conservation. Vegetation has also been mapped at a local scale within the Development Envelope and surrounding vicinity. The local vegetation communities are typical, both in terms of structure and species composition to those mapped in other regional surveys, as well as those described by Beard (1972, 1990). None of the local vegetation communities are considered unique or restricted in the region.

The Proposal is located within an area designated as a Priority 3 banded ironstone formation PEC. Banded ironstone formations or any form of outcropping are not present within the Development Envelope. The terrain in the Development Envelope is gently undulating flats with occasional low rises, none of which exhibited any outcropping. Vegetation associations consistent with the PEC and associated communities were also not identified within the Development Envelope. Further, the Proposed Layout for the Proposal represents only about 6% of the area designated as PEC. As such, it is anticipated that the Proposal would not significantly impact the conservation significance of the PEC.

The Proposal has the potential to impact one Declared Rare Flora, *Banksia sphaerocarpa* var. *dolichostyla* and nine Priority Flora species.

The proposal would result in direct impact of less than 0.56% to the currently known local population (92 individuals of the currently known local population of 16,503) and 0.37% of the regional population of *Banksia sphaerocarpa* var. *dolichostyla*. Indirect impacts have the potential to impact individuals that are located within 50 m of Proposed Layout, with an additional potential indirect impact to 17.12% of the currently known local population (2,826 individuals of the currently known local population of 16,503) and 11.47% of the regional population. Mitigating actions (Section 5.4) will reduce the potential for indirect impacts to this species.

Direct losses of Priority Flora are expected, however the probability of impacts to the species are considered low. Impacts to local and regional populations has been considered and the impact is not considered significant. Direct impacts to M*icrocorys* sp. Mt Holland (D. Angus DA 2397) is expected to directly impact 18.07% of the currently known local population and potentially indirectly impact an additional 3.68%. M*icrocorys* sp. Mt Holland (D. Angus DA 2397) has been included in the Flora Management Plan (Appendix 4) to minimise impact.

The potential indirect impacts represent a conservative maximum potential impact. It is expected that the mitigation and monitoring measures discussed in Section 5.4 and 5.5 respectively will substantially minimise the potential of indirect impact within 50 m around the Proposed Layout to a small proportion of the indirect impacts.

The Proposal has been designed to minimise direct impacts on the *Banksia sphaerocarpa* var. *dolichostyla* local population to the maximum extent practicable, although direct loss will occur. During the detailed design stage of the Proposal, further attempts to minimise direct loss to individuals shall be implemented. If direct loss of a *Banksia sphaerocarpa* var. *dolichostyla* individual occurs as a result of the Proposal, rehabilitation, translocation and associated research programs should result in no net loss of individuals from the currently known local population (16,503).

Overall, the Project is considered to pose a relatively low risk to *Banksia sphaerocarpa* var. *dolichostyla*, as a very small percentage of known individuals will be directly impacted by the Proposal and the number of plants surveyed outside of the Development Envelope is a significant percentage (68% or 11,283 individuals) of the currently known local population identified in targeted surveys. *Banksia sphaerocarpa* var. *dolichostyla* has been included in the Flora Management Plan (Appendix 4) to minimise impact.

As discussed in Section 5.3.9, cumulative impacts are expected to be low due to the potential for additional populations in a range of vegetation communities outside the Development Envelope within a bioregion with low clearing pressures. In addition, pressures from weed spread and plant disease are considered to be low due to the Proposal's buffered location from agricultural areas. The *Banksia sphaerocarpa* var. *dolichostyla* and M*icrocorys* sp. Mt Holland (D. Angus DA 2397) have been observed to actively recruit in disturbed and burnt areas, indicating a resilience to changed fire regimes.

Therefore, on the above basis, the Proposal is not expected to cause significant impact to flora and vegetation. There is a high level of confidence to prevent potential indirect impacts as the mitigation measures within the 50m buffer are industry standards and have been shown to be successful within the region and other minesites. However, there remains uncertainty as to the effectiveness of the rehabilitation strategy (Section 5.4.1), if required, to ensure a no net loss of *Banksia sphaerocarpa* var. *dolichostyla*. Due to this uncertainty, there remains the potential for significant impacts to flora and vegetation. However, when mitigation measures have been implemented, as summarised in Table 5-21, it is expected that the Proposal will meet the EPA's objective for the flora and vegetation factor.

Table 5-21: Summary of flora and vegetation objective, potential impacts assessed against the mitigation hierarchy and predicted outcomes

Element	Description
Flora and vegetation	
EPA objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.
Potential impacts	• further loss and fragmentation of native vegetation and habitat.
	• spread of weeds and alteration of fire regimes.
	• dust deposition on vegetation from mining and related activities.
	• impact to flora and vegetation from overspray of hypersaline water used for dust suppression.
	• changes to vegetation structure and composition through altered surface drainage flow patterns.
	• impact to flora and vegetation from spillage of tailings, hypersaline water and hydrocarbons.
Mitigation	Avoid:
	• all populations of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) will have a 50 m buffer and development of new infrastructure within the buffer will be avoided if possible • avoid accidental clearing though implementation of an internal clearing permit procedure and preclearance surveys. • implement *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) specific measures that include avoidance, buffers and monitoring protocols.
	Minimise:
	• minimise direct and indirect impacts to Ironcaps Banksia (*Banksia sphaerocarpa* var. *dolichostyla)* and *Microcorys* sp. Mt Holland (D. Angus DA2397) local population to the maximum extent practicable through locating new infrastructure outside of 50m protective buffer where possible. • All populations of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA2397) within 50 m buffers adjacent to disturbed areas will be demarcated and signed as Conservation Significant Flora Exclusion Zones • Impacts caused by dust due to vehicle movements by keeping roads and other areas well-watered. Dust suppression measures that include maintenance practices for vehicles, cleared areas, and active stockpiles. • Hypersaline water used for dust suppression will be applied to road surfaces by dribble bars and not allowed to overspray specifically where *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) is located adjacent to existing roads. • weeds through control measures that include vehicle hygiene procedures, stockpiling of on-site topsoil for reuse, and annual monitoring. • impacts due to uncontrolled fire through control of ignition sources, procedures and regional coordination on prescribed burns.
	Rehabilitate:
	• *Banksia sphaerocarpa* var. *dolichostyla* seeds and/or cuttings will collected and stored appropriately for rehabilitation (where seed is present). *Banksia sphaerocarpa* var. *dolichostyla* will be considered as part of the plant mix for rehabilitation areas near existing populations. • rehabilitation trials and research programs (in consultation with DBCA and Kings Park and Botanical Gardens) will be undertaken to increase translocation and rehabilitation success. • Directly impacted individuals will be attempted to be translocated into an area of suitable soils • Rehabilitation of areas will occur to provide suitable habitat for *Banksia sphaerocarpa* var. *dolichostyla.* • Seeding of areas with suitable soils within the Development Envelope with *Banksia sphaerocarpa* var. *dolichostyla* seeds will occur. • Monitoring of translocated individuals and rehabilitated areas will be undertaken.

Element	Description
Outcomes	Residual Impact:
	The Proposal has the potential to impact one Declared Rare Flora, *Banksia sphaerocarpa* var. *dolichostyla*. The proposal would result in direct impact of less than 0.56% to the currently known local population (92 individuals of the currently known local population of 16,503) and 0.37% of the regional population. Indirect impacts have the potential to impact individuals that are located within 50 m of Proposed Layout, with an additional potential indirect impact to 17.12% of the currently known local population (2,826 individuals of the currently known local population of 16,503) and 11.47% of the regional population. The Proposal has the potential to impact nine Priority Flora species, with the most significant risk to *Microcorys* sp. Mt Holland (D. Angus DA 2397). The Proposal directly impacts on 18.07% of the currently known local population of *Microcorys* sp. Mt Holland (D. Angus DA 2397) and has the potential to indirectly impact on 3.68%. The Proposal has been designed to minimise direct impacts on remaining *Banksia sphaerocarpa* var. *dolichostyla* local population to the maximum extent practicable, however direct loss will occur. During the detailed design stage of the Proposal, further attempts to minimise direct loss to individuals shall be implemented. Any direct loss of individuals will result in rehabilitation and translocation attempts to achieve no net loss of individuals in the currently known local population (16,503) Indirect impacts on *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) would be avoided through the placement of new infrastructure away from the existing populations and the management of driving to facilities within 50 m of existing individuals. Mitigating actions will reduce the potential for indirect impacts to this species, therefore the potential indirect impacts are considered conservative maximums. Overall, the Project is considered to pose a relatively low risk to *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397), as less than 0.56% and 18.07% respectively of the currently known local population and 0.37% and 18.07% of the regional populations would be directly impacted by the proposed action. Cumulative impacts are expected to be low for *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) due to the potential for additional populations outside the Development Envelope and low pressures to the species as discussed in Section 5.3.9). Given the size and extent of the local population outside of the Development Envelope and the mitigation measures, the Proposal is not expected to cause significant impact to flora and vegetation. However, uncertainty exists for the rehabilitation strategy proposed for the *Banksia sphaerocarpa* var. *dolichostyla* (if required) to achieve no net loss of individuals from the currently known local population (16,503 individuals). Whilst field observations have determined the species is a good candidate for rehabilitation, no research or trials have occurred to date, therefore uncertainty exists for effectiveness of the rehabilitation strategy and this presents a potential for significant impacts. Accordingly, it is expected that the Proposal will meet the EPA's objective for the flora and vegetation factor based on the mitigation measures and scale of impact, however there is the potential for significant impacts to the *Banksia sphaerocarpa* var. *dolichostyla* due to uncertainty associated with the rehabilitation program effectiveness.
	Offset:
	As discussed in Section 8.1, Significant Residual Impacts are anticipated for *Banksia sphaerocarpa* var. *dolichostyla* as it is protected by statute and the uncertainty associated with the effectiveness of the rehabilitation strategy, although the scale of the Significant Residual Impacts is not considered sufficient to require an offset. Significant Residual Impacts are not anticipated for *Microcorys* sp. Mt Holland (D. Angus DA 2397) as the direct and indirect impacts to the species is not considered to increase its threat status. Therefore, an offset is not proposed.

6. Terrestrial Fauna

6.1 Relevant environmental objectives, policies, guidelines, standards and procedures

The ESD outlines the work required for the environmental impact assessment of key environmental factors and potential impacts of the Proposal in the ERD. The ESD requirements for terrestrial fauna, including the relevant Sections where each requirement is addressed, are outlined in Table 6-1.

Table 6-1: ESD requirements for Terrestrial Fauna

EPA objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	
Relevant aspects	Clearing of native vegetation that supports significant fauna species to extend the existing Earl Grey pit.	Relevant ERD section
Potential impacts and risks	The Proposal may have the following effects: • Further loss and fragmentation of habitat from vegetation clearing.	6.3.1
	• Death, injury and displacement from construction and mining operations, vehicle strikes and changed fire regimes.	6.3.2
	• Increased feral fauna from increased access into areas from new tracks and roads, and attraction to rubbish tips.	6.3.3
	• Secondary impact from dust, noise and vibration during construction and mining operations.	6.3.4
Required work	1. Conduct a desktop study, including a literature review, in accordance with EPA guidance. The desktop study needs to identify terrestrial vertebrate fauna and short range endemic (SRE) invertebrate fauna in the region, and those likely to be present in the Development Envelope.	6.2, Appendix 3
	2. Undertake Level 2 surveys for terrestrial vertebrate fauna in all areas proposed to be impacted in accordance with EPA guidance. Identify from the desktop study any areas in the Development Envelope that have not previously been subject to fauna surveys. Consolidate historical and new survey data to place the impacts of the proposal into local and regional contexts and provide a Figure illustrating records of significant fauna within the Development Envelope and the surrounding area.	6.2.3, Appendix 3
	3. Determine the likelihood of the habitats within the Development Envelope to support SRE invertebrate fauna and undertake surveys for SRE fauna in accordance with EPA guidance. Provide Figures illustrating the locations of SRE fauna in relation to the impacted areas.	6.2.5
	4. Conduct Level 2 targeted surveys for EPBC Act listed fauna species (Chuditch, Malleefowl) in accordance with EPA and EPBC Act guidance.	6.2.3, Appendix 3
	5. Provide justification that the completed desktop study and field surveys are representative of the current conditions in the Development Envelope and determine the likelihood of occurrence of other significant fauna potentially occurring in the Development Envelope.	6.2.3, Appendix 3
	6. Assess direct, indirect and cumulative impacts on fauna and fauna habitats from past, current and approved exploration and mining activities and outline the uncertainties, if any, with determining the impacts.	6.3, 6.3.5
	7. Provide Figures showing the likely extent of the loss of habitat types. This is to be based on quantitative data from relevant local and regional surveys.	5.3.1, 6.2.1, 6.3.1, Appendix 3
	8. Demonstrate that the proposal has been designed to avoid and minimise impacts to terrestrial fauna and fauna habitat, including the placement of any access roads, TSFs and other infrastructure, and that placement has had regard to utilising existing areas of disturbance.	2.3.9
	9. Describe the proposed management, monitoring and mitigation methods to be implemented to address direct and indirect impact on fauna, including actions to prevent fauna death, injury and displacement as a result of the proposal.	6.4, 6.4.8 Appendix 4

EPA objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	
	10. Demonstrate that the proposed management, monitoring and mitigation methods to be implemented addressed the mitigation hierarchy, and ensure residual impacts (direct and indirect) are not greater than predicted.	6.4.8, 6.6
	11. Demonstrate and document in the ERD how the EPA's objective for these factors can be met.	6.6
	12. 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) and include reference to the Commonwealth Assessment Guide for any MNES.	6.6, 8, 10
	13. 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.	8
Relevant policy	***EPA policy and guidance***	
	Environmental Factor Guideline — *Terrestrial Fauna* (EPA 2016c).	
	Technical Guide — *Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2010).	
	Commonwealth policies and guidance	
	Survey guidelines for Australia's threatened birds (Commonwealth Department of the Environment, Water, Heritage and the Arts 2010).	
	Survey guidelines for Australia's threatened mammals (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2011).	
	Chuditch *(Dasyurus geoffroii)* National Recovery Plan: Wildlife Management Program No. 54, (Department of Environment and Conservation 2012).	
	Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (Department of Sustainability, Environment, Water, Population and Communities 2012).	
	Other policy and guidance	
	WA Environmental Offsets Policy (Government of Western Australia 2011).	
	WA Environmental Offsets Guidelines (Government of Western Australia 2014).	

6.2 Required work and receiving environment

The results from six periods of fieldwork undertaken between October 2016 and November 2017 are outlined in Table 6-2 have been used to support the assessment of potential impacts of the Proposal on terrestrial fauna. Western Wildlife was commissioned to complete a detailed fauna and habitat assessment of the Development Envelope. The size and shape of the fauna survey areas evolved as the proposed mine footprint was developed and the Development Envelope finalised. The original survey in October 2016 focused on the area of the orebody, and further surveys were commissioned in 2016 and 2017 to cover the remainder of the Development Envelope and to investigate Chuditch distribution and the full context of Faunal habitats within the Development Envelope and surrounding areas. In addition, Chuditch and Malleefowl surveys were conducted across a wider Regional Survey Area, comprising over 70,000 ha. A summary of the survey methods and findings are described below, and the full report is provided in Appendix 3.

Table 6-2: Terrestrial fauna and habitat surveys

Date	Survey Type and Extent	Survey Details
10–15 Oct 2016	Reconnaissance survey with targeted searches for Malleefowl and Chuditch in the Earl Grey study area	• Literature review and database searches. • Opportunistic records taken. • Habitats recorded and mapped. • **Chuditch**: 12 baited camera traps established for 5 nights totaling 60 trap nights within the Development Envelope. • **Malleefowl**: 269 km of transects completed by 4 personnel at 10 m spacing within the Development Envelope.

21 Nov–4 Dec 2016	Detailed survey (trapping and targeted searches), encompassing four study areas, including Early Grey and Irish Breakfast which occur within the Development Envelope.
	Prince of Wales and Van Uden study areas fall outside the Development Envelope, however provide further regional context to the fauna and habitat assessment
		• Trapping–12 sites established comprising:
		  ⁎ 10 pitfall traps, 10 baited funnel traps, 10 baited Elliott traps and 2 baited cage traps for 8 nights.
		  ⁎ Each site had 80 pitfall trap–nights, 80 funnel trap–nights, 80 Elliott trap–nights and 16 cage trap–nights.
		  ⁎ The survey had 960 trap–nights for pitfalls, funnels and Elliott traps, and 192 trap–nights for cages.
		• Birds: 7 x 20–minute surveys undertaken at each trapping site.
		• Bats: SM2 ultrasonic bat detectors deployed for 1 night at each trapping site and the camp.
		• Spotlighting: 2 nights, 6 people in 3 teams using road–spotting and head–torching.
		• Opportunistic records taken.
		• Habitats recorded and mapped.
		• **Chuditch**: 45 baited camera traps for 4 or 5 trap nights totaling 189 trap nights covering both the Development Envelope and the Regional Survey Area.
		• **Malleefowl**: 306 km of transects completed by six personnel at 10 m spacing. 97 km of transects within Development Envelope and 209 km of transects in Regional Survey Area.

15 Jan–25 Feb 2017	Regional Chuditch survey	• **Chuditch**: 44 baited camera traps deployed for 13 to 24 nights resulting in 794 trap nights covering both the Development Envelope and the Regional Survey Area. • Vegetation and habitat descriptions taken at camera trap locations. • **Malleefowl**: Opportunistic only.
12-21 Sept 2017	Opportunistic Malleefowl survey (in Development Envelope excluding previously surveyed areas in Oct 2016 and Dec 2016) and Chuditch (within Regional Survey Area) survey	• **Chuditch**: 20 baited camera traps deployed resulting in 350 trap nights covering the Regional Survey Area. • **Malleefowl**: Opportunistic only.
2–14 Oct 2017	Level 2 (single season) fauna survey with targeted Malleefowl survey	• **Malleefowl**: 801 km of transects completed by two to six personnel at 10 m spacing. 780 km of transects within Development Envelope and 21 km of transects in Regional Survey Area. • **Chuditch:** 15 baited camera traps deployed for five nights resulting in 75 trap nights in the Development Envelope.
25–30 Nov 2017	Targeted Chuditch (cage trapping) survey	• **Chuditch**: Cage trapping in the Regional Survey Area timed to avoid the breeding season. Two transects of 50 cage traps were established, one to the north and one to the south of the Development Envelope.

6.2.1 Survey Adequacy

Although only a single trapping event was undertaken for each trapping site, it was scheduled in spring to coincide with high levels of activity of most vertebrate fauna groups. The surveys undertaken in other months (October 2016, January/February 2017, September 2017 and November 2017) provided additional opportunities for opportunistic observations, particularly of birds. No conservation significant frog species are present in the region, and the Development Envelope lacks wetland habitats likely to be significant for breeding frogs. Therefore, the only vertebrate group not targeted was frogs and this is considered a minor limitation.

Species accumulation curves were calculated using EstimateS (Colwell 2016). In samples with many 'rare' species, some estimators of predicted species richness are unreliable. As trapping data has a predisposition to containing many 'rare' species (species represented by a single capture) the Chao-1 estimator of species richness is reported for species accumulation curves that are close to reaching asymptote.

Species accumulation curves are presented for terrestrial fauna (i.e. reptiles and small mammals) and birds, where the data collection was systematic, i.e. trapping results and timed bird surveys (Figures 6.1 to 6.6). The species accumulation curves for terrestrial fauna are presented for groups of sites that share similar habitat values, as per the following:

- Shrublands or Mallee woodlands on sand over clay (Sites 1, 4 and 19)
- Shrublands on gravelly sands (Sites 3, 5 and 18)
- Mallee woodlands on clay (Sites 2, 14, and 17)
- Eucalypt woodland on clay-loam (Sites 13 and 15)
- Laterite rises (Sites 6, 16 and 20).

The bird results have been compiled for the entire Development Envelope, as it was considered that habitat heterogeneity was high, i.e. every bird sampling site was likely to have a mix of both woodlands and shrublands.

Note that the species accumulation curves refer only to the trappable (or in the case of birds, observable) portion of the faunal assemblage. Fauna may not be trappable because they are too big (e.g. kangaroo species), are not present (e.g. irruptive, migratory or nomadic species) or are not active (e.g. species that aestivate or hibernate).

Figure 6-1: Species accumulation curve for terrestrial vertebrates in shrublands or mallee woodlands on sand over clay.

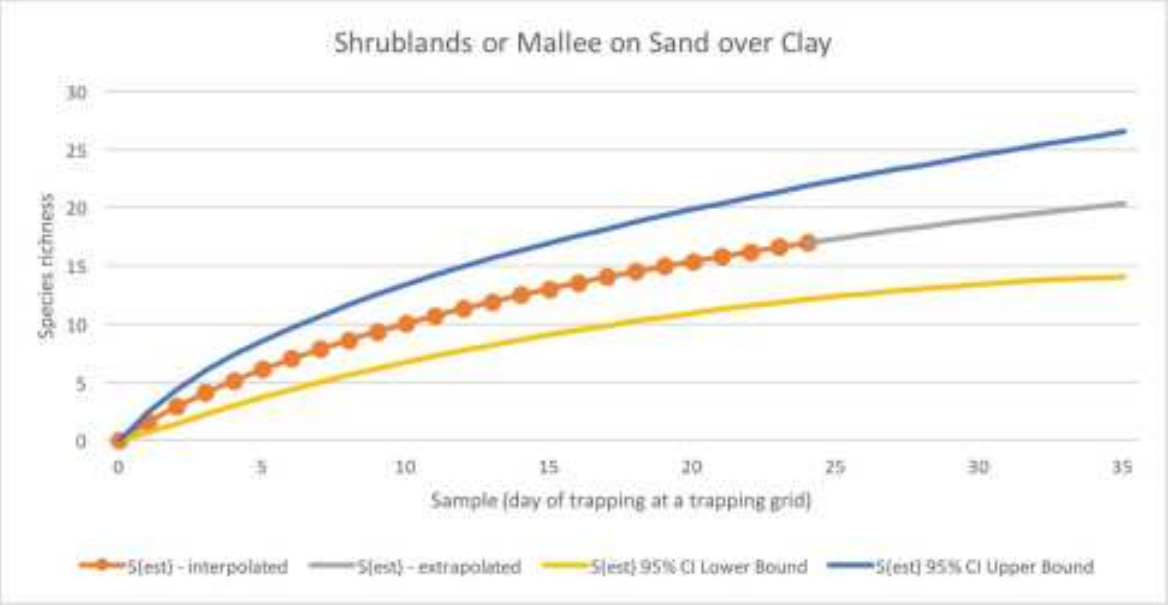


Figure 6-2: Species accumulation curve for terrestrial vertebrates in shrublands on gravelly sands.

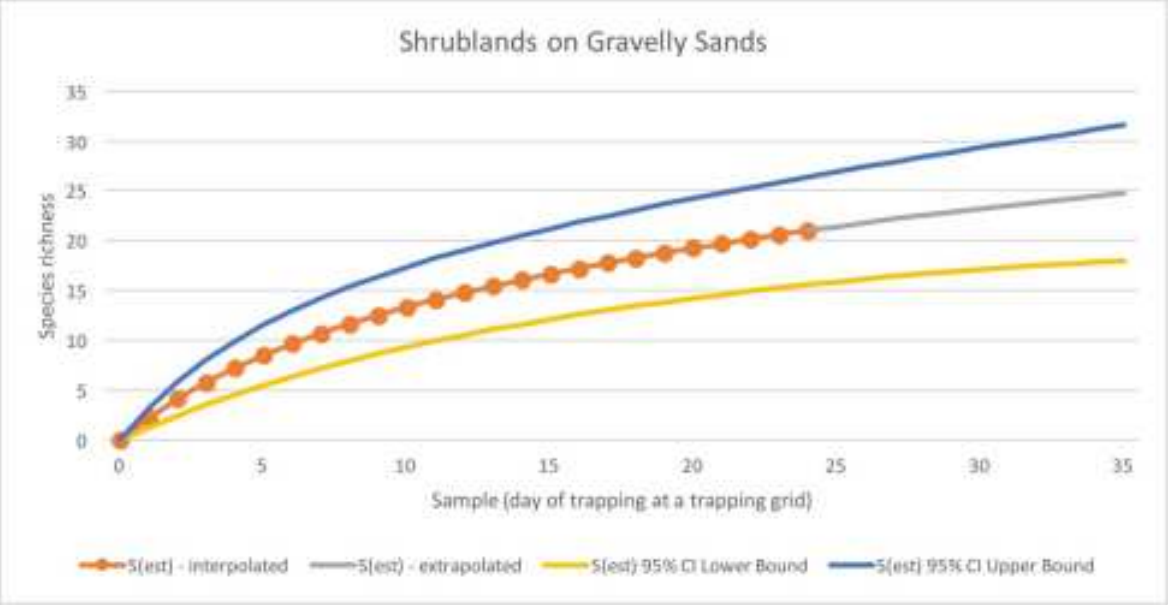


Figure 6-3: Species accumulation curve for terrestrial vertebrates in mallee woodlands on clay.

Figure 6-4: Species accumulation curve for terrestrial vertebrates in eucalypt woodlands on clay-loam.

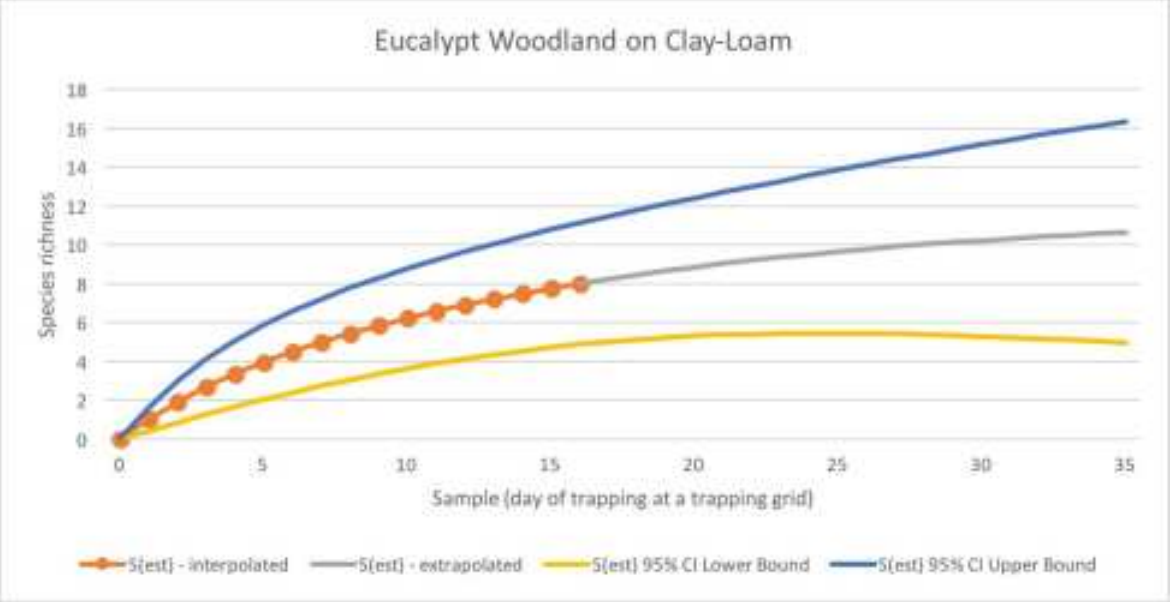


Figure 6-5: Species accumulation curve for terrestrial vertebrates on laterite rises.

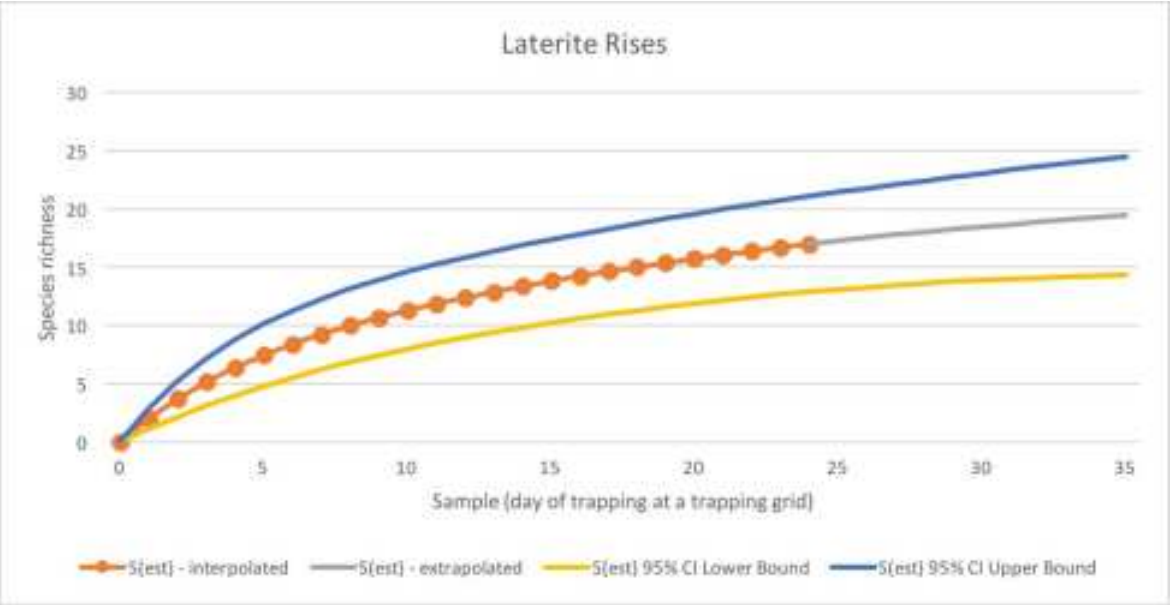
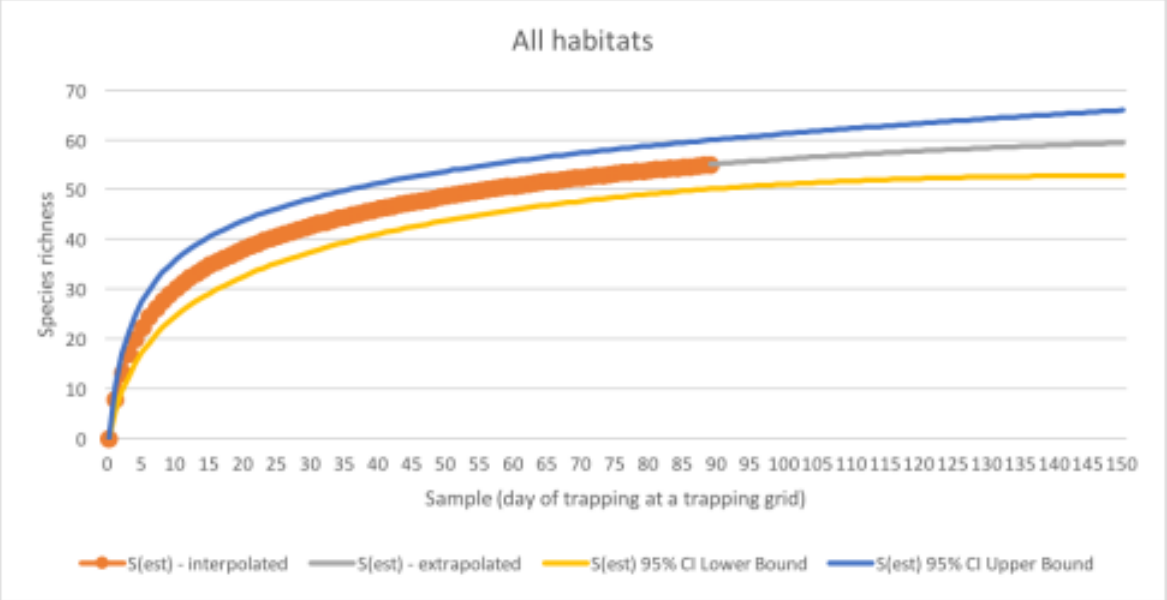


Figure 6-6: Species accumulation curve for birds across all habitats.



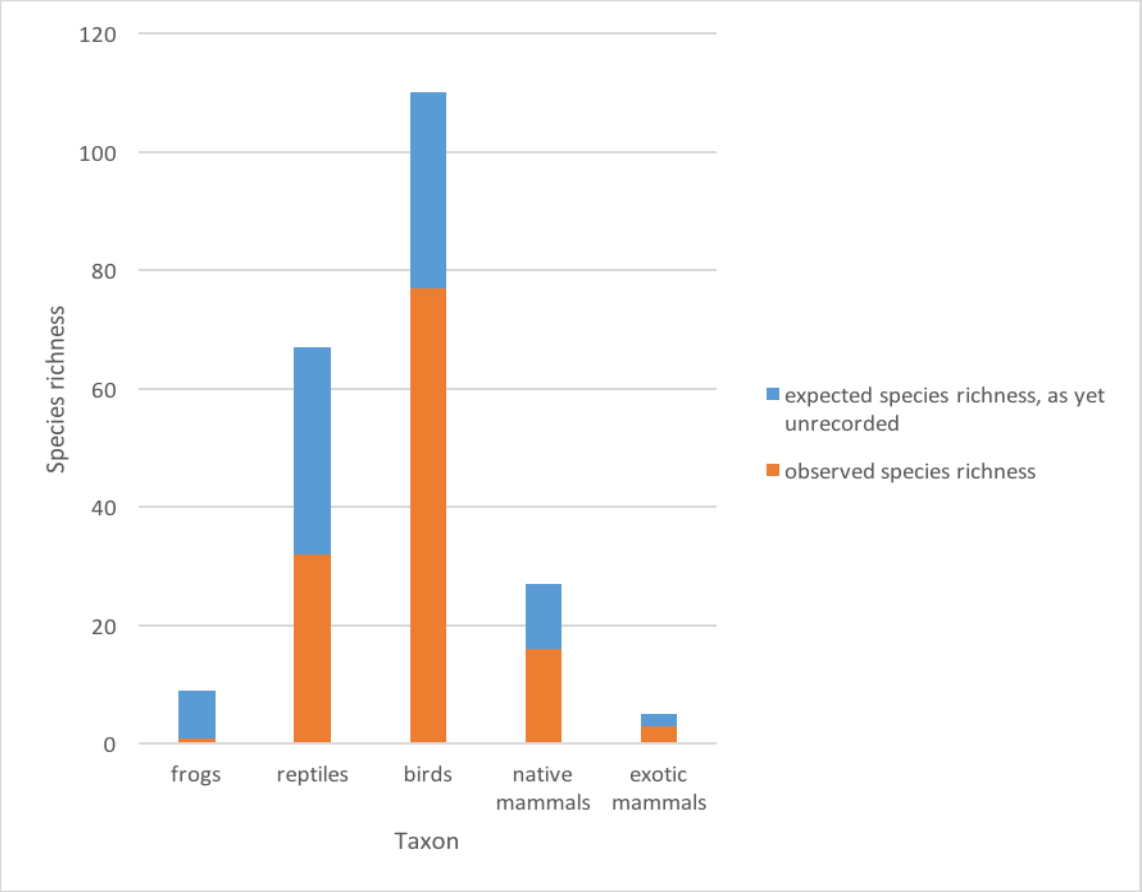
The species accumulation curves for the terrestrial vertebrates indicate that although the rate of accumulation of new individuals has slowed, the curve has not reached the asymptote for most habitats (Figures 6.1 – 6.5). In this case, the predicted species richness cannot be estimated, and further trapping is likely to result in more species being recorded. The Mallee on Clay Habitat (Figure 6.3) is the exception, and the Chao-1 species richness estimator indicates that the predicted species richness is 12.2, compared to the 12 species observed.

The species accumulation curve for birds approaches the asymptotic plateau, indicating most of the observable species were recorded. The Chao-1 species richness estimator indicates that the predicted bird species richness is 56.87, compared to the 55 species observed.

Species accumulation curves are not the complete picture, as they are based only on the systematically collected trapping data. Many species are observed opportunistically, and these records often add considerably to the total species inventory of a particular site. The total number of species observed can be compared to the number of species expected to occur on the site.

The expected species lists for the development envelope were generated from review of database records and the relevant literature (see Western Wildlife 2017). A total of 9 frogs, 77 reptiles, 110 birds, 27 native mammals and 5 exotic mammals were expected to occur. Of these, 11.1% of frogs, 47.8% of reptiles, 70% of birds, 59% of native mammals and 60% of exotic mammals were observed during the fauna survey (Figure 6-7).

Figure 6-7: Proportion of the expected fauna observed during the fauna survey



More than half the expected bird and native mammals were recorded during the survey. The low number of frog species recorded is common to many fauna surveys, as many species aestivate underground and are not usually trapped unless there is rain. Rainy conditions are usually avoided for access concerns (e.g. on unsealed roads) and animal welfare concerns (e.g. waterlogged traps). 48% of reptile species recorded during the survey is a good result considering the survey was conducted in cool trapping conditions in October 2017 which reduced the activity of reptile species. It must be noted also that the list of species expected to occur is relatively conservative, in that it is quite likely that some of these species, though known from the region, do not in fact occur in the Development Envelope.

6.2.2 Habitat

The Regional Study Area includes extensive areas of diverse mallee woodlands and shrublands, as well as smaller patches of open woodland (e.g. Salmon Gum woodlands) and sandplain.

Mattiske Consulting (2018a) noted that the vegetation communities in the Development Envelope are typical of those reported in the Forrestiana region both historically (Beard 1972, 1990) and in recent flora and vegetation surveys. Although the fauna habitats identified are extensive in the region, they are regionally significant in that they are part of the relatively continuous area of habitat known as the Great Western Woodlands.

Uncommon habitat types, such as granite outcrops, salt lakes or freshwater wetlands, are absent from the Development Envelope. Historically cleared areas, waste dumps and open pits are present, and these are only likely to support a small complement of native fauna. Cleared areas, including tracks, can provide access for feral predators.

Parts of the Development Envelope and Regional Survey Area were recently burnt at the time of survey. The fire that intersects the eastern and southwestern parts of the Development Envelope occurred in 2015 (Figure 6-8). Earlier fires burnt the northwest quarter of the Regional Survey Area in about 2009, and a portion of the southern Regional Survey Area in 2016. While these areas are recovering after fire they are likely to support a different faunal assemblage to that in long-unburnt habitats. Unburnt habitats are important, providing habitats for fauna that favour structurally dense habitats and a source from which fauna can recolonise burnt areas as they regenerate.

Three broad fauna habitats were defined by Western Wildlife (2017) in the Development Envelope, as shown in Figure 6-9. Habitats were identified during the fauna surveys on the basis of vegetation mapping (Mattiske 2018a), and are listed below.

Mallee woodland

Mallee woodland is a very common habitat, both within the Development Envelope and in the Regional Survey Area. The 'mallee woodland' habitat describes a structural type, and within the habitat there has much variability in plant species composition and the density and composition of the shrubland understory, ranging from minimal understory to dense shrubland. Mallee woodlands have been sub-divided into three habitats on the basis of the underlying soil type, sands, sandy-clays or clay-loam, as this impacts the ground-dwelling fauna that may occur. Note that even within these subdivisions the soil surface can be variable.

As the mallee trees are relatively small in diameter, this habitat generally lacks tree hollows, though scattered hollow-bearing trees are present. Where the understory is dense, it provides nesting habitat for small birds. The reptile assemblage is likely to vary depending on the substrate (e.g. clay or gravelly sand). Mallee woodland potentially supports significant fauna including the Malleefowl (*Leipoa ocellata*), Chuditch (*Dasyurus geoffroii*), Inland Western Rosella (*Platycercus icterotis*), Lake Cronin Snake (*Paroplocephalus atriceps*) and Central Long-eared Bat (*Nyctophilus major tor*).

Salmon Gum woodland

Salmon Gum woodland is less common in this mallee-dominated region. These woodlands occur mostly in the eastern and southern parts of the Development Envelope, and are characterised by an open canopy of Salmon Gum (*Eucalyptus salmonophloia*), sometimes with Merrit (*Eucalyptus flocktoniae*), Sand Mallee (*Eucalyptus eremophila*), *Eucalyptus urna* or other eucalypts, over a sparse shrub understorey on clay flats. Salmon Gum woodlands were also noted to occur patchily in the Regional Survey Area. Much of this habitat is recently burnt.

Salmon Gum woodland is significant for the tall hollow-bearing trees and large fallen logs that provide shelter and nesting opportunities for a range of fauna. This habitat potentially supports significant fauna including the Chuditch (*Dasyurus geoffroii*), Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Inland Western Rosella (*Platycercus icterotis xanthogenys*), and Central Long-eared Bat (*Nyctophilus major tor*).

Shrubland

Shrublands are common but patchy in occurrence in the Development Envelope, as well as in the Regional Survey Area. Shrublands occur on sandy-clay flats, gravelly sands and lateritic rises and vary in composition, but are usually dominated by species of *Allocasuarina*, *Hakea, Acacia, Banksia* and/or *Melaleuca*. Although sparse low mallee eucalypts may be present, this habitat lacks large trees. The dense structure of the vegetation provides shelter and nesting habitat for ground-dwelling birds. When in flower, shrubland habitats are likely to attract a suite of nectar-feeding bird species. Shrublands also occur in small patches throughout the Mallee Woodland habitat, at a scale too small to be mapped.

Shrublands potentially support significant fauna including the Malleefowl (*Leipoa ocellata*), Chuditch (*Dasyurus geoffroii*), Rainbow Bee-eater (*Merops ornatus*), Western Brush Wallaby (*Macropus irma*) and Lake Cronin Snake (*Paroplocephalus atriceps*).

It is important to recognise that the fauna habitats are extremely variable on the local scale. For example, within the mallee woodland are small patches of shrubland that are too small to be separately mapped, but can provide Malleefowl breeding habitat within a matrix of less suitable habitat. This variability within the habitats contributes to the richness of the faunal assemblage.

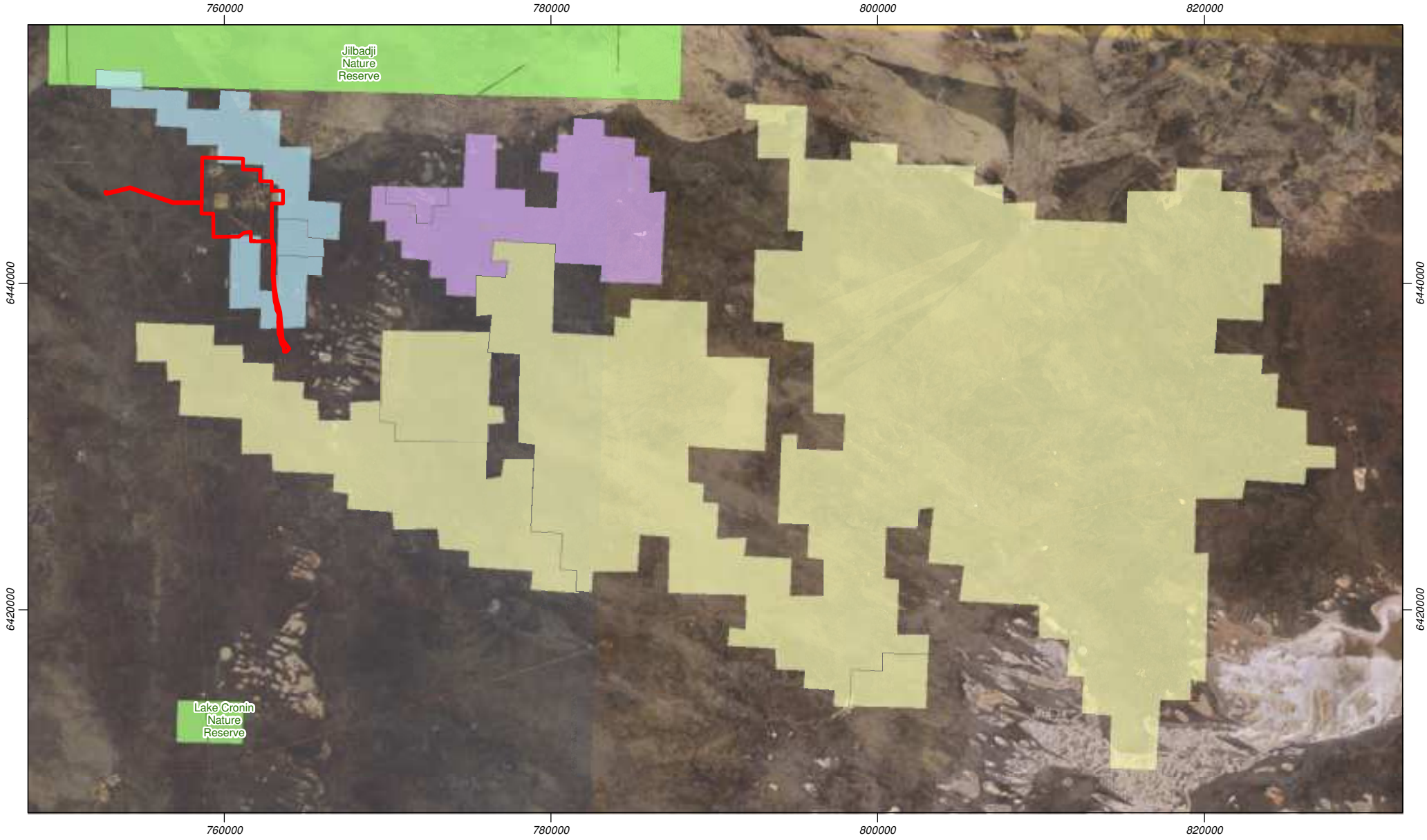


Figure 6-8: Fire History in the vicinity of the Proposal

Scale 1:320,000 at A4

0 3.2 6.4 9.6 km

N

Legend

- Development Envelope
- Nature reserve

Year burnt

- 2013
- 2015
- 2016

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 22/11/2018
Author: vdinh
Source: Landgate: Aerial imagery - 2017; SQM: Development envelope; DWER: Nature reserve - 2017; NOAA: Fire history - 17/11/2017.

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Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G013_RevD.mxd

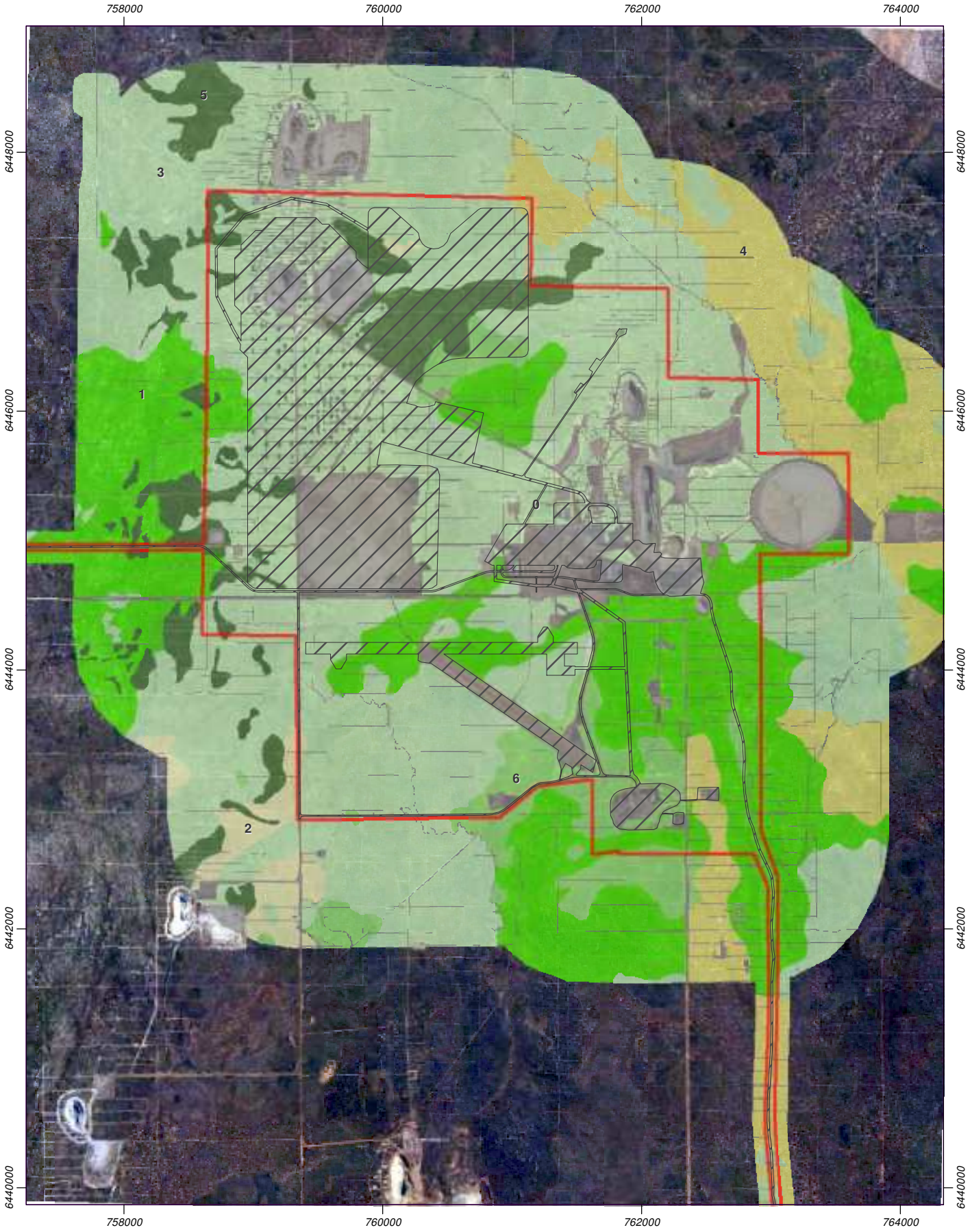

Figure 6-9: Faunal habitats (terrestrial fauna) in the Development Envelope

Scale 1:40,000 at A4

0 400 800 1,200 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 12/01/2019

Author: vdinh

Source: SQM: Aerial imagery - 2017,Development Envelope, Clearing & disturbance - 17/11/2017.

Path: C:\GIS\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G031_RevE.mxd

Legend

- Indicative proposed footprint
- Development Envelope

Fauna habitat

- 1 - Mallee woodland on clay loams
- 2 - Mallee woodland on sands
- 3 - Mallee woodland on sandy clays
- 4 - Salmon Gum woodland
- 5 - Shrubland on flats
- 6 - Shrubland on laterite rises
- Cleared Land

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6.2.3 Terrestrial fauna surveys

The broader study area assessed by Western Wildlife is likely to support a relatively intact faunal assemblage, with only regionally extinct species likely to be missing from the area.

The fauna surveying program included:

- identification of fauna habitats
- trapping for terrestrial fauna
- bird surveys
- bat call survey
- spotlighting
- opportunistic record keeping and hand-searching
- targeted searches for evidence of conservation significant species covering both 2016 and 2017:
  - Malleefowl (*Leipoa ocellata*) – transects to search for mounds
  - Chuditch (*Dasyurus geoffroii*) – camera trap survey at 101 locations.

The fauna surveys were undertaken in accordance with EPA Statement of Environmental Principles, Factors and Objectives (EPA 2016g), Environmental Factor Guidelines – Terrestrial Fauna (EPA 2016c), Technical Guide – Terrestrial Fauna Surveys (EPA 2016d) and the Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA & DEC 2010). All field studies were carried out under Regulation 17 License to Take Fauna for Scientific Purposes 08-000081-1, 08-000122-2 and 08-000186-1, as issued by the then DPaW (now DBCA). The location of the cage trapping is shown in Figure 6-10 and the location of the camera trapping is shown in Figure 6-11.

The faunal assemblage is diverse as it contains elements from both the Eremaen (arid with irregular rainfall) and Bassian (southwest with regular winter rainfall) regions. The results of the fauna survey, supplemented with database records and published information, indicate that there are up to nine frogs, 67 reptiles, 110 birds and 32 mammals (27 native mammals) that have the potential to occur. A large proportion of these species, including one frog, 32 reptiles, 77 birds, 18 native mammals and five introduced mammals were recorded in the Development Envelope and regional areas during fauna surveys (Table 6-3). Conservation significant species are discussed in detail in Section 6.2.4 and listed in Table 6-4.

Table 6-3: Terrestrial fauna species recorded

Taxon	Species	
Amphibians		
	Western Toadlet *Pseudophryne occidentalis*	
Reptiles		
	Southern Barking Gecko *Underwoodisaurus milii*	*Ctenotus uber*
	Clawless Gecko *Crenadactylus ocellatus*	*Egernia richardi*
	Wheatbelt Ground Gecko *Diplodactylus granariensis*	*Hemiergis initialis*
	Tree Dtella *Gehyra variegata*	*Lerista distinguenda*
	Delma australis	*Lerista kingi*
	Fraser's Legless Lizard *Delma fraseri*	*Liopholis multiscutata*
	Common Scaly-foot *Pygopus lepidopodus*	Dwarf Skink *Menetia greyii*
	Crested Dragon *Ctenophorus cristatus*	*Morethia butleri*

Taxon	Species	
	Spotted Military Dragon *Ctenophorus maculatus*	Dusky Morethia *obscura*
	Thorny Devil *Moloch horridus*	Western Blue-tongue *Tiliqua occipitalis*
	Bearded Dragon *Pogona minor*	Bobtail *Tiliqua rugosa*
	Fence Skink *Cryptoblepharus buchananii*	Gould's Monitor *Varanus gouldii*
	Ctenotus atlas	Southern Heath Monitor *Varanus rosenbergi*
	Odd-striped Ctenotus *Ctenotus impar*	Southern Blind Snake *Anilios australis*
	Ctenotus mimetes	Prong-snouted Blind Snake *Anilios bituberculatus*
	Ctenotus schomburgkii	Dugite *Pseudonaja affinis*
Birds		
	Emu *Dromaius novaehollandiae*	Brown-headed Honeyeater *Melithreptus brevirostris*
	Grey Teal *Anas gracilis*	Brown Honeyeater *Lichmera indistincta*
	Malleefowl *Leipoa ocellata*	White-cheeked Honeyeater *Phylidonyris nigra*
	Square-tailed Kite *Hamiostra isura*	White-fronted Honeyeater *Purnella albifrons*
	Whistling Kite *Haliastur sphenurus*	Tawny-crowned Honeyeater *Glyciphila melanops*
	Spotted Harrier *Circus assimilis*	Spotted Pardalote *Pardalotus punctatus*
	Collared Sparrowhawk *Accipiter cirrocephalus*	Striated Pardalote *Pardalotus striatus*
	Wedge-tailed Eagle *Aquila audax*	White-browed Scrubwren *Sericornis frontalis*
	Painted Button-quail *Turnix varia*	Shy Heathwren *Calomanthus cautus*
	Little Button-quail *Turnix velox*	Redthroat *Pyrrholaemus brunneus*
	Common Bronzewing *Phaps chalcoptera*	Weebill *Smicrornis brevirostris*
	Brush Bronzewing *Phaps elegans*	Western Gerygone *Gerygone fusca*
	Pallid Cuckoo *Cacomantis pallidus*	Inland Thornbill *Acanthiza apicalis*
	Fan-tailed Cuckoo *Cacomantis flabelliformis*	Yellow-rumped Thornbill *Acanthiza chrysorrhoa*
	Horsfield's Bronze-Cuckoo *Chrysococcyx basalis*	White-browed Babbler *Pomatostomus superciliosus*
	Southern Boobook Owl *Ninox boobook*	Chestnut (Copper-back) Quail-Thrush *Cinclosoma clarum*
	Tawny Frogmouth *Podargus strigoides*	Dusky Woodswallow *Artamus cyanopterus*
	Spotted Nightjar *Eurostopodus argus*	Grey Butcherbird *Cracticus torquatus*
	Australian Owlet-Nightjar *Aegotheles cristatus*	Grey Currawong *Strepera versicolor*
	Sacred Kingfisher *Todiramphus sanctus*	Black-faced Cuckoo-shrike *Coracina novaehollandiae*

Taxon	Species	
	Rainbow Bee-eater *Merops ornatus*	Crested Bellbird *Oreoica gutturalis*
	Peregrine Falcon *Falco peregrinus*	Gilbert's Whistler *Pachycephala inornata*
	Brown Falcon *Falco berigora*	Western Golden Whistler *Pachycephala occidentalis*
	Australian Kestrel *Falco cenchroides*	Rufous Whistler *Pachycephala rufiventris*
	Galah *Cacatua roseicapilla*	Grey Shrike-thrush *Colluricincla harmonica*
	Purple-crowned Lorikeet *Parvipsitta porphyrocephala*	Grey Fantail *Rhipidura albiscapa*
	Regent Parrot *Polytelis anthopeplus*	Willie Wagtail *Rhipidura leucophrys*
	Australian Ringneck *Platycercus zonarius*	Restless Flycatcher *Myiagra inquieta*
	Inland Western Rosella *Platycercus icterotis*	Australian Raven *Corvus coronoides*
	Elegant Parrot *Neophema elegans*	Jacky Winter *Microeca fascinans*
	Rufous Treecreeper *Climacteris rufus*	Red-capped Robin *Petroica goodenovii*
	Blue-breasted Fairy-wren *Malurus pulcherrimus*	Western Yellow Robin *Eopsaltria australis griseogularis*
	Red Wattlebird *Anthochaera carunculata*	Southern Scrub-robin *Drymodes brunneopygia*
	Spiny-cheeked Honeyeater *Acanthagenys rufogularis*	White-backed Swallow *Cheramoeca leucosterna*
	Yellow-throated Miner *Manorina flavigula*	Welcome Swallow *Hirundo neoxena*
	Purple-gaped Honeyeater *Lichenostomus cratitius*	Tree Martin *Petrochelidon nigricans*
	Singing Honeyeater *Gavicalis virescens*	Australian Pipit *Anthus australis*
	White-eared Honeyeater *Lichenostomus leucotis*	Mistletoebird *Dicaeum hirundinaceum*
	Yellow-plumed Honeyeater *Ptilotula ornata*	
Mammals		
	Echidna *Tachyglossus aculeatus*	Ash-grey Mouse *Pseudomys albocinereus*
	Chuditch *Dasyurus geoffroii*	White-striped Free-tailed Bat *Austronomus australis*
	Little Long-tailed Dunnart *Sminthopsis dolichura*	Western Free-tailed Bat *Ozimops kitcheneri*
	White-tailed Dunnart *Sminthopsis granulipes*	Gould's Wattled Bat *Chalinolobus gouldii*
	Western Pygmy Possum *Cercartetus concinnus*	Chocolate Wattled Bat *Chalinolobus morio*
	Western Brush Wallaby *Macropus irma*	Inland Forest Bat *Vespadelus baverstocki*
	Western Grey Kangaroo *Macropus fuliginosus*	Southern Forest Bat *Vespadelus regulus*
	House Mouse *Mus musculus*	Feral Cat *Felis catus*
	Mitchell's Hopping-Mouse *Notomys mitchellii*	Rabbit *Oryctolagus cuniculus*

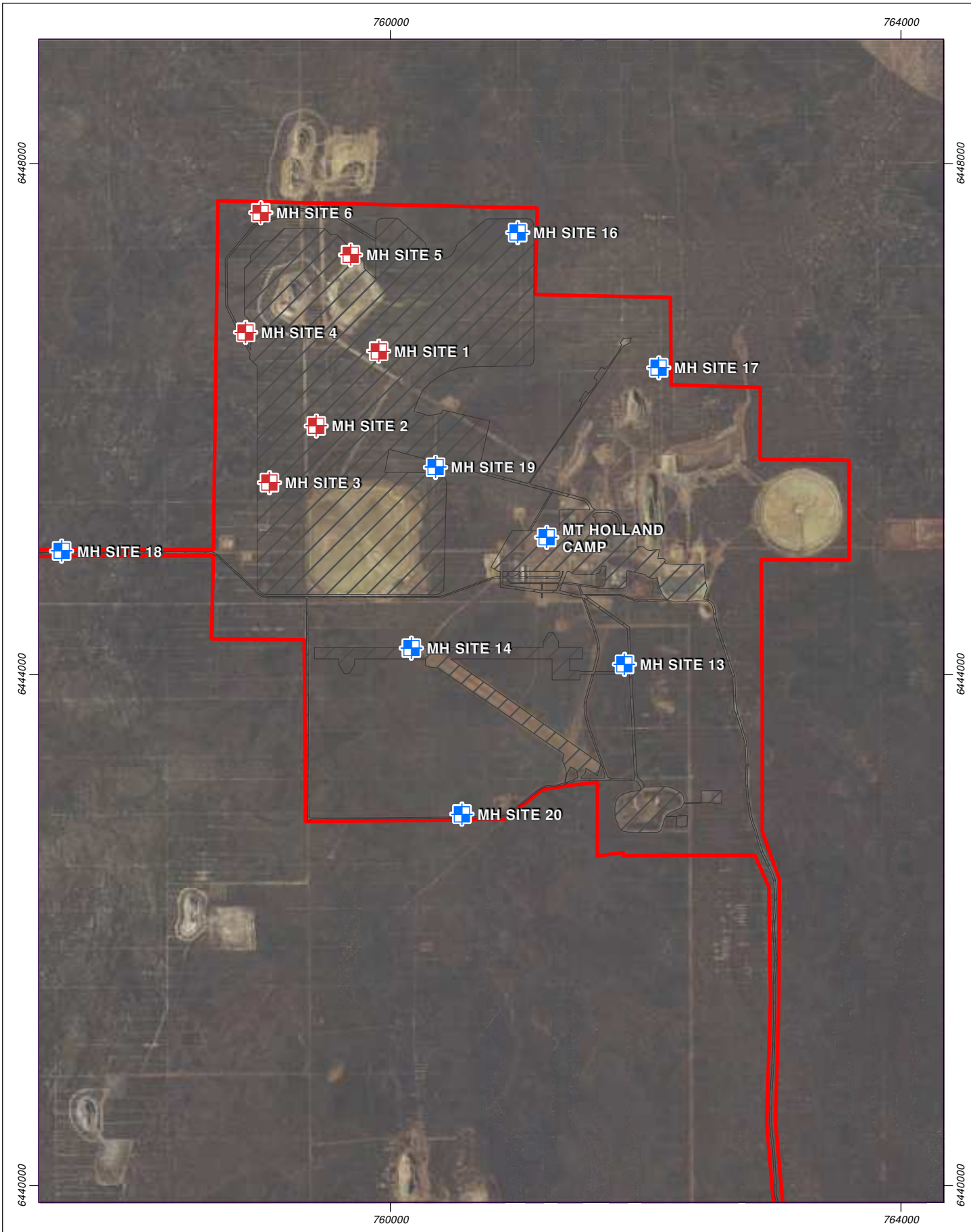

Figure 6-10: Cage trapping site

Scale 1:40,000 at A4

0 400 800 1,200 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 12/01/2019

Author: vdinh

Source: SQM: Aerial imagery - 2017,
Development Envelope, Cage trapping site - 17/11/2017.

Path: C:\GIS\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G026_RevB.mxd

Legend

- Development Envelope
- Indicative proposed footprint

Cage trapping site

- 2016
- 2017

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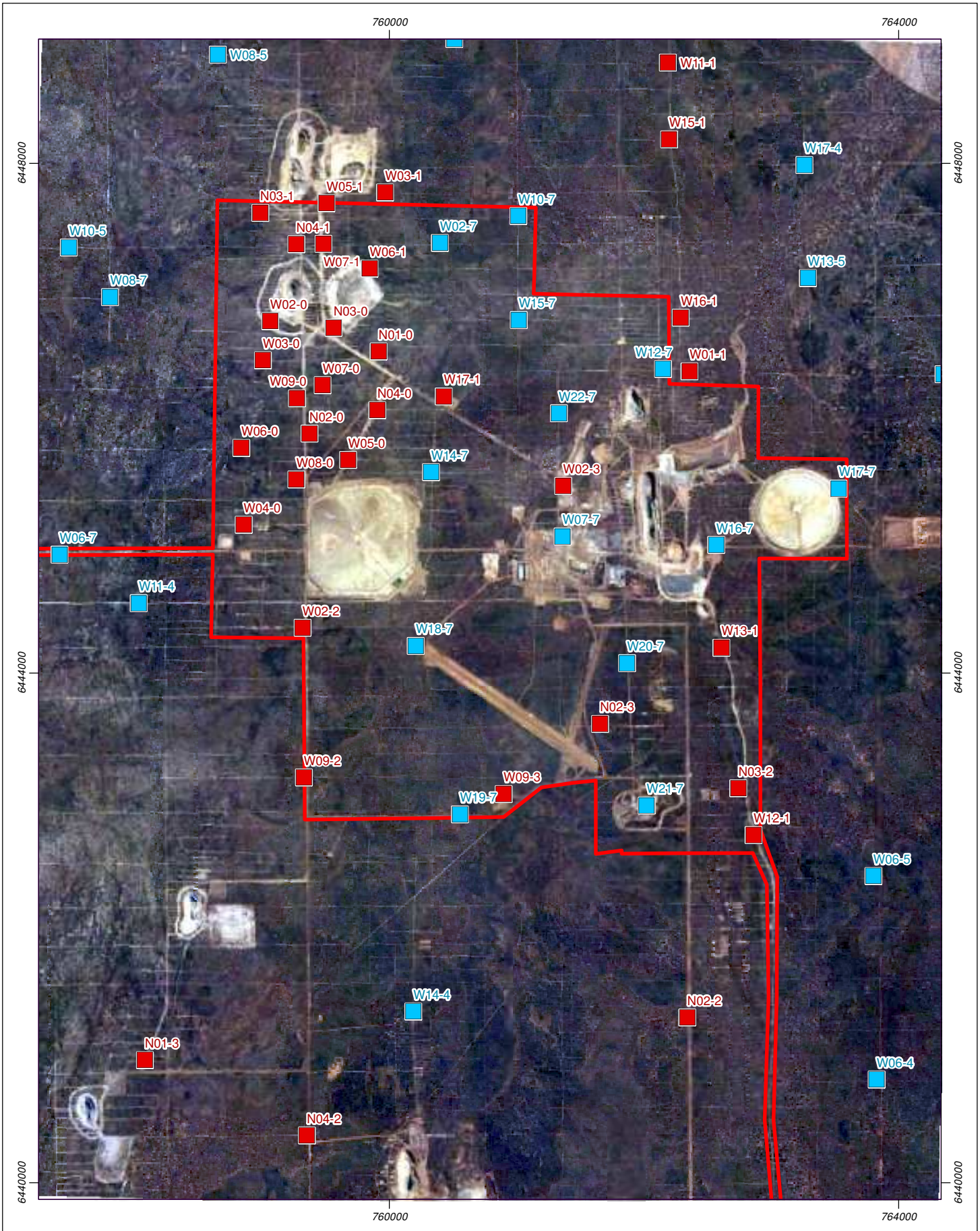

Figure 6-11: Camera trapping

Scale 1:40,000 at A4

0 400 800 1,200 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 22/11/2018

Author: vdinh

Source: SQM: Aerial imagery - 2017,
Development Envelope, Camera location - 17/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G025_RevB.mxd

Legend

Camera location

- 2016
- 2017
- Development

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6.2.4 Significant fauna

Twelve vertebrate fauna of conservation significance have the potential to occur in the Development Envelope and surrounds. These species are listed in Table 6-4.

Table 6-4: Conservation Significant Species That May Occur in the Development Envelope

Species	Conservation Status		Notes
	Western Australia	Commonwealth EPBC Act	
Reptiles			
Lake Cronin Snake *Paroplocephalus atriceps*	Priority 3	NA	Not recorded during fauna survey, but potentially occurs in woodland or shrubland habitats within the Development Envelope.
Woma *Aspidites ramsayi*	Priority 1	NA	Likely to be locally extinct. Potential habitat occurs outside of the Development Envelope, but not in the Development Envelope.
Birds			
Malleefowl *Leipoa ocelata*	Vulnerable BC Act	Vulnerable	Known to occur; 18 bird sightings over two years, 1 currently active mound (in 2017), 6 recently active mounds (including 1 active in 2016) and 37 inactive mounds or failed mound attempts were recorded within the study area of which 12 bird sightings, 1 active mound, 3 recently active mounds and 34 inactive mounds or failed mound attempts occurred in the Development Envelope.
Carnaby's Black–Cockatoo *Calyptorhynchus latirostris*	Endangered BC Act	Endangered	On the eastern limit of known distribution, this species may occur outside Development Envelope in the Van Uden area. It was not recorded in the Development Envelope. Development Envelope may provide foraging habitat.
Peregrine Falcon *Falco peregrinus*	Specially Protected Species BC Act	NA	Likely to occur, was recorded outside of the Development Envelope during fauna surveys, may utilise man–made structures like pits for nesting.
Rainbow Bee–eater *Merops ornatus*	Specially Protected Species BC Act	NA	Known to occur, this common and widespread species was recorded in the Development Envelope, and may breed in sandy soils, however the Development Envelope is unlikely to be of significance to this species.
Fork–tailed Swift *Apus pacificus*	Specially Protected Species BC Act	Migratory	Largely aerial species, the study area is unlikely to be of significance to this species.
Inland Western Rosella *Platycercus icterotis xanthogenys*	Priority 4	NA	Known to occur, recorded in the Development Envelope during the survey, the species may forage in the area however the Development Envelope does not constitute significant breeding habitat.
Mammals			
Chuditch *Dasyurus geoffroii*	Vulnerable BC Act	Vulnerable	Known to occur – 28 individual Chuditch were trapped (13 adults and 15 dispersing young), of which 23 were trapped within the Development Envelope. Chuditch were also recorded on 41% of camera traps averaged over the two survey years, but with a preference for unburnt habitats.
Red–tailed Phascogale *Phascogale calura*	Endangered BC Act	Endangered	Although there is a historical record from 10 km south, this species is considered to have a low likelihood of inhabiting the Development Envelope, and no individuals were captured during trapping.
Western Brush Wallaby *Macropus irma*	Priority 4	NA	Likely to occur, this species was recorded outside of the Development Envelope.

Species	Conservation Status		Notes
	Western Australia	Commonwealth EPBC Act	
Central Long–eared Bat *Nyctophilus major tor*	Priority 4	NA	May occur in the area, there are records from Jilbadji Nature Reserve, however none were recorded in the development area during the surveys.

According to database records and published information, the Development Envelope may support seven vertebrate species of Significant Fauna:

- Malleefowl (Leipoa ocellata)
- Chuditch (Dasyurus geoffroii)
- Peregrine Falcon (Falco peregrinus)
- Carnaby's Black-Cockatoo (Calyptorhynchus latirostris)
- Fork-tailed Swift (Apus pacificus)
- Rainbow Bee-eater (Merops ornatus)
- Red-tailed Phascogale (Phascogale calura).

Of these, the Malleefowl, Peregrine Falcon, Rainbow Bee-eater and Chuditch were recorded during the fauna surveys within the Development Envelope.

The Malleefowl was widely recorded (including active mounds and sightings of birds) and is likely to forage in most habitats but breed in shrublands or woodlands on gravelly sands. The Chuditch was also commonly recorded, occurring in most habitats and at high densities compared to Chuditch elsewhere in the bioregion. For both species habitat loss, habitat fragmentation and feral predators are recognized as current threats. Large-scale fires are also likely to impact these species, resulting in loss of den sites and prey for Chuditch, loss of leaf-litter for Malleefowl to build their mounds and invasion of feral predators into the open habitats created by fire.

The Chuditch and Malleefowl are listed as Vulnerable under the EPBC Act and were recorded within and outside of the Development Envelope. As breeding and foraging habitat for these species is well represented at a local and regional scale outside of the Development Envelope and management measures can be readily implemented to minimise indirect impact to species habitat and individuals within the Development Envelope it is considered that the proposed clearing in the Development Envelope can be managed so as not to have a significant impact on these species at a local and regional scale.

Both the Rainbow Bee-eater and Fork-tailed Swift are migratory species. However, their populations are large and stable, so clearing in the Development Envelope is unlikely to have significant impacts on these species. The Peregrine Falcon is likely to nest in the open pits and forage in open areas. This species is only likely to be locally impacted if a nest site were disturbed, as its population is large and secure.

Of the species listed in Table 6-4, the Malleefowl, Peregrine Falcon, Rainbow Bee–eater, Chuditch, Inland Western Rosella and the Western Brush Wallaby were recorded by Western Wildlife within the Development Envelope and/or regional surrounds. Each of these species is are considered likely to occur within the Development Envelope and are discussed in the following sub–sections.

Malleefowl

Malleefowl were historically common across southern Australia, however, since European settlement populations have reduced and become fragmented. The Malleefowl is found in semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias and are likely to occur throughout the woodlands and shrublands of the region. Malleefowl have been found to range over one to many square kilometres. Western Wildlife (2017) identified numerous records of Malleefowl within 90 km of the Development Envelope through DBCA database searches.

The Malleefowl was sighted and active mounds were recorded in the fauna surveys. The fauna survey for Malleefowl included 269 km of intensively searched transects at 10 m spacing. In 2016 the search effort was focused on the location of potential deposits; Earl Grey, Irish Breakfast and Prince of Wales mine sites. In 2017 the survey effort covered the Development Envelope to fully characterise habitat utilisation. It is considered the inventory of mounds within these areas is near complete, but some mounds may remain unrecorded.

One active and three recently active mounds were recorded in the Development Envelope; with another three recently active mounds recorded outside of the Development Envelope within the Regional Survey Area (see Figure 6-12 and Figure 6-13). Over the course of two years, 12 birds were sighted (or observed on camera traps) in the Development Envelope and 6 outside of the Development Envelope (see Figure 6-15).

Malleefowl in the study areas are likely to range over all habitats, favoring patches of shrubland on gravelly sands for mound construction. Although birds may forage in recently burnt habitats, unburnt areas are required for mound construction. Habitat loss, habitat fragmentation and feral predators are recognised as current threats. Large–scale fires are also likely to impact this species, resulting in loss of leaf–litter to build their mounds.

Chuditch

The Chuditch is currently restricted to the south-west of Western Australia, with the majority occurring in the Jarrah forest with some wheatbelt/goldfields populations in drier woodlands, heath and mallee shrublands. Until recently, there were only occasional records of the Chuditch from the wheatbelt and goldfields, with this population estimated at 2,000 mature individuals. However, Western Wildlife (2017) identified numerous records of Chuditch within 90 km of the Development Envelope through DBCA database searches. The recent records were predominately in Forrestania mostly in association with the Cosmic Boy Mine approximately 55 km to the south of the Development Envelope.

Overall, Chuditch were recorded on 24 of the 42 camera traps set in the Development Envelope and 29 of the 94 camera traps in the Regional Survey Area. Due to the Chuditch's high mobility, the camera traps may be recording individuals at numerous camera traps, however this still indicates that the Chuditch are distributed across a large area.

Over the course of two survey years, 28 individual Chuditch were trapped (13 adults and 15 dispersing young), of which 23 were trapped within the Development Envelope (Figure 6-14). Chuditch were also recorded on 41% of camera traps averaged over the two survey years, showing a preference for unburnt habitats. Factors that may have positively influenced Chuditch numbers in the survey include low numbers of feral predators and the presence of long–unburnt habitats within the Development Envelope to provide shelter and denning sites relative to the surrounding area. Individuals are likely to have a core home range of 1,500 ha (males) or 300 – 400 ha (females), though they are highly mobile and likely to range even more widely and the core home–ranges are likely to overlap (Serena and Soderquist 1989).

Chuditch are likely to occur in all habitats in the study areas, and may use hollow logs, burrows and old White–browed Babbler nests as den sites, as well as man–made structures such as rocky bund walls. Current threats are habitat loss, habitat fragmentation and feral predators. Large–scale fires impact this species through loss of den sites and prey.

In 2016 surveys, 18 individual Chuditch were trapped (ten adults and eight dispersing young) and Chuditch were recorded on 44 of the 101 camera trap locations showing a preference for unburnt habitats. In 2017 surveys, 10 individual Chuditch were trapped (three adults and seven dispersing young) and Chuditch were recorded on 52 of the 136 camera trap locations. Chuditch have a short life cycle, with males breeding within two years and dying, which results in Chuditch population being subject to substantial changes in population numbers over a short time. While the surveys only covered two years the substantial changes in population numbers can be seen. As the vegetation that was previously burnt to the east, north and south of the Development recovers the Chuditch population is expected to return to these areas.

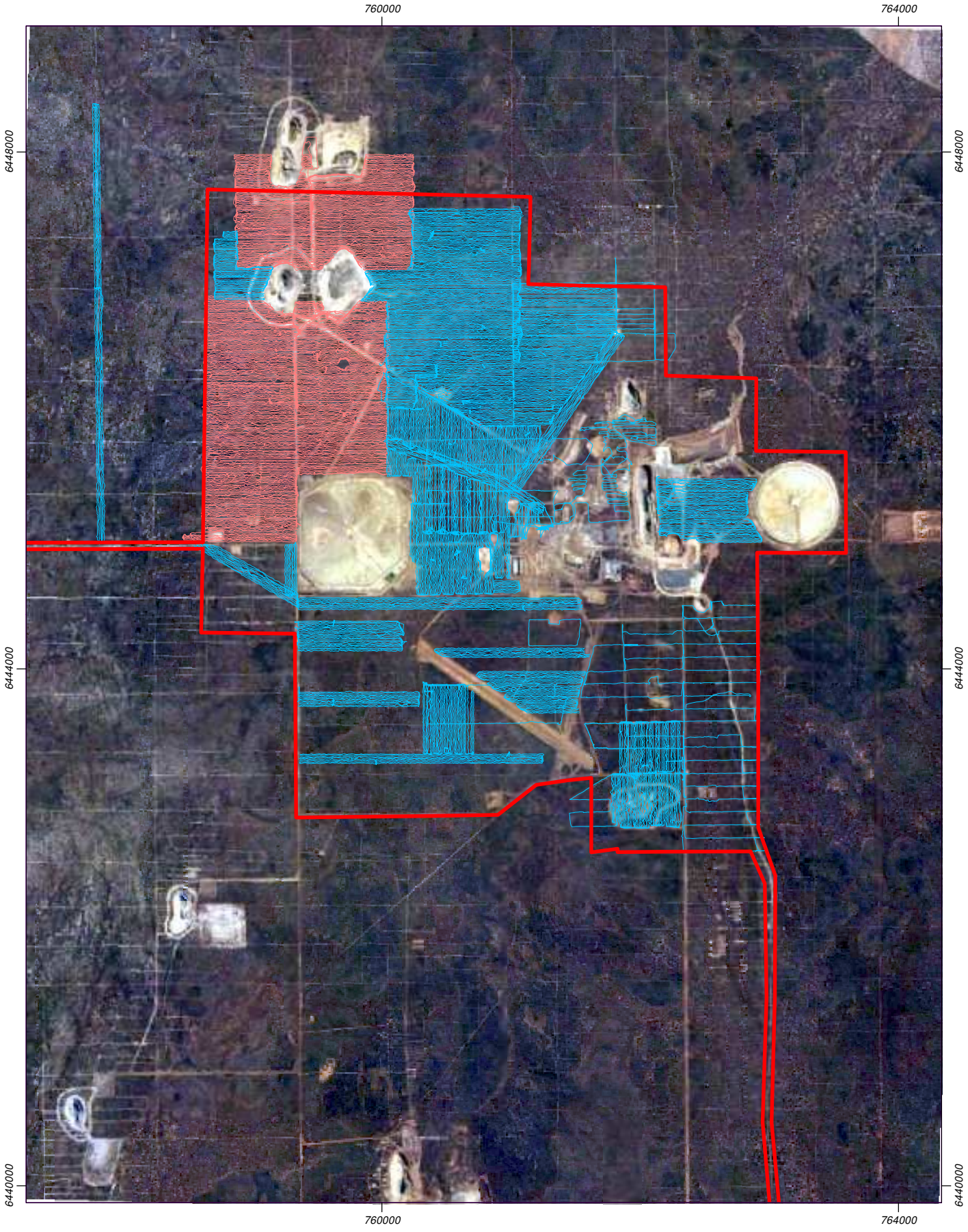

Figure 6-12: Malleefowl survey effort within Development Envelope

Scale 1:40,000 at A4

0 400 800 1,200 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 22/11/2018

Author: vdinh

Source: SQM: Aerial imagery - 2017,
Development Envelope, Malleefolw survey - 17/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G027_RevB.mxd

Legend

- Malleefolw survey 2016
- Malleefolw survey 2017
- Development Envelope

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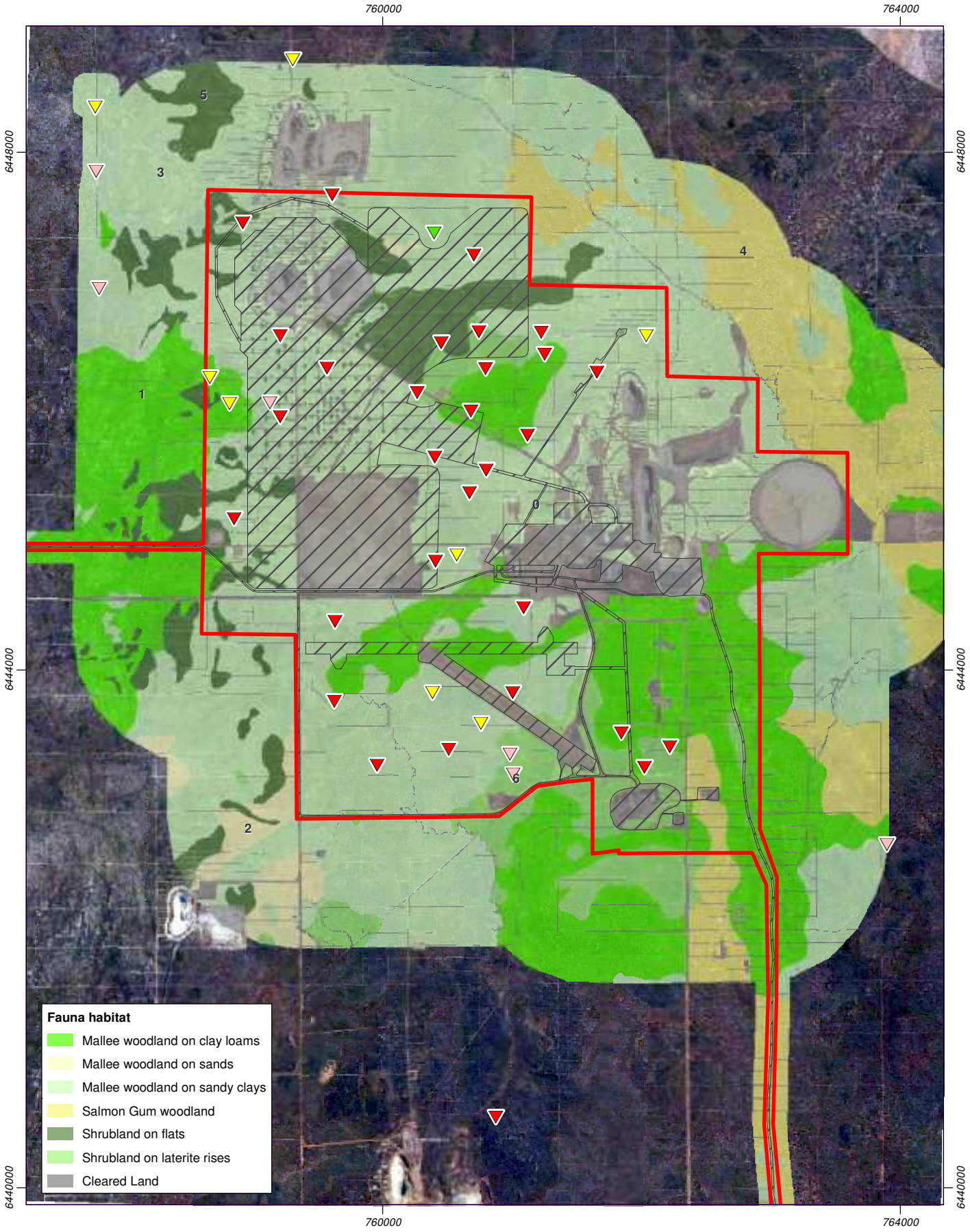

Figure 6-13: Malleefowl mounds in the development envelope

Legend

- Malleefowl active mound
- Malleefowl recently active mound
- Malleefowl mound attempt
- Malleefowl inactive mound
- Development Envelope
- Indicative proposed footprint

Scale 1:40,000 at A4

0 400 800 1,200 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 22/11/2018

Author: vdinh

Source: SQM: Aerial imagery - 2017,
Development Envelope, Mallefowl records - 17/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G024_RevF.mxd

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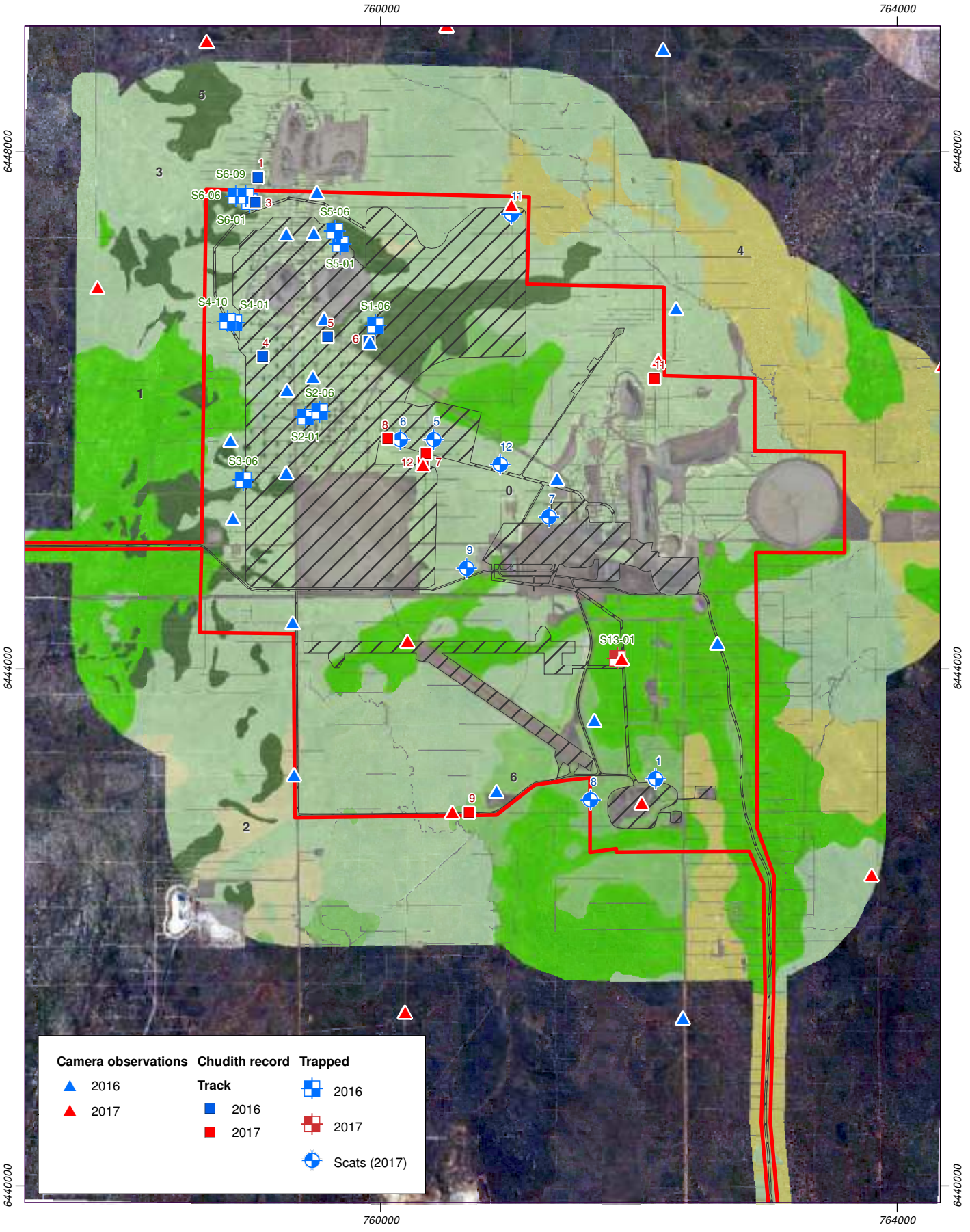

Figure 6-14: Chuditch records

Scale 1:40,000 at A4

0 400 800 1,200 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 22/11/2018

Author: vdinh

Source: SQM: Aerial imagery - 2017,
Development Envelope, Chuditch records - 17/11/2017.

Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G028_RevD.mxd

Legend

- Development Envelope
- Indicative proposed footprint

Fauna habitat

- Mallee woodland on clay loams
- Mallee woodland on sands
- Mallee woodland on sandy clays
- Salmon Gum woodland
- Shrubland on flats
- Shrubland on laterite rises
- Cleared Land

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Other significant fauna species

Carnaby's Black Cockatoo – is endemic to the southwest of Western Australia and has declined due to loss of breeding habitat in the wheatbelt and foraging habitat along the west coast (Johnstone and Storr 1998). This species feeds on the seeds of eucalypts and proteaceous vegetation, as well as a range of other seeding species including *Allocasuarina* spp. (Johnstone and Storr 1998). There are several records of this species on DBCA's Threatened and Priority Fauna Database, mostly from surveys around Cosmic Boy Mine, but also at Hatters Hill and Flying Fox Mine (Western Wildlife 2017, Appendix 4). Although the Development Envelope is on the very eastern limits of the known range of this species and whilst this species was not recorded during field surveys, Carnaby's Black-Cockatoo potentially breeds in Salmon Gum woodlands, with potential foraging habitat in the surrounding eucalypt woodlands and shrublands.

Peregrine Falcon – is a widespread bird of prey that globally has a very large range and a very large population that appears to be secure, as in Western Australia, though this species may experience reductions at a local level due to human disturbance at nesting sites. The species is likely to forage in open habitats and often takes advantage of man–made structures nest on ledges in open pits. The Peregrine Falcon was recorded outside of the development area during the fauna surveys; it potentially nests in the existing open pits.

Fork-tailed Swift – is a non-breeding visitor to Australia between September and April (Boehm 1962). While it can be common further north, in southwest Australia this species is generally scarce (Johnstone and Storr 1998). The bird is primarily observed foraging for insects in proximity to cyclonic weather (Boehm 1962). This species has been recorded in the region on DBCA's Threatened and Priority Fauna Database (Western Wildlife 2017, Appendix 4). Although a migratory species, the Fork-tailed Swift has a large range and a large population that appears to be stable (Birdlife International 2017). In Western Australia, the Fork-tailed Swift is largely aerial and it is unlikely that the Development Envelope is of particular significance for this species.

Red-tailed Phascogale – has declined in numbers and in range and is generally restricted to woodlands. It favours Wandoo or York Gum woodlands with Rock Sheoak (Allocasuarina huegeliana), but it also is known to occur in shrublands and mosaics of woodlands and shrublands (Woinarski et al. 2014). There is a record of this species from 10 km south of Marvel Loch in 1998 on DBCA's Threatened and Priority Fauna Database (Western Wildlife 2017, Appendix 4), about 50 km north of the Development Envelope, with the remaining records from granite outcrops. Most of records of the Red-tailed Phascogale on NatureMap (DPAW 2007-) are to the west of the Development Envelope. Though the Red-tailed Phascogale may potentially occur in the Development Envelope, it is considered that the likelihood is low. Although there are shrublands with Allocasuarina, these generally do not occur in conjunction with the hollow-bearing trees that this species shelters in, and no phascogales were caught despite trapping with Elliott traps in this habitat.

Rainbow Bee–eater – is a common species that migrates south in summer to breed, it is likely to be a breeding summer visitor to the area. The population is large and secure, it is widespread in Western Australia and was recorded in the outside of the Development Envelope during the fauna survey. The Rainbow Bee–eater may forage anywhere over the Development Envelope. The Rainbow Bee-eater is only likely to breed where there are lighter soils in which to burrow, potentially breeding alongside tracks or in open patches in shrublands or woodlands. As the Rainbow Bee–eater has an extremely large range and an extremely large population size that does not appear to be, it is unlikely that the Development Envelope is of particular significance for this species.

Inland Western Rosella – is endemic to southern Western Australia. The population is stable in the Great Western Woodlands. This species occurs in eucalypt and Casuarina woodlands, nesting in tree hollows. The Inland Western Rosella was recorded in the Development Envelope and the bird is considered likely to forage in the greater study area in both woodlands and shrublands. The Development Envelope does not constitute significant breeding habitat as it lacks large trees that may contain hollows. The greater study area includes habitats with tall, hollow–bearing eucalypts that are potential breeding habitat (Western Wildlife 2017).

Central Long-eared Bat – is widespread across the arid south of Australia, and though thought to have a population of substantially more than 10,000 individuals, the reliability of this estimate is low (Woinarski et al. 2014). Although only known from 15 localities in Western Australia, it is considered locally common in the Coolgardie Bioregion (Duncan et al. 1999). It occurs in eucalypt woodlands with a tall shrub understorey and around granite outcrops, roosting beneath bark, in tree crevices or in the foliage of trees (Duncan et al. 1999, Van Dyck and Strahan 2008). The Central Long-eared Bat is known from Jilbadji Nature Reserve (Duncan et al. 1999) and may occur in the Salmon Gum and mallee woodlands of the Development Envelope.

Western Brush Wallaby – is endemic to the southwest of Western Australia. The Western Brush Wallaby is likely to occur throughout the mallee woodlands and shrublands and occurs in open forests or woodlands. The home–range size of this species has been estimated at about 9.9 ha for males and 5.3 ha for females. There are several local historical records of the Western Brush Wallaby in Forrestania and Jilbadji Nature Reserve. This species was observed in the greater regional area opportunistically and recorded on camera traps (Figure 6-15). The Western Brush Wallaby is likely to occur in shrubland and woodland habitats, including recently burnt habitats (Western Wildlife 2017).

The Lake Cronin Snake – is known from very few localities in the semi-arid southern interior of Western Australia (Storr et al. 2002). The Lake Cronin Snake has been recorded from areas of woodland (including Salmon Gum woodlands) and tall shrubland), including one past observation immediately south of the southern terminus of the borefield and Development Envelope (Western Wildlife 2017, Appendix 4). However, there is also a record from Jilbadji Nature Reserve to the north, so the distribution of this species may overlap the Development Envelope. Although not recorded during the fauna survey, the Lake Cronin Snake potentially occurs in any of the woodland or shrubland habitats in the Development Envelope. Although not known to have declined, this species may be threatened by clearing for agriculture and mining (Cogger et al. 1993, Bush et al. 2007).

Figure 6-15: Fauna survey records of conservation significant birds

Scale 1:40,000 at A4

0 400 800 1,200 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 22/11/2018
Author: vdinh
Source: SQM: Aerial imagery - 2017,
Development Envelope, Significant birds - 17/11/2017.
Path: Q:\Consult\2017\SQM\SQM17406\01_GIS_documents\ArcMap_documents\SQM17406_G029_RevA.mxd

Legend

- Western Rosella
- Peregrine Falcon
- Rainbow Bee-eater
- Development Envelope

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6.2.5 Short Range Endemics

Short range endemic (SREs) invertebrates are species with naturally limited distributions of less than 10,000 km^2 (Harvey 2002). SREs' limited distributions are typically a result of poor dispersal powers, confinement to discontinuous or rare habitats, slow growth and low fecundity (Harvey 2002). The phenomenon is considered to be widespread. Western Australian invertebrate groups that consist principally of SREs include *Gastropoda* (snails and slugs, both freshwater and terrestrial), *Oligochaeta* (earthworms), *Onychophora* (velvet worms), *Araneae* (mygalomorph spiders), *Schizomida* (schizomids), *Diplopoda* (millipedes), *Phreatoicidea* (phreatoicidean crustaceans), and *Decapoda* (freshwater crayfish).

A desktop review of SRE and listed invertebrates was conducted for the Development Envelope and surrounding habitats (Bennelongia 2017) and is included in full in Appendix 3. At least 48 species from SRE Groups have been recorded in the 100 km x 100 km vicinity of the Proposal. No confirmed SRE invertebrate species have been recorded in this area. Of the species recorded, 23 are widespread, six are potential but unlikely SRE species and 19 are potential SREs. Potential SRE species include 15 mygalomorphs, two isopods, a pseudoscorpion and a millipede. Bennelongia, based on professional judgement, considers many of these potential SRE species are likely to be widespread, but current records are insufficient to accurately predict their distributions. No listed invertebrate species has been recorded in the search area and it is highly unlikely that any occur.

Potential SRE habitat units were assessed based on the Western Wildlife (2017) and Mattiske (2017) assessments, in addition to broad-scale habitat units from Beard et al (2013) and modified based on the context of SRE species. The faunal habitats and vegetation communities were assessed for SRE habitat suitability based on the availability of moisture, soil structure, geological diversity, vegetation type and extent of shade and shelter.

Six habitat units were determined as shown in Figure 6-16 and detailed below:

1. Mallee woodland on clay/sandy clay soils on flats and slopes - is an amalgamation of four vegetation communities characterised by low and mid mallee woodland over sparse shrubland or heathland on red, orange and brown clays or sandy clays on flats and slopes. This habitat type covers 30% of Development Envelope, and is likely to occur as part of regionally extensive vegetation associations outside the Development Envelope. Although SRE groups are likely to occur in deposits of leaf litter, this unit is of low prospectivity for SRE species due to its wide extent and good regional connectivity.
2. Open mallee woodland/woodland on clay/sandy clay on flats and slopes is the most common and widespread SRE habitat type, combining 15 mallee and two non-mallee open woodland communities and covering 33% of the Development Envelope. It is characterised by open mallee woodland (or less commonly open non-mallee or gimlet woodland) over sparse shrubland or heathland on grey, brown, orange, yellow and red clays and sandy clays on flats and slopes. Due to the wide extent both within and beyond the development envelope and wider region, a low degree of prospectivity for SRE species is inferred.
3. Open mallee woodland on lateritic clayey sand on slopes and ridges comprises a single vegetation association, W17, and covers less than 1% of the Development Envelope. However, it was not identified in the mapped area outside the Development Envelope. The separation of this habitat from other open mallee woodland units is based on the presence of lateritic surface rocks that may offer some specialist microhabitats for a range of specialist species, such as selenopid wall crab spiders, pseudoscorpions and burrowing species such as mygalomorphs and *Urodacus* scorpions that may favour rocky substrate. In reality, however, the absence of outcropping rock reduces the likelihood of species being restricted to this small area of habitat, with species instead being likely to utilise microhabitats present in surrounding mallee woodland. In addition, SRE Group species are likely to reside in deposits of bark and leaf litter, especially at the bases of larger trees. The significance of this small area of laterite within the local landscape is unclear, although is likely to be low on a regional scale. A moderate degree of prospectivity for SRE species is inferred for this habitat, although this may be overestimated by desktop and species from SRE Groups utilising this small pocket of habitat may also occur in surrounding mallee woodlands.

4. **Open mallee woodland on sandy clay with pebbles on flats and slopes** comprises a single vegetation community, W4, which cover 1% of the Development Envelope, although there may be some justification for its amalgamation into habitat 2. Although similar to habitat 2 in terms of vegetation, habitat 4 is separated on the basis of having some rocks (mainly ironstone and quartz pebbles), which may alter the structure of soil in such a way as to favour some specialised species that burrow in rocky substrate, at the expense of generalist burrowing species or those that prefer finer soils (such as those in habitat 2). It is also possible, although unlikely, that non-burrowing specialist species that favour rocky habitats (such as some spiders and pseudoscorpions) occur in this unit. This habitat is highly likely to occur within regionally extensive and interconnected vegetation associations. Therefore, it is inferred to have a low degree of prospectivity for SRE species.
5. **Open heathland on rocky, sandy clay with on slopes** comprises a single vegetation association, H1, covering 2 ha in the southern portion of the Development Envelope. It is absent from within the Development Envelope and as such will not be threatened by the Proposal. Given the general lack of eucalypts or other species that would generate significant amounts of leaf litter and provide cover, this habitat is highly exposed, and few (if any) moist microhabitats are present. Rocky substrate may provide some, though probably limited, habitat for specialist species including burrowing forms and, to a lesser extent, non-burrowing rock specialists. Given the absence of regionally significant geological features and high degree of exposure, this habitat is considered to have low prospectivity for SRE species, although species from SRE Groups may occur in low abundance. Larger areas of heathland occur outside the Proposal area in vegetation associations 1148 and 2048 and possibly amongst areas of mallee woodland (Figure 5-5).
6. **Tall shrubland on clay soils with some rocks on flats and slopes** is made up of three similar vegetation associations and is characterised by tall shrubland (ranging from open to closed) over sparse heathland and shrubland on clay soils. It covers 10% within the Development Envelope as well as occurring in externally in the mapped area and probably also in regionally extensive vegetation associations. Significant microhabitats for SRE species are unlikely to occur in this habitat, with larger trees that would provide leaf litter, bark and shade cover absent. Significant surface rocks are absent, although soils are pebbly or gravelly in places, possibly favouring burrowing species that prefer coarse media over generalists. Overall, a low degree of prospectivity is inferred.

The extent of the habitats beyond the Development Envelope were assessed, as well as extent of habitat connectivity and the presence of habitat isolates, which might restrict dispersal of SRE.

These units generally have low prospectivity for SRE species, although widespread species belonging to SRE Groups are likely to utilise the habitats. All units extend outside the Proposal with the exception of habitat 3 (open mallee woodland on lateritic clayey sand on slopes and ridges), although in reality it is likely that this habitat also occurs regionally outside the area covered by habitat/vegetation mapping. It is also considered unlikely that habitat 3 provides truly specialised habitat usually necessary to indicate prospectivity for SRE species due to a its lack of truly distinguishing geological features, such as outcropping rock, granites or BIF.

Floristic, soil and climate characteristics are moderately consistent across the habitat units present, suggesting that they are likely to represent similar habitats from the viewpoint of an SRE species. Mesic microhabitats within all six habitats are restricted to litter deposits that occur sparsely within a generally xeric landscape. Rock outcrops suitable for some specialist SRE taxa are absent. Based on the extent and connectivity of habitat units and lack of barriers to dispersal, species from SRE Groups at the Proposal are expected to be widespread and it is considered unlikely that any listed invertebrate species occur.

The size of the area covered by the proposed development is negligible compared with the likely ranges of the SRE Group species that may be present. Overall, it is considered unlikely that the Proposal will have any significant conservation implications for SRE or listed terrestrial invertebrate species.

The work requirement from the ESD is to "*undertake surveys for SRE fauna in accordance with EPA guidance*" and to "*Provide Figures illustrating the locations of SRE fauna in relation to the impacted areas*". As the Desktop Survey determined low prospectivity of SRE species within faunal habitats and SRE habitat units within the area are widespread and well-connected across the wider landscape, the proponent has not commissioned SRE surveys and no SRE species mapping is included in the ERD. The potential for impacts is considered low based on the conclusions of the Desktop Survey. SRE are expected to be widespread and it is considered unlikely that any listed invertebrate species occur.

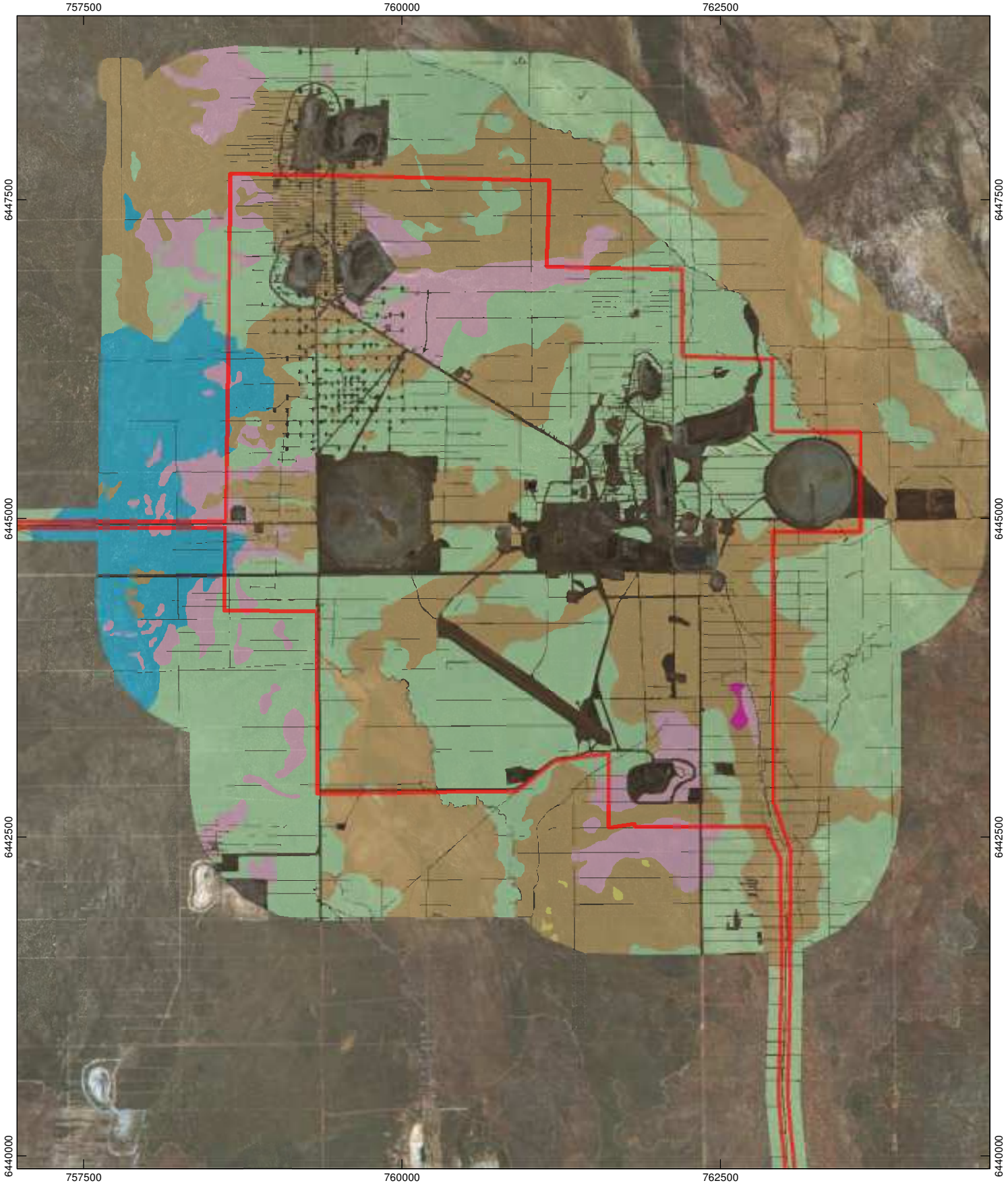

Figure 6-16: SRE faunal habitat

Legend

- Development Envelope
- SRE Faunal Habitat
- Disturbed areas
- Mallee woodland on clay/sandy clay soils on flats and slopes; Mallee woodland on clay/sandy clay soils on flats and slopes
- Open heathland on rocky, sandy clay with on slopes
- Open mallee woodland on lateritic clayey sand on slopes and ridges
- Open mallee woodland on sandy clay with pebbles on flats and slopes
- Open mallee woodland/woodland on clay/sandy clay on flats and slopes
- Tall shrubland on clay soils with some rocks on flats and slopes

N

Scale 1:40,000 at A4

0 0.5 1 km

Coordinate System:
GDA 1994 MGA Zone 50

Date: 21/01/2019

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6.2.6 Design considerations to avoid impacts

The Proposal has been designed to completely avoid the removal of Malleefowl mounds that were identified as active during the 2016 and 2017 surveys. In the event that a previously inactive mound identified for clearing becomes active or clearing of any active mound is found to be necessary, impacts would be limited to the maximum extent practicable. As currently designed, the Proposal avoids all direct impacts to active Malleefowl mounds within the Development Envelope.

6.3 Assessment of impacts

6.3.1 Loss and fragmentation of habitat for terrestrial fauna

Figure 5-4 identifies that of the Vegetation associations present in the Development Envelope, less than 2% has been cleared historically within the Coolgardie Region or the Southern Cross Subregion, showing negligible loss of vegetation to date at a regional and local scale. This illustrates that the Vegetation associations present in the Development Envelope are all well represented in the wider region. The Proposal also builds upon the prior mine Development Envelope through reuse of existing facilities, minimising the footprint of new clearing to 392 ha. The extension of clearing at the site does not extend the development in a linear fashion that bisects or fragments existing vegetation associations. The Proposal also does not extend the development footprint to a topographic barrier that would fragment or impair habitat functions within the vegetation association.

In an un-fragmented landscape fauna are free to move, allowing gene-flow between populations and the capacity to move to take advantage of dispersed or temporary resources such as food or nesting sites. Habitat fragmentation occurs when a large contiguous area of native vegetation is broken up into smaller patches. These patches can be large or small and can exhibit varying degrees of linkage. Fauna are better able to persist in a modified landscape when vegetation patches are large and there are more links between patches. The Development Envelope is within the Great Western Woodlands, a landscape of generally continuous woodlands and shrublands, and the relative intactness of these habitats is a key value of the area.

Recent work in the Great Western Woodlands have quantified the impacts of development, including the effects of linear infrastructure (including roads and drill lines), that improve the understanding of the Proposal within the context of the Great Western Woodlands and regional impacts on faunal habitats (Raiter et al. 2017). Previously unmapped linear infrastructure, only detectable through manual digitisation, accounts for the greatest proportion of the direct development footprint within the Great Western Woodlands. Across the 16 million ha area, estimated development accounts for 0.43% of the region (69,000 ha), of which 67% consists of linear infrastructure and the remainder is ‘hub’ infrastructure (Raiter et al. 2017), including the existing mine sites at Mt Holland. The results of the study have also identified Mt. Holland and the Development Envelope as lying within an existing area of “medium” density mining development, where linear infrastructure can be a significant proportion of the existing development. These quantitative conclusions are visible in the landscape of the Mt Holland area, where numerous drill lines have existed since at least 1987 in the region and further infrastructure impacts occurred with the Development of the Bounty and Earl Grey mines, starting in 1988 through to 2002, when the last active mine within the Development Envelope went into administration.

While faunal habitats extended across the full range of the site, including for Malleefowl and Chuditch, loss of faunal habitats, as shown in Figure 6-9 and Table 6-5, constitute approximately 26.5% of the area currently uncleared within the Development Envelope, but is negligible within the overall context of the greater 8.5 million hectares of woodland existing within the designated boundaries of the Great Western Woodlands. While impacts to Mallee woodland exceed 25% of what is currently remaining within the Development Envelope, the regional impact is not significant in the context of the nearly 1.2 million hectares of Mallee woodland habitat that exists along the southeastern edge of the Great Western Woodlands and is well represented within the protected area of the Jilbadji Nature Reserve north of the Development Envelope. Additionally, the faunal habitats that would be impacted by the proposal are already fragmented by existing exploration drill lines and infrastructure associated with the prior Bounty and Earl Grey gold mines.

Table 6-5: Regional faunal habitat loss resulting from the Proposal*

Habitat	Habitat occurring in the Development Envelope (ha)	New area to be cleared under Proposal (ha)	% of habitat in Development Envelope to be cleared under Proposal	Habitat mapped in the Great Western Woodlands (ha)	% of Great Western Woodlands to be cleared under Proposal
Mallee Woodland	1,239.3	304.6	25%	1,174,490.50	0.03%
Salmon Gum Woodland	41.8	1.7	4%	7,377,876.50	0.00002%
Scrub/Shrubland	199.9	85.8	43%	--	--
Cleared	503.1	--	--	--	--

* - Habitat mapped regionally for the Great Western Woodlands is per Beard (1990) and did not map scrub/shrubland.

Chuditch and Malleefowl are likely to occur throughout the project area in all habitats, though they may be temporarily absent in areas that have been recently and extensively burnt. Based on anecdotal evidence from the 2016 and 2017 field surveys, areas surrounding the mine site are currently lower quality habitat for conservation significant species. Ongoing survey of areas around the site during implementation would be valuable in understanding the regional context and while both Chuditch and Malleefowl have been observed in some of the previously burned areas, use of these habitats may increase during the early years of the project and provide valuable successional habitats for significant fauna.

Within the above context the Proposal would avoid active mounds and not significantly reduce the extent of habitats within any landform. Chuditch and Malleefowl have been recorded outside the Development Envelope in the Regional Survey Area and further afield based on DBCA database searches with the Chuditch in particular being highly mobile with a large home range. New clearing proposed does not separate existing contiguous habitats and is within a portion of the local environment already significantly impacted by the presence of exploration drill lines and the infrastructure of the prior Bounty and Earl Grey gold mines. It is considered unlikely that the additional clearing would significantly affect Terrestrial Fauna.

6.3.2 Death, injury and displacement of terrestrial fauna

Mining development and operations would involve the utilisation of vehicles. The passage of vehicles on haul roads and access tracks or during the clearing of native vegetation has the potential to result in isolated incidents of injury or fatality of native fauna.

Mortalities can be minimised by restricting vegetation disturbance to the maximum extent possible. Fauna most at risk of direct mortality are those with limited mobility, such as reptiles, frogs, small mammals, dependent young or nocturnal species. Avoiding clearing during late winter and spring (where possible), will aid in minimising mortality of young birds in nests. The Rainbow Bee-eater may nest along tracks in shrublands and mallee woodlands on sand, and young birds in burrows would be vulnerable to direct mortality.

When in operation, vehicles and heavy machinery may cause fauna mortalities, though many species are likely to avoid human activity. Road mortalities are undesirable both from a fauna welfare point of view as well as driver safety. Reptile species that bask on roads, larger mammals (such as kangaroos) and birds that forage on road edges are particularly at risk. In general, road mortalities are unlikely to negatively impact the conservation status of a fauna species, unless the fauna population was small or otherwise fragile. However, conservation significant species that are at risk of road mortalities include the Malleefowl, Chuditch, Lake Cronin Snake and Western Brush Wallaby.

The Malleefowl is at risk as it is a large bird that forages on the ground, and if the male is attending an active mound near a road, he may often be on or near the road. Nocturnal species (e.g. Chuditch) could be at heightened risk given the 24–hour operation of the Proposed mine. Chuditch may come into contact with vehicles when attracted to food waste in camps, foraging along roads or eating other road kill (DEC 2012). They may also become inadvertently trapped in steep-sided containers (e.g. skips or large bins) when in search of food, and these should be kept securely lidded to avoid mortalities. Many records of the Lake Cronin Snake are from inadvertent mortalities on mine sites in the region (Bush et al. 2007). The implementation of speed limits to minimise the incidence and likelihood of fauna road deaths, and avoidance of driving at dusk and dawn would limit the impact of the Proposal. It is unlikely that isolated deaths of individuals would affect the conservation status and distribution of any fauna species.

Fauna may also become trapped in containers, uncapped drill holes, trenches, excavations or water storage structures. Steep sided or slippery structures may prevent escape and result in direct mortality.

6.3.3 Introduced species and feral fauna

Feral fauna, particularly predators such as foxes, cats and wild dogs, have the potential to negatively impact native fauna (including the Malleefowl and Chuditch), with predation by feral cats and foxes, both recognised as key threatening processes.

During field surveys (Western Wildlife 2017), the common house mouse (*Mus musculus*) was observed within the Earl Grey Mine footprint and has the potential to occur across the pre-existing Mt. Holland mine given the long history of disturbance and use of the site. Rabbits, foxes, cats and wild dogs were all observed in the surrounding area of the site and not within the Development Envelope, but are likely to occur within the Development Envelope.

6.3.4 Impacts to terrestrial fauna from dust, light, noise and vibration

The project has the potential to create a range of disturbances to fauna due to noise, light, vibration and dust generation from heavy machinery, the workshop, and the presence of people or vehicles. Fauna, including Malleefowl and Chuditch may avoid disturbance, but would potentially experience increased stress, expending energy in avoidance behaviours. Noise, light, vibration, and dust may alter fauna behaviour and distribution within the vicinity of the Development Envelope. Significant residual impacts are not anticipated and impacts are not expected to affect the viability of species populations.

6.3.5 Impacts to terrestrial fauna from altered fire regimes

Chuditch and Malleefowl, along with other faunal assemblages, are likely to occur throughout the project area in all habitats, though they may be temporarily absent in areas that have been recently and extensively burnt. Large-scale fires result in loss of den sites and prey for Chuditch and loss of leaf-litter for Malleefowl to build their mounds. Based on the recent fire history in the vicinity of the Proposal, shown in Figure 6-8, regional fires from 2013–2016 have potentially impacted regional habitat for species and may be resulting in a preferential use of the mine site by a number of species. With the implementation of standard fire management practices, significant impacts are not anticipated and impacts are not expected to affect the viability of faunal assemblages and conservation significant species.

6.3.6 Cumulative impacts

The Proposal would result in in 392 ha of new clearing in addition to the clearing undertaken for the prior mine. Within the 1,984 ha Development Envelope, 668 ha of the site is already cleared or otherwise developed. Within the context of the Development Envelope, this represents an 20% increase in clearing of habitat at the site. While significant within the context of the Development Envelope, overall clearing of habitat at both a regional and subregional scale is less than 2% of total vegetation association cover (discussed further in Section 5.3.1) and as an increase in clearing of less than 1% regionally, would not be a cumulatively significant contribution at a regional scale. The impact does not extend into existing contiguous habitat and is occurring in a landscape with existing fragmentation and impacts from exploration drill lines, prior mine developments, and other existing infrastructure.

In addition, the timescale for effects places emphasis on existing disturbed areas of previous mining in the early years of work, with the new mine pit and airstrip being the primary areas of clearing in the early years of the proposal, as shown in Table 5-20. The proposed slow and relatively minor clearing progression in the context of greater than 98% of regional vegetation associations providing habitat and local conservation areas such as Jilbadji Nature Reserve less than 5 km north of the Development Envelope ensures that overall habitat impacts are not cumulatively significant.

6.4 Mitigation

A fauna management plan for the Proposal, addressing both Chuditch and Malleefowl, is provided in Appendix 4. A summary of proposed management actions is provided below. Proposed management measures are also applicable to the maintenance of other fauna populations and habitat.

6.4.1 Fauna specialist during clearing

A suitably qualified environmental professional (fauna specialist) will be present during all land clearing to ensure timely identification and avoidance of Chuditch and Malleefowl. The fauna specialist will identify any Malleefowl mounds and potential Chuditch dens and undertake relocation activities. The person will hold a permit to handle and move conservation significant fauna under Regulation 28 of the *Biodiversity Conservation Regulations 2018* and have access to a care facility that can be used to rehabilitate injured fauna.

6.4.2 Avoid Malleefowl Breeding

The Proposal does not directly impact any currently known active Malleefowl mounds, however pre-clearance surveys will occur to identify any Malleefowl mounds and record the presence/absence of Malleefowl and active/recently active mounds in the area to be cleared.

The Proposal will avoid disturbance to active Malleefowl mounds through:

- all Malleefowl, active and inactive mounds will be recorded in a “Malleefowl Register” which will include date, observer, status of mound/Malleefowl and a GPS/location description
- clearing that will impact on Malleefowl mounds will be preferentially undertaken outside the mound building, breeding, and egg incubation period (i.e. between April and June) to the maximum extent practicable
- if it is essential that a Malleefowl mound is cleared between July and March, then pre–clearance surveys will be completed prior to all clearing to record the presence/absence of Malleefowl and active/recently active mounds in the area to be cleared
- if avoidance is possible, a 100 m buffer will be applied to active/recently active mounds to be flagged in the field as no–go zones. The 100 m buffer for active Malleefowl mounds is considered industry standard associated with maintaining adequate surrounding vegetation and habitat and minimising indirect impacts (noise, dust and vibrations). The buffer distance is based on similar approved Malleefowl Management Plans and Ministerial Statements within similar vegetation associations
- if eggs are present and the mound is essential for removal, then with the approval of DBCA, eggs may be removed and incubated in a place approved by DBCA (e.g. Perth Zoo, Yongergnow Malleefowl Centre) with hatched chicks to be released on site or in suitable habitat outside the Development Envelope unless otherwise directed by DBCA.

The classification of active Malleefowl mounds will be based on the National Malleefowl Monitoring Procedure (NMRT 2016) and be assessed by a fauna specialist.

Monitoring of the Malleefowl population via mounds will be conducted in consultation with DBCA and will adopt the National Malleefowl Monitoring Procedure (NMRT 2016). The monitoring program will establish analogue sites not impacted by the Proposal. Monitoring will identify any decline and determine, where possible, the cause, and if it is considered to be project related, remedial actions will be investigated and discussed with DBCA and any other identified party of interest.

If required, captive raising of Malleefowl at Yongergnow is anticipated to have a higher survival rate than natural survival. Chick survival at Yongergnow's projects have been between 60% and 80%, as compared to natural survival of 1 to 2% (Yongergnow 2017). Yongergnow successfully released 13 birds into the wild since 2011.

6.4.3 Chuditch relocation

Chuditch are highly mobile and have been recorded in all habitats. As such avoidance is not assumed to be practicable. The Proposal would minimise disruption to the species through temporal avoidance as much as is practical and through relocation when direct impacts are within essential portions of the Development Envelope. Relocation of Chuditch has been done since the late 1980's and is well understood (DEC 2012). Relocation success is anticipated to be high, especially if focused on similar unburnt local habitats close to the Development Envelope or within the Jilbadji Nature Reserve.

The most suitable time for relocating Chuditch, especially females, is between January and April, outside of the breeding season. Translocating female Chuditch at other times of the year has the potential to result in the mortality of dependant young or else place animals into established territories with increased competition and stress on the individuals. January to April is a time when the species are more mobile and are most likely to successfully establish in new surroundings.

The preferred option for captured Chuditch is to release individuals into bushland adjacent to the Development Envelope before nightfall or within the same day into another local location recommended by DBCA. If absolutely necessary or specifically requested by DBCA, Chuditch could be incorporated into a DBCA captive breeding program in lieu of relocation.

6.4.4 Traffic management

The Proposal would minimise direct impacts and mortality of Malleefowl and Chuditch resulting from accidental vehicle strike through implementation of the following traffic control management actions:

- avoid accidental disturbance to fauna and habitat by enforcing strict traffic management rules (e.g. keeping to designated tracks, limiting driving between dusk and dawn, driving to road and weather conditions, reduced speed limits, Malleefowl and Chuditch signage)
- all sightings and interactions with Malleefowl and Chuditch to be reported to the Environmental Department
- development of working relationships with suitable wildlife carers/vets for injured Malleefowl and Chuditch
- environmental personnel to identify and establish working relationships with local wildlife carers/vets for injured Malleefowl and Chuditch
- worker awareness training (described in full in Section 5.4.2).

6.4.5 Minimise pollution from light, noise, vibration and dust

The Proposal would minimise disruption and indirect impacts on Malleefowl and Chuditch from noise and light emissions by implementing the following management actions:

- dust suppression measures that include maintenance practices for vehicles, cleared areas, and active stockpiles
- dust suppression measures such as the use of watercarts will be used during dry and windy conditions, as required
- project travel between dusk and dawn will be limited to essential mining operations
- installation of lighting that minimises light intensity and spill and direct lights toward plant areas to minimise light spill into adjacent vegetated areas
- equipment design will specify compliance with Australian Standard noise limits
- machinery and equipment will be fitted with noise attenuation measures as appropriate.

6.4.6 Fauna entrapment

Entrapment of terrestrial fauna during construction and operation of the Proposal would be minimised through implementation of the following management actions:

- all construction pipes, culverts, or similar structures, greater than 0.5 m in diameter, stored on–site overnight, will be inspected thoroughly for wildlife by a qualified biologist or properly trained on–site personnel before the pipe is buried, capped, used, or moved
- if inspection indicates presence of conservation significant species inside stored materials or equipment, work on those materials will cease until a qualified biologist determines the appropriate course of action
- to prevent entrapment of animals, all excavations, steep–walled holes or trenches more than one meter deep will be secured against animal entry at the close of each day, where possible. Any of the following measures may be employed, depending on the size of the hole and method feasibility:
    - construction holes and trenches will be securely covered (no gaps) with plywood or similar materials at the close of each working day, or any time the opening will be left unattended for more than one hour
    - in the absence of covers, the excavation will be provided with escape ramps constructed of earth or untreated wood, sloped no steeper than 2:1, and located no farther than 100 m apart
    - in situations where escape ramps are infeasible, the hole or trench will be surrounded by filter fabric fencing or a similar barrier with the bottom edge buried to prevent entry as appropriate, determined in consultation with a fauna specialist
    - If a trench with a greater distance than 100 m is required to be left open for more than one day, trench inspections shall be undertaken to identify any entrapped fauna and relocation completed. The requirement and specifics (frequency and timing) for trench inspections will be determined by a fauna specialist, however inspections after sunrise, before sunset and prior to backfilling are required.
- domestic waste facilities will be fenced and putrescible wastes will be regularly covered
- containers to have doors closed securely when not in use
- worker awareness training (described in full in Section 5.4.2)
- permanent water sources (tanks, ponds and dams) to be fenced and / or have fauna egress mats installed.

6.4.7 Feral species control

The feral species population (particularly predators including cats, foxes and wild dogs) will be managed through the implementation of the following management actions:

- feral species identified will be reported to the Environmental Department and recorded to monitor occurrences
- avoid attraction of feral species to the Development Envelope by implementing domestic waste management procedures (e.g. fencing of landfills, regularly covering putrescible waste, secure lids on bins)
- feral species control will be undertaken on site in cooperation with regional control programs
- worker awareness training (described in full in Section 5.4.2).

6.4.8 Fire Management

To avoid or minimise increases in fire frequency, the Proponent will contribute to fire management at the mine site and in the region through the following measures:

- implementation of fire management procedures (e.g. maintenance of fire breaks, Hot Work Permit system, firefighting training, Emergency Response Plan)
- firefighting equipment will be located on site and in vehicles

- lightning protection equipment will be installed as part of Project design where necessary
- vehicles will not be permitted to leave access tracks or cleared areas
- coordination with DBCA and Department of Fire and Emergency Services (DFES) to undertake prescribed burns.

6.5 Monitoring

The following monitoring will be undertaken in conjunction with Fauna Management Actions:

- annual monitoring of Malleefowl and Chuditch populations using best practice techniques. Monitoring programs will be developed to determine if any population impacts are caused by Proposal activities
- Malleefowl monitoring may consist of:
  - monitoring mounds to record the number of Malleefowl mounds, identify any decline in active mounds (as determined by the National Malleefowl Monitoring Manual - Standards, Protocols and Monitoring Procedures and in consultation with DBCA), and determine the cause. If decline in mound activity is considered to be Proposal related, mitigative actions will be investigated and discussed with DBCA and any other identified party of interest
  - Lidar survey utilising the algorithm developed by the National Malleefowl Recovery Team to identify mounds within the Development Envelope to ensure that all Malleefowl mounds are identified
- Chuditch monitoring may consist of cage trapping to determine population changes within the Development Envelope
- monitoring of incident reports for Malleefowl and Chuditch predation, vehicle strike, speeding and night driving
- internal audit and inspection of areas of clearing, areas of potential entrapment, speeding and night driving
- monitoring of clearing register for compliance to approvals
- review of clearing footprint to determine clearing proximity to active Malleefowl mounds
- monitoring of the existing feral species populations (focussing on the fox and cat populations). This information is intended to provide a baseline for comparison of feral species numbers over the life of mine. The information will also guide any feral species control programs implemented in the Proposal area
- annual monitoring of vegetation condition as an indicator of fauna habitat quality.

Reporting requirements for the monitoring program and other triggers is anticipated to include:

- preparation annually of a Compliance Assessment Report (CAR) to be submitted to the appropriate regulatory authorities. The CAR will include:
  - a summary of compliance requirements
  - summary of compliance during the reporting period
  - non-compliances and corrective / preventative actions
  - compliance assessment table
  - documentary evidence
- provision of data (annually) from monitoring programs to relevant regulatory authorities
- in the event that a management target is exceeded (or not met), the relevant regulatory authorities will be notified within 7 days of identification of the exceedance, including information on remediation actions that have been or will be implemented.

Additionally, Table 6-6 outlines proposed internal and external reporting actions specific to notification events outside of the required CAR.

Table 6-6: Terrestrial fauna reporting actions

Notification Event	Action	Responsibility	Timing
Fauna specialist confirms new, active, Malleefowl mound within approved project disturbance footprint and relocation of individuals is required	Report to DBCA as part of Licence to Take Fauna requirements and inform DoEE	Fauna specialist	At time of monitoring
Trigger exceedance	The relevant regulatory authorities (DWER and DoEE) will be notified within 7 days of identification of the exceedance, including trigger contingency actions which have been implemented due the exceedance of trigger criteria	Environmental Manager	At time of event
Threshold exceedance	The relevant regulatory authorities (DWER and DoEE) will be notified within 7 days of identification of the exceedance, including threshold contingency actions which have been implemented due the exceedance of threshold criteria	Environmental Manager	At time of event
Mortality of conservation significant fauna	The relevant regulatory authorities (including DBCA and DoEE) will be notified within 48 hours of the incident	Environmental Manager	At time of event
Evaluation and revision triggered	Review and report to regulator, as required by legislation or legislative condition	Environmental Manager	At time of event

The Fauna Management Plan (Appendix 4) details management actions and targets (and associated early response triggers) and environmental criteria (and associated triggers and thresholds) for managing impacts to the Malleefowl and Chuditch. Where an early response action, management target, trigger or threshold is breached, the Fauna Management Plan identifies the resulting actions to be initiated.

6.6 Predicted outcome

The EPA objective for the factor Terrestrial Fauna is: “To protect terrestrial fauna so that biological diversity and ecological integrity are maintained”. The EPA’s Environmental Factor Guideline for Terrestrial Fauna indicates that in the context of this objective, terrestrial fauna are defined as animals living on land or using land (including aquatic systems) for all or part of their lives; and Fauna habitat is defined as the natural environment of an animal or assemblage of animals, including biotic and abiotic elements, that provides a suitable place for them to live.

As previously described, the Proposal would result in clearing of a relatively small area of 392 ha within a bioregion which is almost fully vegetated, therefore having limited impact on fauna habitat generally. In addition, the timescale for effects places more emphasis on existing disturbed areas in the early years of work, with the new mine pit and airstrip being the primary areas of clearing in the early years of the proposal, as shown in Table 5-20. The Proposed slow and relatively minor clearing progression in the context of greater than 98% of regional vegetation remaining and local conservation areas such as Jilbadji Nature Reserve less than 5 km north of the Development Envelope ensures that overall habitat impacts are not residually significant in the regional context.

The Proposal has potential to affect two vulnerable species, Malleefowl and Chuditch, at a local scale. The Proposal has the potential to affect the size and viability of the local Malleefowl and Chuditch populations principally through disturbance of breeding habitat and potential incidental mortality from operational activities, particularly traffic movement.

Faunal surveys of the site have been used in the design of proposed facilities to ensure that direct impacts on Malleefowl individuals and active mounds, and Chuditch have been avoided to the maximum extent practicable. Based on the current design and available survey information, the Proposal would not result in any direct loss of currently known, active Malleefowl mounds. Given the presence of suitable fauna habitat throughout the Proposal is significant, minor impacts on Chuditch breeding habitat and breeding habitat for other terrestrial fauna assemblages is anticipated.

Management measures have also been proposed to avoid incidental mortalities of Malleefowl and Chuditch to the maximum extent practicable. Due to the compact nature of the indicative footprint and relatively small area of the Development Envelope, the risk of incidental mortalities to terrestrial fauna, including Malleefowl and Chuditch, is considered not significant.

The implementation of progressive rehabilitation during the life of the mine would enable post closure rehabilitation methodologies to be refined and improved throughout the life of the mine, which is expected to provide much greater rehabilitation outcomes for the mine site when the remaining areas are closed at the completion of mining, but would provide tangible ecological benefits for common faunal assemblages and conservation significant species over the operation life of the mine.

After application of the mitigation hierarchy, potentially significant impacts on terrestrial fauna, including Malleefowl and Chuditch, may still result from the proposal. Loss of fauna habitats through clearing reduces the availability of higher quality unburnt habitat in the local area during the life of the mine operation. Consequently, the Proponent is proposing the application of an offset, described in Section 8.

As summarized in Table 6-7, it is expected that the Proposal will meet the EPA's objective for the terrestrial fauna factor.

Table 6-7: Summary of terrestrial fauna objective, potential impacts assessed against the mitigation hierarchy and predicted outcomes.

Element	Description
Terrestrial fauna	
EPA objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
Potential impacts	• Further loss and fragmentation of habitat from vegetation clearing.
	• Death, injury and displacement from construction and mining operations, vehicle strikes and changed fire regimes.
	• Increased feral fauna from increased access into areas from new tracks and roads, and attraction to rubbish tips.
	• Secondary impact from dust, noise and vibration during construction and mining operations.
Mitigation	Avoid:
	• Avoid clearing of vegetation within 100 m of active Malleefowl mounds and accidental clearing of faunal habitat though implementation of an internal clearing permit procedure. • Avoid removal of active nest mounds during the operational life of the project.
	Minimise:
	• Ensure that a fauna specialist is present during clearing so that timely identification, avoidance, and relocation, can be undertaken if required. • If trapped during clearing, Chuditch would be relocated into bushland adjacent to the Development Envelope before nightfall or within the same day. • Implement traffic management measures including speed limits and driving restrictions at dusk and dawn to reduce potential vehicle strikes. • Ensure dust suppression measures that include maintenance practices for vehicles, cleared areas, and active stockpiles are undertaken. • Prevent entrapment of animals in all excavations (including steep–walled holes or trenches which are more than one meter deep) by securing against inadvertent animal entry at the close of each day or ensure that escape ramps are installed. • Control feral predators (cats, wild dogs, foxes) by implementing local control measures.
	Rehabilitate:
	• If Malleefowl mounds have eggs and the mound is essential for removal, then with the approval of DBCA, eggs may be removed and incubated in a place approved by DBCA (e.g. Perth Zoo, Yongergnow Malleefowl Centre) with hatched chicks to be released on site unless otherwise approved by DBCA.
Outcomes	Residual Impact:
	Within the context of the Coolgardie vegetation region, the Proposal would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Chuditch and Malleefowl that are currently less than 2% cleared and have 17% protected for conservation within the Southern Cross Bioregion. The Proposal has potential to affect two vulnerable species, Malleefowl and Chuditch, within the Development Envelope. The Proposal has the potential to affect the size and viability of the local Malleefowl and Chuditch populations principally through disturbance of breeding habitat and potential incidental mortality from operational activities, particularly traffic movement. Based on the current design and available survey information, the Proposal would not result in any direct loss of currently known, active Malleefowl mounds. There would be a small effect on Chuditch breeding habitat. Management measures have also been proposed to avoid incidental mortalities of Malleefowl and Chuditch to the maximum extent practicable. Due to the compact nature of the disturbance footprint and relatively small area of the Development Envelope, the risk of incidental mortalities is considered not significant. Once the mitigation measures and offsets are taken into account, it is expected that the Proposal will meet the EPA's objective for the terrestrial fauna factor.
	Offset:
	As discussed in Section 8.1, Significant Residual Impacts are anticipated for Chuditch and Malleefowl fauna habitat impacts, therefore an offset is proposed. An offset proposal is defined in Section 8, *Offsets*. Covalent proposes to offset potentially Significant Residual Impacts through DBCA consultation to undertake land acquisition and management of up to 2,000 ha of similar or better quality land.

7. Other environmental factors impact assessment

The EPA has identified the following other environmental factors or matters relevant to the Proposal that must be addressed during the environmental review and discussed in the Environmental Review Document:

- **Terrestrial Environmental Quality** — if water is present in the existing TSF, placing waste material on the TSF to construct the WRD may increase hydraulic pressure (head) resulting in an increase in the rate of seepage. Therefore, if water is present in the existing TSF, the proponent is required to determine if placing the TSF on top of an existing facility would change the seepage rate
- **Subterranean Fauna** - provide comment using site characteristics (geology and groundwater salinity) if there are likely to be stygofauna present on the site and impacted by the proposal. If stygofauna are likely to be present and would be impacted by the proposal, undertake stygofauna work in accordance with EPA guidance
- **Social Surroundings** - investigate if the proposal is likely to result in an adverse impact, or reduction in access, to the Holland Track. If it is, implement actions that ensure access to the Holland Track is maintained for all users
- **Air Quality** (Greenhouse Gas Emissions) — an estimate of the annual GHG emissions as a result of the Proposal, and any mitigation measures committed to by the proponent.

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 7-1 provides a summary of the impacts, mitigations and outcomes for these factors.

Table 7-1: Other environmental factors

Element	Description
Terrestrial Environmental Quality	
EPA objective	*To maintain the quality of land and soils so that environmental values are protected.*
Policy and guidance	• Environmental Factor Guideline – Terrestrial Environmental Quality (EPA 2016i).
Potential impacts	• Placement of waste rock and dry tailings on existing Western TSF has the potential to result in contaminant leaching.
Mitigation	Avoid:
	The reuse of the existing Western TSF has been specifically undertaken to minimise the requirement to clear native vegetation and terrestrial fauna habitat. Currently, all TSFs at the site are uncovered. Reuse of the Western TSF for integrated waste disposal would enable the TSF to be covered and closed appropriately.
	Minimise:
	An assessment report (MBS 2017) has been undertaken the characterise the waste rock and expected tailings material. The assessment has identified that, with the exception of minor quantities of dispersive material that cannot be placed on the outside batters of the WRD, the material is considered to be Non-Acid Forming (NAF) and not anticipated to be a risk to the surrounding environment and saline groundwater. A further assessment was then conducted on the compatibility of the existing tailings with the addition of tailings and waste rock. The seepage from lithium tailings is predicted to be saline and circum-neutral to moderately alkaline and generally low in dissolved metals (especially those present in elevated concentrations in the gold tailings). In addition, Traffic compaction from the construction of the waste rock dump on the existing Western TSF is expected to provide a low permeability layer which would be beneficial to limiting ingress of water and oxygen to the underlying tailings.

Element	Description
Outcomes	Residual Impact:
	Covering the Western TSF would result in the following environmental benefits: • Reduce the volume of water infiltrating through the tailings by increasing storage within the overlying mine wastes, or increased evapo-transpiration rates. • Provide soluble alkalinity from overlying Earl Grey lithium mine waste that is predicted to precipitate soluble metals present in gold tailings porewater, without mobilising other contaminants such as adsorbed metalloids (arsenic, selenium and antimony) or residual cyanide. An assessment of reuse of the Western TSF determined the existing tailings mass is limited (1-4 m deep), reducing potential leachate volumes and the risk of increased seepage through the historic tailings (SRK 2018). The Proposal would not affect terrestrial environmental quality values and would not increase the potential for ongoing leaching from the existing TSFs. The creation of the new IWL will require approval and licensing from DWER under Part V of the EP Act. Consultation has begun with DWER regarding the approval requirements for the IWL.
Subterranean fauna	
EPA objective	*To protect subterranean fauna so that biological diversity and ecological integrity are maintained.*
Policy and guidance	• Environmental Factor Guideline – Subterranean Fauna (2016j).
Potential impacts	• Potential impacts to subterranean fauna through groundwater abstraction, which may affect subterranean habitat. • Potential impacts to subterranean fauna through removal of potential habitat from mining below the water table.
Mitigation	Avoid:
	Based on the results of numerical modelling, the connectivity between Yilgarn calcrete aquifers to the south of the Proposal and fractured rock aquifers at the Proposal, including both the mine pit and proposed/existing borefield, is low. Potential subterranean fauna habitat in palaeochannel units, including calcrete, will not be removed through excavations (Bennelongia 2018; Appendix 3). Proposal does not involve increasing groundwater abstraction beyond what is already approved from the existing borefield. Groundwater in vicinity of the mine pit is hypersaline and does not support stygofauna habitat.
	Minimise:
	N/A.
Outcomes	Residual Impact:
	The Proposal would not affect subterranean fauna values as unsuitable geologies, high salinities, and in the case of the proposed pit, large depth to the water table do not provide habitat for stygofauna and local geology is unsuitable for troglofaunal (Bennelongia 2018). The ongoing operation of the borefield will be required to be operated in accordance with DWER licence under the *Rights in Water and Irrigation 1914* (RiWI Act).
Social surroundings	
EPA objective	*To protect social surroundings from significant harm.*
Policy and guidance	Environmental Factor Guideline – Social surrounding (2016k).
Potential impacts	Potential impact if there is an adverse impact, or reduction in access, to the Holland Track.
Mitigation	Avoid:
	The Holland track runs to the south and east of the Development Envelope and only intersect the Development Envelope at the southern end of the borefield road. As use of this road is intermittent and there is not conflict between mining operations and use of the track, the Proposal would not be affect access or amenity of the Holland Track.
	Minimise:
	N/A.
Outcomes	Residual Impact:
	N/A.

Element	Description
Air Quality	
EPA objective	*To maintain air quality and minimise emissions so that environmental values are protected.*
Policy and guidance	• Environmental Factor Guideline – Air Quality (2016j).
Potential impacts	• The primary source of greenhouse gas (GHG) emissions would be on site diesel generators with a combined maximum power output of 12 MW. In addition, there would also be a range of mobile fleet that would contribute greenhouse gas emissions. • GHG emissions are reported on in accordance with National Greenhouse and Energy Reporting Act 2007 (NGER Act). The NGER Act requires greenhouse gas emissions to be reviewed and reported annually.
Mitigation	Avoid:
	Review of electricity usage and the requirements to operate diesel generators on-site are ongoing. Opportunities to reduce the use of generators (i.e. potentially through the use of existing Western Power substation if possible).
	Minimise:
	The site has been designed to reduce GHG emissions as much as possible, including minimising haulage routes.
Outcomes	Residual Impact:
	The Proposal would not affect a significant impact on air quality values. The construction and operation of the diesel generators will require approval and licensing from DWER under Part V of the EP Act.

8. Offsets

Environmental offsets are actions that provide environmental benefits which counterbalance the Significant Residual Environmental Impacts or risks of a Proposal. In accordance with the WA Environmental Offsets Policy, EPBC Act Environmental Offsets Policy, Western Australian Government's Environmental Offsets Guideline (Government of Western Australia 2014) and EPBC Act Offsets Assessment Guide for use in determining offsets under the EPBC Act, (October 2012), offsets may be applied after other mitigation measures have been considered, as per the following hierarchy:

- Avoid;
- Minimise;
- Rehabilitate;
- Offset.

As noted in WA Environmental Offsets Guidelines, "Environmental offsets address significant environmental impacts that remain after on-site avoidance and mitigation measures have been undertaken. Environmental offsets will only be considered after strategies to avoid and mitigate significant environmental impacts have been applied." As such factors, all reasonable and feasible actions under the mitigation hierarchy should be considered to address residual significance prior to considering offsets. Significant Residual Impacts include those that:

- affect rare and endangered plants and animals (such as declared rare flora and threatened species that are protected by statute)
- areas within the formal conservation reserve system
- important environmental systems and species that are protected under international agreements (such as Ramsar listed wetlands)
- and areas that are already defined as being critically impacted in a cumulative context.

Covalent has considered all of these potential residual impacts and risks in the context of both State and Commonwealth values in defining offsets.

8.1 Significant Residual Impacts

At a regional level, the Proposal would result in clearing of a relatively small area of 392 ha within a bioregion which is almost fully vegetated (discussed in detail in Section 5.3.1) with the Proposal resulting in an increase of approximately 0.62% in clearing within the bioregion. The Proposal has been designed to, as much as possible, avoid clearing of native vegetation and associated loss of terrestrial fauna habitat. The design of the Proposal maximises the reuse of existing disturbance with approximately 40% of the Proposal located on previously disturbed areas (as shown in Figure 2-3). As the site is previously disturbed and substantially crossed by drill lines that have existed for over 20 years, additional fragmentation of habitats and cumulative impacts on faunal habitats are not considered residually significant.

The timescale for clearing, places more emphasis on existing disturbed areas, with the new mine pit and airstrip being the primary areas of native vegetation clearing in the early years of the proposal. Progressive clearing is anticipated to reach 270 ha by the 20-year mark of the project, as shown in Table 5-20, and would still be below 150 ha at the 10-year mark.

Section 5.3 assesses the Proposal impacts for the *Banksia sphaerocarpa* var. *dolichostyla* against the *Statement of Environmental Principles, Factors and Objectives* (EPA 2018) and it was determined that the Proposal is potentially a significant impact. The following provides an assessment of significance of impacts of the Proposal on *Banksia sphaerocarpa* var. *dolichostyla* against applicable matters listed in section 5 of the *Statement of Environmental Principles, Factors and Objectives* (EPA 2018):

(a) Values, sensitivity and quality of the environment which is likely to be impacted:

The Proposal will impact individuals of *Banksia sphaerocarpa* var. *dolichostyla*, listed as Threatened - Vulnerable under the BC Act and Vulnerable under the EPBC Act. Individuals in the Development Envelope are within the S3 vegetation community which is of an excellent condition. A total of 24,636 individuals have been recorded in the regional area.

(b) Extent (intensity, duration, magnitude and geographic footprint) of the likely impacts:

The Proposal has the potential to directly and indirectly impact on the regional population of *Banksia sphaerocarpa* var. *dolichostyla*. As noted in Sections 5.3.1 and 5.3.2, the direct and potential indirect impacts are 0.37% and 11.47% respectively on the known numbers of regional individuals. As noted in Section 5.4.1, a rehabilitation strategy (translocation and propagation) will be implemented with the objective of achieving no net loss of individuals within the known local population.

(c) Consequence of the likely impacts (or change):

This limited extent of clearing and proposed rehabilitation strategy are expected to evolve a limited and temporary loss of *Banksia sphaerocarpa* var. *dolichostyla* individuals at no more than 0.56% of the currently known local populations. The maximum potential indirect impacts are 17.12% of the currently known local population, however mitigation measures are expected to minimise potential indirect impacts.

This limited and temporary loss is not expected to pose a significant impact to the species. Given the extent of recorded occurrence of the individuals and the limited clearing proposed, the consequence is not expected to represent a significant impact to the species. The proportion of impact to the regional population is not considered significant.

Surveys associated with the Proposal have resulted in a significant increase in known individuals resulting in a low impact to population numbers from the Proposal. Given this, the Proposal is unlikely to significantly change the distribution, area of occupancy or cause a decline of the species. A rehabilitation strategy is proposed for any direct loss of individuals to achieve no net loss of individuals from the current locally known population.

(d) Resilience of the environment to cope with the impacts or change:

Clearing and potential indirect impacts to *Banksia sphaerocarpa* var. *dolichostyla* represents 17.68% of known local individuals with 82.32% of local individuals expected not to be impacted in any way. Resilience is associated with the scale of impact to the local population, with the species known to be an active recruiter and is expected to re-colonise (Mattiske 2018b).

(e) Cumulative impact with other existing or reasonably foreseeable activities, developments and land uses connections and interactions between parts of the environment to inform a holistic view of impacts to the whole environment:

As per Section 5.3.9, cumulative impacts to *Banksia sphaerocarpa* var. *dolichostyla* (11.85% total regional impact) are not expected to be significant given the additional five known regional records and the increase in individual records as a result of this Proposal. The regional records are widely distributed across bioregions and additional populations are considered likely to occur outside the Development Envelope.

The species were recorded in good condition and actively recruiting within the S3 vegetation community. The S3 vegetation community was in excellent condition and minimal evidence of weed invasion.

(f) Level of confidence in the prediction of impacts and the success of proposed mitigation:

There is a high level of confidence around the predicted impacts to *Banksia sphaerocarpa* var. *dolichostyla* and the proposed mitigation measures.

Field observations associated with the species indicates it is an active recruiter and is present adjacent to areas of previous disturbance. However, research into its resilience to potential indirect impact is lacking and uncertainty exists around the resilience potential for this species.

Uncertainty exists around the rehabilitation potential for this species and the success of the rehabilitation strategy. Whilst limited research has occurred on rehabilitation and translocation success, the field observations associated with the species indicates it is an active recruiter.

In summary, the clearing is expected to be limited and temporary due to the rehabilitation program and the extent of impact. However, some uncertainty exists with rehabilitation program success. Accordingly, there is a potential impact to the *Banksia sphaerocarpa* var. *dolichostyla* under the *Statement of Environmental Principles, Factors and Objectives* (EPA 2018).

An assessment of Significant Residual Impact using the Residual Impact Significance Model is shown in Table 8-1 for *Banksia sphaerocarpa* var. *dolichostyla,* Priority 1 flora species and fauna habitat.

Given *Banksia sphaerocarpa* var. *dolichostyla* is listed as a Threatened Species (Vulnerable), it is classified as a Significant Residual Impact according to the WA Environmental Offsets Guidelines (Government of Western Australia 2012). The impact to *Banksia sphaerocarpa* var. *dolichostyla* has been assessed as a potentially significant (under the EPA Guidelines 2018) due to the uncertainty associated with the effectiveness of the rehabilitation strategy. However, the scale of impact as discussed above does not justify an offset.

As presented in Table 8-1, under the WA Environmental Offsets Guidelines, Significant Residual Impacts have the potential to occur for Malleefowl and Chuditch due to loss of fauna habitat at a local level (392 ha). As discussed in Table 8-2, mitigation measures will be undertaken, however the scale of local impact is considered significant.

Direct impacts on Malleefowl breeding are avoided by prohibiting clearing of vegetation within 100 m of active Malleefowl mounds. The 100 m buffer for active Malleefowl mounds is considered industry standard associated with maintaining adequate surrounding vegetation and habitat and minimising indirect impacts (noise, dust and vibrations). The buffer distance is based on similar approved Malleefowl Management Plans and Ministerial Statements within similar vegetation associations.

After application of the mitigation hierarchy, potentially significant impacts on terrestrial fauna may still result from the proposal. Loss of fauna habitats through clearing reduces the availability of higher quality unburnt habitat in the local area for the life of the mine operation. Consequently, the Proponent is proposing the application of an offset for fauna habitat.

Table 8-1: Residual Impact Significance Model

Part IV Environmental Factors	**Vegetation and Flora**						
				Terrestrial Fauna			
Part V Clearing Principals	**Rare flora**	**Threatened ecological communities**	**Remnant vegetation**	**Wetlands & waterways**	**Conservation areas**	**High biological diversity**	**Habitat for fauna**
Residual impact that is environmentally unacceptable or cannot be offset							
Significant residual impacts that will require an offset – **All significant residual impacts to species and ecosystems protected by statute or where the cumulative impact is already at a critical level**	Clearing of up to 92 individual plants of the Threatened flora species *Banksia sphaerocarpa* var. *dolichostyla* (VU) may occur through the Proposal. The direct and potential indirect impacts to the estimated regional population are 0.37% and 11.47% respectively for a total impact of 11.85%. The mitigation measures discussed in Section 5.4 associated with the species are considered adequate to minimise impacts. These mitigating actions will reduce the potential for indirect impacts, therefore the potential indirect impacts (11.47% to regional population) are considered conservative maximums. The Proponent will aim to achieve no net loss to the currently known local population through rehabilitation and translocation (in addition to trials and research programs). Therefore, whilst the impact to a species protected by statute will occur, the scale of impact is considered to be insufficient to warrant an offset.						The proposal will have a Significant Residual Impact as it will result in the removal of 392 ha of native vegetation which is potential habitat for Malleefowl and Chuditch. Therefore, an offset is proposed.
Significant residual impacts that may require an offset – **Any significant residual impact to potentially threatened species and ecosystems, areas of high environmental value or where the cumulative impact may reach critical levels if not managed**	Clearing of up to 7,498 individual plants of *Microcorys* sp. Mt Holland (D. Angus DA 2397), Priority 1 species may occur through the Proposal. The residual impact is not considered to be significant as 18.07% of the regional population of *Microcorys* sp. Mt Holland (D. Angus DA 2397) will be impacted. An additional 3.68% is potentially indirectly impacted (1,525 individuals). This species is also considered to be a disturbance coloniser, and is likely to be easily germinated in rehabilitated areas. It is not expected that the impacts from this Proposal will increase its threat status, therefore no offsets are proposed.						
Residual impacts that are not significant	The following Priority 1 flora species are impacted by the Proposal: • *Acacia* sp. Mt Holland (B. Ellery BE1147) with 458 individuals directly impacted and 309 individuals indirectly impacted, respectively representing 0.42% and 0.28% of the regional population. The impact to the local populations is considered to not be significant. • *Labichea rossii* with 189 individuals directly impacted and no individuals indirectly impacted, representing 8.39% of the regional population and no indirect impacts. Regional populations are known to occur within the Southern Cross IBRA sub-region, therefore impacts are not considered to be significant.	No Threatened Ecological Communities (TEC) listed under the EPBC Act or BC Act, or Priority Ecological Communities PEC) listed by DBCA have been identified within the Proposal Area. The Development Envelope is situated wholly within the designated area for Ironcap Hills Vegetation Complexes, a Priority 3 ecological community. A qualitative review of species and vegetation communities observed within the Development Envelope as compared to the Ironcap Hills vegetation complexes defined by Thompson and Allen (2013) (Table 5-14). The comparison reveals a poor correlation between the identified vegetation communities, dominant vegetation types and representative species associated with Ironcap Hills Vegetation Complexes in addition to the lack of comparative landforms and geology associated with the PEC. Given this, it is considered that the Proposal is not of consequence in relation to the Ironcap Hills PEC.	The proposal would result in the Clearing of 392 ha of remnant vegetation. This will occur within a bioregion almost fully vegetated (discussed in detail in Section 5.3.1) and resulting in an increase of approximately 0.62% in clearing within the bioregion. The site is previously disturbed and substantially crossed by drill lines that have existed for over 20 years. Given this, additional fragmentation of habitats and cumulative impacts on faunal habitats are not considered residually significant.	There are no conservation significant wetlands within or in proximity to the Development Envelope. The 392ha of vegetation which will be cleared for the Proposal will not remove vegetation that is watercourse or wetland dependent.	There are no formal conservation reserves or areas under conservation covenant within or in close proximity to the Development Envelope. The closest conservation area to the Development Envelope (Jilbadji Nature Reserve) is located approximately 5km north.	The Proposal occurs within Southern Cross sub-region. This area is not recognised as a biodiversity hotspot.	

Table 8-2: WA Environmental Offsets Table

Existing Environment / Impact	Mitigation			Significant Residual Impact	Offset Calculation Methodology				
	Avoid / Minimise	Rehabilitation Type	Likely Rehabilitation Success		Type	Risk	Likely Offset Success	Time Lag	Offset Quantification
Clearing of up to 0.37% of the regional population (92 individuals of 24,636) of *Banksia sphaerocarpa* var. *dolichostyla*	Avoid • all populations of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) will have a 50 m buffer and development of new infrastructure within the buffer will be avoided if possible • avoid accidental clearing though implementation of an internal clearing permit procedure and preclearance surveys. • implement *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) specific measures that include avoidance, buffers and monitoring protocols Minimise • Impacts caused by dust due to vehicle movements by keeping roads and other areas well-watered. Dust suppression measures that include maintenance practices for vehicles, cleared areas, and active stockpiles. • All populations of *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA2397) within 50 m buffers adjacent to disturbed areas will be demarcated and signed as Conservation Significant Flora Exclusion Zones • Hypersaline water used for dust suppression will be applied to road surfaces by dribble bars and not allowed to overspray specifically where *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) is located adjacent to existing roads. • weeds through control measures that include vehicle hygiene procedures, stockpiling of on-site topsoil for reuse, and annual monitoring. • impacts due to uncontrolled fire through control of ignition sources, procedures and regional coordination on prescribed burns.	Rehabilitation studies and trials will be undertaken during operations to determine the most effective methodologies for rehabilitating and translocating individuals. The initial rehabilitation objective for the mine involves the no net loss of the currently known local population. Rehabilitation strategy includes: • *Banksia sphaerocarpa* var. *dolichostyla* seeds and/or cuttings will collected and stored appropriately for rehabilitation (where seed is present). *Banksia sphaerocarpa* var. *dolichostyla* will be considered as part of the plant mix for rehabilitation areas near existing populations. • rehabilitation trials and research programs (in consultation with DBCA and Kings Park and Botanical Gardens) will be undertaken to increase translocation and rehabilitation success. • Directly impacted individuals will be attempted to be translocated into an area of suitable habitat. • Rehabilitation of areas will occur to provide suitable habitat for *Banksia sphaerocarpa* var. *dolichostyla.* • Seeding of areas with suitable habitat within the Development Envelope with *Banksia sphaerocarpa* var. *dolichostyla* seeds will occur, • Monitoring of translocated individuals and rehabilitated areas will be undertaken.	Can the environmental values be rehabilitated? The field observations associated with the species indicates it is an active recruiter. However, uncertainty does exist for the effectiveness of the rehabilitation strategy, as research programs and rehabilitation trials have not occurred to date. What is the type of vegetation being rehabilitated? *Banksia sphaerocarpa* var. *dolichostyla* within the S3 vegetation community	Extent 0.37% of the regional population (92 individuals of 24,636) of *Banksia sphaerocarpa* var. *dolichostyla* Conservation Significance *Banksia sphaerocarpa* var. *dolichostyla* is both Vulnerable under BC Act and EPBC Act. According to the agreed significance framework, Significant Residual Impact is considered to be significant as the species is protected by statue and the uncertainty associated with the effectiveness of the rehabilitation strategy. However, no net loss of individuals from the currently known local population is proposed. In addition, the extent of impact to the regional population (0.37% direct impacts and a maximum of 11.47% potential indirect impacts) is not considered significant. Therefore, the scale of Significant Residual Impact is considered low and an offset is not proposed.	No offset is proposed.				

392 ha of terrestrial fauna habitat clearing	Avoid clearing of vegetation within 100 m of active Malleefowl mounds and accidental clearing of faunal habitat though implementation of an internal clearing permit procedure. avoid removal of active nest mounds during the operational life of the project. Ensure that a fauna specialist is present during clearing so that timely identification, avoidance, and relocation, can be undertaken if required. If trapped during clearing, Chuditch would be relocated into bushland adjacent to the Development Envelope before nightfall or within the same day. Implement traffic management measures including speed limits and driving restrictions at dusk and dawn to reduce potential vehicle strikes. Ensure dust suppression measures that include maintenance practices for vehicles, cleared areas, and active stockpiles are undertaken. Prevent entrapment of animals in all excavations (including steep–walled holes or trenches which are more than one meter deep) by securing against inadvertent animal entry at the close of each day or ensure that escape ramps are installed. Control feral predators (cats, wild dogs, foxes) by implementing local control measures.	Rehabilitation studies and trials will be undertaken during operations to determine the most effective methodologies for rehabilitating the different landforms used under the Project. The initial rehabilitation objective for the mine involves the reestablishment of native vegetation and fauna habitats.	Can the environmental values be rehabilitated? There are already a number of rehabilitated landforms present within the abandoned Mt Holland mine site, with varying degrees of rehabilitation success, these would be assessed to further refine rehabilitation designs of new landforms. What is the type of vegetation being rehabilitated? Mallee / woodland.	Extent 392 ha of potential habitat for Malleefowl and Chuditch. Quality 8 (out of 10) per the Commonwealth offset calculator. Conservation Significance Malleefowl and Chuditch are both Vulnerable under BC Act and EPBC Act. Land Tenure Mining Tenements. Time Scale 30 years. According to the agreed significance framework, residual impact is considered to be significant due to the impact to Malleefowl and Chuditch habitat.	Land acquis-ition and manage-ment.	Low Covalent is committed to providing funding to DBCA for the purchase and management of the offset. It is also expected that the offsets will be a condition of the Ministerial approval of the project.	High Land acquisition and management in the wheatbelt is well understood and has been previously implemented by DBCA as an offset for other proposals.	N/A.	Land connectivity activities would include: • Direct acquisition, purchase and management of up to 2,000 ha of land within the wheatbelt along the fringes of the GWW for the purpose of conservation and connectivity between wheatbelt fragments and the GWW. In the event that direct offsets are not 100% achievable NRM activities would include: • Working with the Wheatbelt NRM and/or Rangelands NRM to improve land management activities (fire or weed management) undertaken within the GWW. In the event that direct offsets are not 100% achievable research activities would include: • An indirect offset may be utilised to fund additional research by organisations, universities or other conservation bodies for the purpose of improving knowledge of the GWW and the conservation significant species/protected matters which occur in the area. Suitable research areas might include ◦ Chuditch population dynamics and genetics. ◦ Malleefowl population dynamics. ◦ Influence of fire management on Chuditch and Malleefowl. ◦ Influence of feral animal control on Chuditch and Malleefowl. ◦ The ratio of land protected compared to that cleared (4.8:1) was determined using the Commonwealth Calculator as a guide to provide a greater than 100% impact of offset (refer to Table 8-3).

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8.2 Offset Proposal

Covalent proposes to directly offset potentially significant residual impacts to Chuditch and Malleefowl through undertaking 100% land acquisition within the wheatbelt to connect remnant patches and provide better connectivity around the Great Western Woodlands (GWW). Consultation with DBCA is occurring regarding the final offset sites, however the site will be of equal or better value than the Proposal impact site. The final offset sites would be located within the regional area shown in Figure 8-1.

If direct offsets (land acquisition) is not 100% achievable, up to 10% of indirect offsets are proposed. This could involve assisting with activities completed by conservation and natural resource management groups and providing funding for research programs within the GWW that contribute to scientific knowledge resulting in better protection and proliferation of Chuditch and Malleefowl. These conservation and natural resource management activities could include supporting feral animal control programs, rehabilitation, fire management,, revegetation and weed management activities.

8.2.1 Offset calculation

The DoEE Offset calculator was used to provide an offset assessment guide (parameters) associated with the impact of the Proposal and the proposed offset sites. Offset calculator values used for potential Chuditch and Malleefowl habitat (breeding and foraging) offset sites are included in Table 8-3 and the calculator spreadsheet is included in Appendix 5.

Table 8-3: Assessment of environmental values associated with potential Offset sites

Site	Offset Parameter	Values used in calculator		Justification of value
		Chuditch Habitat	Malleefowl Habitat	
Impact site	Impact area (ha)	392	392	Additional clearing required for Proposal.
	Quality (out of 10)	8	8	The Proposal comprises of fauna habitat which is unburnt in an area with a historical fire history. Malleefowl breeding habitat is patchy and Chuditch breeding and foraging is likely throughout the Development Envelope. Feral animal predation is considered likely to occur based on fauna survey results. The proximity to a previously disturbed minesite may impact presence of feral animals and weeds.
Offset site	Offset area (ha)	1920	1920	
	Start quality (out of 10)	8	8	The proposed offset sites would need to comprise an area of high quality unburnt mallee woodland, salmon gum woodland and shrubland. The offset sites would provide a foraging and breeding resource for Malleefowl and Chuditch to surrounding areas. The proposed offset site is to be of equal or better value than the impact site (8).
	Future quality without offset (out of 10)	7	7	Quality of the offset sites may decline without any protection measures, resulting in a reduction of available foraging and breeding resources in the area. The decline could be associated with feral animal populations, weed introduction, clearing and impacts of fire.

Site	Offset Parameter	Values used in calculator		Justification of value
		Chuditch Habitat	Malleefowl Habitat	
	Future quality with offset (out of 10)	8	8	The quality of the offset sites could be maintained through feral animal control, weed management and fire management activities.
	Time over which loss is averted (max. 20 years)	20	20	It is recommended that the offset sites should be protected as a Conservation Reserve.
	Time until ecological benefit	1	1	Ecological benefit would be realised immediately as a direct offset would be provided.
	Risk of loss (%) without offset	20	20	There are no formal protection mechanisms or active conservation management (i.e. weed control, fire management and access management) at proposed offset sites. The proposed offset sites are located within highly cleared areas (agriculture and mining) adjacent to Nature Reserves at risk of future degradation, particularly from weed infestation and predation by feral animals.
	Risk of loss (%) with offset	5	5	Formal protection of the proposed offset sites will ensure that the risk of loss is minimised as much as possible. It is recommended that the proposed offset site would be included in Conservation Reserves. Ongoing conservation management (weed control, feral animal control, fire management and access management) will contribute to the protection of the proposed offset site condition.
	Confidence in result (%)	90	90	Protection mechanisms, once established, will provide a higher level of certainty that the proposed offset sites will be conserved.
Summary	% of impact offset	107	107	

The Offset calculator was completed on proposed offset sites in consultation with DBCA. These proposed offset sites are located in the Shire of Yilgarn and the Shire of Westonia, with both located adjacent to two nature reserves. Both were identified by DBCA after a review of conservation targets within the Eastern Wheatbelt to assist in conservation of threatened species. The proposed offset sites are considered to support habitat for both Malleefowl and Chuditch, with Malleefowl having been recorded within 2 km and Chuditch within 30 km of the sites. This indicates that the species occur in the area and are likely to use the proposed offset sites. The proposed offset sites contain remnant vegetation in a landscape that has a low representation of Conservation Reserves and high levels of fragmentation.

8.2.2 Offset strategy

The Proponent will continue to consult with DBCA regarding the selection of a final offset site, its purchase and management. The final offset site would be located in a position within the wheatbelt to connect remnant patches around the GWW and be of equal or better value than the impact site. The final offset site would be included in secure conservation tenure. This option is considered superior as it will provide a clear and measurable conservation outcome in the area for the Malleefowl and Chuditch. The wheatbelt region has been subject to extensive clearing and the provision of conservation tenure and ongoing management would benefit connectivity of faunal habitat in this area.

Land acquisition would have positive conservation outcomes targeting key factors where residual significance has been identified, contiguous with the GWW. Further consultation with relevant government department/s will be required to validate land acquisition in the wheatbelt and finalise the offset proposal.

Land connectivity activities would include:

- direct acquisition, purchase and management of up to 2,000 ha land (dependent on quality of final offset site) within the wheatbelt along the fringes of the GWW for the purpose of conservation and connectivity between wheatbelt fragments and the GWW. This would allow additional movement of fauna between larger reserves within the Wheatbelt and the GWW. The associated activities tie in to the work completed as part of the Gondwana Link Project further south carried out by Bush Heritage, Greening Australia and Gondwana Link with the aim of land connectivity from the south west to the GWW. This activity also aligns with the aims of the Malleefowl and Chuditch Recovery Plans by reducing isolated populations and improving animal movement along habitat corridors (Benshemesh, 2007; DEC, 2012). The selected offsite site would provide suitable Chuditch and Malleefowl breeding and foraging habitat.

Environmental assessments of the final offset site would be conducted to ensure it meets these requirements. Once the final offset site is selected, the Proponent will provide funding to DBCA to purchase the site. In the event the purchase is unsuccessful, consultation with DBCA will occur to determine suitable alternatives that meet the requirements of the offset strategy. The Proponent proposes to develop a Memorandum of Understanding with DBCA regarding the provision of funds for the purchase and ongoing management of the final offset site, including feral animal, weed and fire management activities. Ongoing consultation with DBCA will occur regarding this offset strategy.

In the event that direct offsets are not 100% achievable, up to 10% of indirect offsets may be required. Indirect offsets would include supporting conservation and natural resource management groups and research activities, as discussed below.

Natural resource management and conservation activities could include:

- working with the conservation and natural resource management groups to improve land management activities undertaken within the GWW for a period of 10 years. Covalent could support feral animal control programs and fire management activities with these groups, however would also consider supporting other land management activities, such as revegetation and weed management activities.

Research activities could include:

- an indirect offset to fund additional research by organisations, universities or other conservation bodies for the purpose of improving knowledge of the GWW and the conservation significant species/protected matters which occur in the area. Suitable research areas might include:
    - Chuditch population dynamics and genetics
    - Malleefowl population dynamics
    - Influence of fire management on Chuditch and Malleefowl
    - Influence of feral animal control on Chuditch and Malleefowl.

8.3 Predicted Outcome

The application of the proposed offset is anticipated to address residual significance and risk associated with the Proposal particularly in relation to significant fauna habitat. With all other aspects of the proposal manageable within the mitigation hierarchy, the predicted outcome is that remaining residual significance to State and Commonwealth Vulnerable species can be effectively managed through the application of the offset and address potentially significant residual impacts on habitat availability for significant fauna species during the life of the mine.

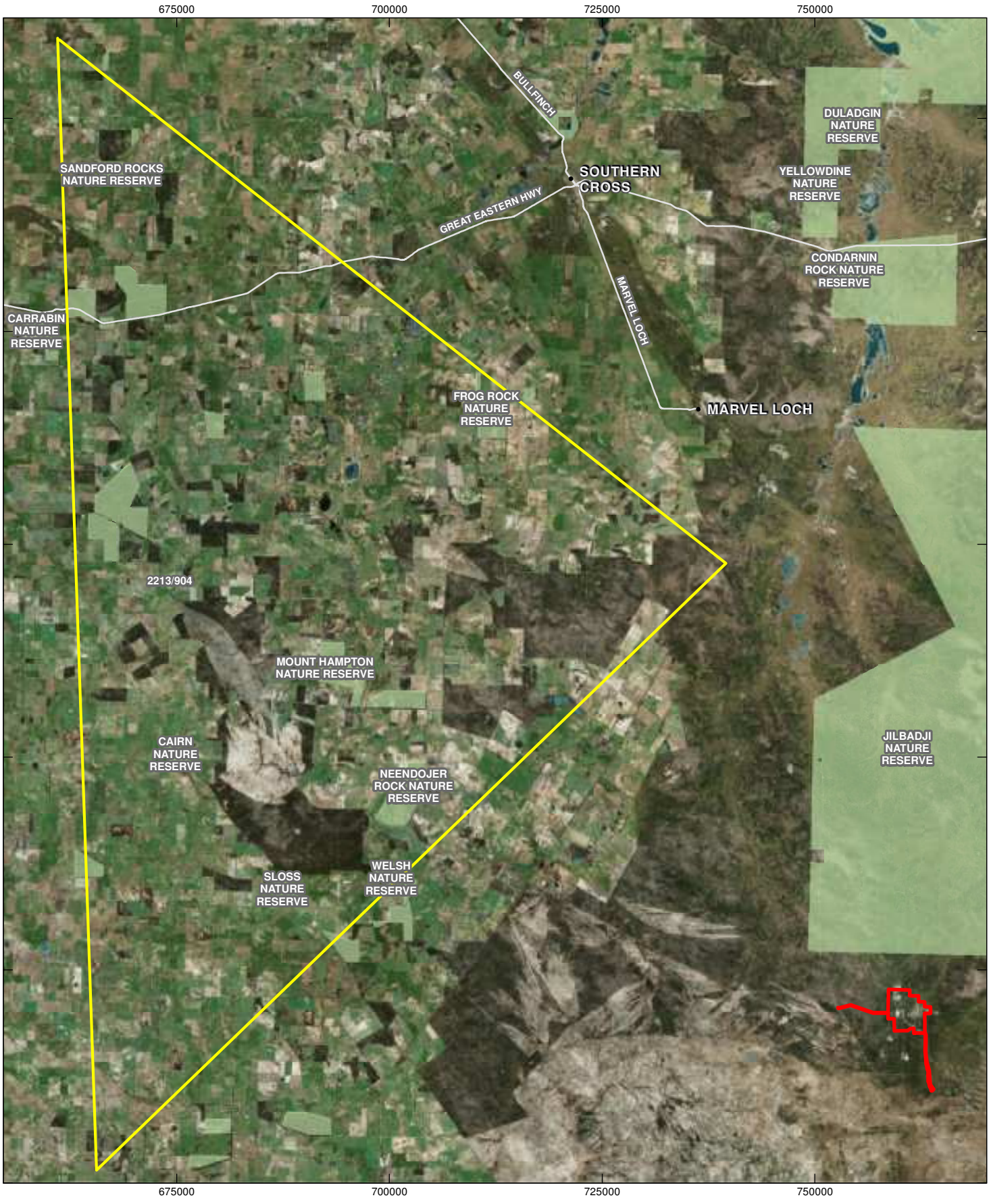

Figure 8-1: Proposed offset site locations

N

Scale 1:600,000 at A4

0 5 10 km

Coordinate System:
GDA 1994 MGA Zone 50

Date: 12/01/2019

Legend

- Regional offset selection area
- Development Envelope
- Nature reserve
- Roads

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Client: Earl Grey Mine. Created by: c.thatcher

9. Matters of National Environmental Significance

Approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) is required if a proposal is likely to have a significant impact on matters of national significance (MNES), as defined in the EPBC Act.

The Proposal was referred to the Commonwealth Department of Environment and Energy (DoEE) under the EPBC Act and received a 'Controlled Action' decision (2017/7950). The Proposal was also authorised to be assessed under the WA assessment process and is being assessed as an accredited assessment under section 87 of the EPBC Act. In line with this the PER addresses matters set out in Schedule 4 of the *Environment Protection and Biodiversity Conservation Regulations 2000.* This section summarises the key matters related to potential impacts on MNES, which have been addressed in more details in previous sections in the report.

The relevant MNES, all listed as vulnerable, for this Proposal are:

- Ironcaps Banksia (*Banksia sphaerocarpa* var. *dolichostyla*)
- Malleefowl (Leipoa ocellata)
- Chuditch (Dasyurus geoffroii).

Under the EPBC Act, in determining whether an action is likely to have a significant impact, it is necessary to take into account the nature and magnitude of potential impacts. In determining the nature and magnitude of an action's impacts, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of an important population
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- introduce disease that may cause the species to decline, or
- interfere substantially with the recovery of the species.

Evaluation of each species was considered against these significant impact criteria for vulnerable species as set out in the Significant Impact Guidelines 1.1 for Matters of National Environmental Significance (Government of Australia 2013).

9.1 Environmental record of the person proposing to take the action

Covalent (previously Western Australian Lithium Pty Ltd (WA Lithium)) is the managing entity for the purpose of a 50:50 joint venture between Kidman Resources Limited (Kidman) and Sociedad Quimica y Minera de Chile (SQM).

Kidman is an Australian Stock Exchange listed lithium developer. Kidman has exploration projects in the Northern Territory and New South Wales.

SQM is a global company involved in strategic industries for human development, such as specialty plant nutrition, lithium and derivatives, iodine and derivatives, industrial chemicals and potassium. Through its history of 50 years, SQM is an established company in the lithium, potassium nitrate, iodine and thermo-solar salts markets. SQM has 20 commercial offices, distributed over five continents with a presence in 115 countries.

Mr Mark Fones is the Chief Executive Officer for Covalent and was previously the SQM Finance Vice President and was appointed the CEO when Covalent was known as WA Lithium. Mr Fones has significant experience in business administration and previously held the role of Finance and Development Director at SQM China and other roles within SQM with responsibility for business development and planning.

There have been no proceedings actioned against Mr Fones or Covalent Lithium, no previous referrals have occurred under the EPBC Act and Covalent has not been responsible for undertaking an action referred under the EPBC Act.

The Proposal will be undertaken in accordance with the Covalent Lithium Environmental Policy as detailed in Appendix 6. Covalent recognises its responsibility in ensuring its activities, including the Proposal, are performed in an environmentally conscious manner, which includes:

- environmentally responsible business practises been identified, implemented and promoted
- a commitment to return the Proposal to a safe, stable, non-polluting, self-sustaining agreed end land use
- provision of training to all employees and contractors regarding environmental responsibilities
- Enhancing the understanding of the surrounding biodiversity and impact of the Proposal through monitoring programs
- the efficient use of resources to minimise waste
- complying with legal requirements and reporting on environmental performance to internal and external stakeholders
- continually assessing environmental risks and potential impacts of activities
- ensuring risk based objectives, targets and standards are established
- continuous improvement in environmental performance through development and achievement of key performance indicators
- communication and consultation with employees, contractors, the community, regulators and other relevant stakeholders
- a commitment to provide adequate and appropriate resources to achieve environmental goals and objectives
- alignment and maintenance of the Environmental Management System with ISO14001.

9.2 Ironcaps Banksia (Banksia sphaerocarpa var. dolichostyla)

9.2.1 Relevant policies and guidance

Ironcaps Banksia (*Banksia sphaerocarpa* var. *dolichostyla)* is listed as vulnerable under the EPBC Act. There is an approved Conservation Advice for the species pursuant to s266B of the EPBC Act (DoEE Species Profile and Threats Database) but no approved Recovery Plan.

The relevant policies and guidance includes:

- Department of the Environment, Water, Heritage and the Arts (2008). Approved Conservation Advice for *Banksia sphaerocarpa* var. *dolichostyla* (Ironcaps Banksia). Canberra: Department of the Environment, Water, Heritage and the Arts
- Department of Conservation and Land Management (2001). Western Australian Wildlife Management Program No. 30 Declared Rare and Poorly Known Flora in the Narrogin District. Narrogin: Department of Conservation and Land Management.

9.2.2 Existing environment

As described in Section 5.2.3, *Banksia sphaerocarpa* var. *dolichostyla* occurs between the Mt Holland and South Ironcap areas. Targeted surveys recorded 16,503 plants occurring locally in 18 populations within 2 km the Proposal. Within the Development Envelope, 5,220 plants have been recorded in seven populations, as outlined in Table 9-1.

Table 9-1: *Banksia sphaerocarpa* var. *dolichostyla* within the Proposed Layout, Development Envelope, and the local vicinity of the Proposal.

Location	Individual Plants	Populations	% direct impacts	% indirect impacts	Total % impacts	Notes
Region	24,636	7 recorded populations	0.37%	11.47%	11.85%	Estimated based on Table 5-8.
Locally occurring	22,586	18	0.41%	12.51%	12.92%	During targeted surveys, an additional 6,083 plants were estimated (using methodology detailed in Section 5.2.1) to be present in areas outside of the Development Envelope that could not be completely surveyed during the targeted survey program.
Within Targeted Survey Area	16,503	18	0.56%	17.12%	17.68%	Based on targeted surveys for *Banksia sphaerocarpa* var. *dolichostyla* in 2018 (Mattiske 2018b).
Within the Development Envelope	5,220	7	1.76%	54.14%	55.90%	Based on targeted surveys for *Banksia sphaerocarpa* var. *dolichostyla* across the entire Development Envelope in 2018 (Mattiske 2018b).
Within 50 m buffer of Proposed Layout[5] (indirect impacts)	2,826	6	Not applicable			Populations adjacent to the primary access road and the existing airstrip come within 50 m of the proposed layout. Majority of plants are in lower use areas of the Development Envelope, including the accommodation village, main access road, former airstrip being used for soil stockpiling and roads to the accommodation village. Five individuals are located within the 50 m buffer adjacent to the Waste Rock Dump, which is a high use area.
Within the Proposed Layout (direct impacts)	92	2	Not applicable			Individuals are located within Proposed Layout within accommodation village, former airstrip being used for soil stockpiling and access road. Further opportunities to avoid the 92 individuals still exist during final project design and attempts to avoid direct loss shall occur.

[5] Excludes 92 individuals within Proposed Layout.

9.2.3 Potential impacts, avoidance and mitigation

As described in Section 5.3, the Proposal has potential to impact *Banksia sphaerocarpa* var. *dolichostyla* Ironcaps through:

- direct loss of up to 92 individuals as a result of clearing
- potential indirect impacts of up to 2,826 individuals from operation of mine and support infrastructure, particularly from dust.

Flora surveys of the site have been used in the design of proposed facilities to ensure that direct impacts on *Banksia sphaerocarpa* var. *dolichostyla* have been avoided to the maximum extent practical. Based on the current design, the Proposal would result in direct impact to 92 *Banksia sphaerocarpa* var. *dolichostyla* individual plants.

Potential indirect impacts on *Banksia sphaerocarpa* var. *dolichostyla* would be minimized, however an additional 2,826 individual plants could be indirectly impacted. Decommissioning of the former airstrip and construction of a new airstrip away from known *Banksia sphaerocarpa* var. *dolichostyla* populations would minimize long term indirect impacts on the species.

In addition, the Proponent is committed to achieving no net loss of individuals of the currently known local population through rehabilitation, translocation and associated research and trials. Management actions to avoid and minimize indirect impacts are set out in Section 5.4 and the Flora Management Plan provided in Appendix 4.

9.2.4 Residual impacts and offsets

The Proposal has the potential to impact one Declared Rare Flora, *Banksia sphaerocarpa* var. *dolichostyla*.

The proposal would result in direct impact of less than 0.37% to the regional population (92 individuals of 24,636). Indirect impacts have the potential to impact individuals that are located within 50 m of Proposed Layout, with an additional potential indirect impact to 11.47% of the regional population (2,826 individuals of 24,636). Mitigating actions will reduce the potential for indirect impacts to this species, therefore this is considered a conservative maximum.

The Proposal has been designed to minimise direct impacts on remaining *Banksia sphaerocarpa* var. *dolichostyla* local population to the maximum extent practicable, however direct loss will occur. During the detailed design stage of the Proposal, further attempts to minimise direct loss to individuals shall be implemented. In the event of any direct loss of *Banksia sphaerocarpa* var. *dolichostyla individuals*, a rehabilitation strategy shall be implemented to achieve no net loss of individuals within the known local population (16,503 individuals). Whilst field observations have determined the species is a good candidate for rehabilitation, no research or trials have occurred to date, therefore uncertainty exists for the effectiveness of the rehabilitation strategy.

Overall, the Project is considered to pose a relatively low risk to *Banksia sphaerocarpa* var. *dolichostyla*, as a very small percentage of known individuals will be impacted by the Proposal and the number of plants surveyed outside of the Development Envelope is a significant percentage (68% or 11,283 individuals) of the total local population identified in targeted surveys.

Therefore, the Proposal has the potential to have a significant residual impact (due to the uncertainty associated with the effectiveness of the rehabilitation strategy) when considered against significant impact criteria for vulnerable species as described in the introduction to Section 5.6 and Section 9.2.5.

9.2.5 Assessment against the Significant Impact Criteria for Vulnerable species

lead to a long-term decrease in the size of an important population of a species

The currently known local population will have 92 individuals directly impacted as a result of the proposed action. This represents 0.37% of the regional population. An additional 2,826 individuals have the potential to be indirectly impacted by the proposed action representing 11.47% of the total regional populations. Management measures will be implemented (as detailed in the Flora Management Plan) to reduce the potential indirect impact of the proposed action. Any direct loss of individuals will result in rehabilitation and translocation attempts to achieve no net loss of individuals in the currently known local population (16,503). Whilst field observations have determined the species is a good candidate for rehabilitation, no research or trials have occurred to date, therefore uncertainty exists for the effectiveness of the rehabilitation strategy. Monitoring programs, with reference to trigger values and threshold values, will ensure corrective actions are implemented should impacts occur. Given the low level of direct impact to the species and management measures to reduce indirect impacts, in addition to the rehabilitation strategy, the proposed action is unlikely to lead to a long-term decrease in the size of the population.

(a) Reduce the area of occupancy of an important population:

The currently known local population extends over an area of approximately (2,207 ha). As a result of the proposed action, the spatial distribution of the species will not be reduced. Given this, the proposed action is unlikely to reduce the area of occupancy of the population.

(b) Fragment an existing important population into two or more populations:

The proposed action will directly impact 92 individual plants. This will occur within two separate sub-populations. The impacts to these individuals will not create a new gap of more than 60 m between remaining individuals. The potential indirect impacts to 2,826 individuals are restricted to areas less than 50 m in size and will not create a new gap of more than 230 m between remaining individuals. A maximum gap of 175 m within a population currently occurs due to previous disturbance. Given this, the proposed action will not fragment the Population.

(c) Adversely affect habitat critical to the survival of a species:

The vegetation community associated with *Banksia sphaerocarpa* var. *dolichostyla*, S3, has 12.7 ha mapped within the proposed action area. Outside of the proposed action area, the S3 community has been mapped over 93.3 ha. This represents habitat critical to the survival of the *Banksia sphaerocarpa* var. *dolichostyla*. The proposed action will clear 12% of the local (mapped) extent of the S3 community. Given 88% of potential *Banksia sphaerocarpa* var. *dolichostyla* habitat remains within the local area, the proposed action is unlikely to adversely affect habitat critical for its survival.

(d) Disrupt the breeding cycle of an important population:

The proposed direct impact of 92 individuals and 12.7 ha of habitat represents 0.537% of the regional population, and 12% of the known local habitat. The impacts to these individuals will not create a new gap of more than 60 m between remaining individuals. The potential indirect impacts to 2,826 individual plants is restricted to areas less than 50 m in size and will not create a new gap of more than 230 m between remaining individuals in an area with an existing gap of 175 m due to previous disturbance. Pollination is recorded to occur through bees, wasps and ants (Taylor & Hopper 1988). The proposed action is unlikely to prevent the pollination of individuals not subject to impacts. Given this, the proposed action is unlikely to disrupt the breeding cycle of an important population.

(e) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline:

The vegetation community associated with *Banksia sphaerocarpa* var. *dolichostyla*, S3, has 12.7 ha mapped within the proposed action area. Outside of the proposed action area, the S3 community has been mapped over 93.3 ha. This represents habitat critical to the survival of the *Banksia sphaerocarpa* var. *dolichostyla*. The proposed action will clear 12% of the local (mapped) extent of the S3 community. Given 88% of potential *Banksia sphaerocarpa* var. *dolichostyla* habitat remains within the local area, the proposed action is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

(f) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat:

Weed and hygiene management protocols will be implemented during the construction stage of the proposed action. This will reduce the risk of weed species invasion within the habitat of *Banksia sphaerocarpa* var. *dolichostyla*. The species habitat will also be demarcated to ensure unauthorised access to the habitat is prevented. This will ensure that harmful invasive species will not become established within the habitat.

(g) Introduce disease that may cause the species to decline:

The species is susceptible to Phytophthora sp. disease. While no recorded infection within currently known local populations exists, standard hygiene practices will be undertaken to prevent the introduction of this disease into the populations (Flora Management Plant). Given the controls to be implemented, the proposed action is unlikely to introduce disease that may cause the species to decline

(h) Interfere substantially with the recovery of the species:

There are no current or planned recovery plans for the species. The number of individuals plants recorded in the regional population is 24,636. This is greater than the previous total number of individuals known. The proposed direct impact of 92 individuals and 12.7 ha of habitat represents 0.37% of the regional population, and 12% of the known local habitat. Given this, the proposed action is unlikely to interfere substantially with the recovery of the species.

9.3 Malleefowl (Leipoa ocellata)

9.3.1 Relevant policies and guidance

Malleefowl (*Leipoa ocellata*) is listed as vulnerable under the EPBC Act. There is no approved Conservation Advice for the species pursuant to s266B of the EPBC Act. There is an approved National Recovery Plan for Malleefowl (Department for Environment and Heritage, South Australia, 2007).

The relevant policies and guidance includes:

- Benshemesh, J. (2007). National Recovery Plan for Malleefowl. Department for Environment and Heritage, South Australia.

9.3.2 Existing environment

As described in Section 6.2.4, Malleefowl occur broadly in the region. Malleefowl have been sited within the Development Envelope for the Proposal and local area. One active mound and three recently active mounds have been recorded in the Development Envelope and three recently active mounds were recorded outside of the Development Envelope.

Based on the ecology of the Malleefowl and the results of surveys, it is likely the Development Envelope contributes to supporting a small local population of birds at any given time. Malleefowl populations are likely to occur broadly across the bioregion with preference to areas not recently burned.

9.3.3 Potential impacts, avoidance and mitigation

The Proposal has potential to impact Malleefowl primarily through:

- direct loss of active mounds resulting from clearing
- clearing of up to 392 ha of potential foraging and breeding habitat
- potential incidental mortality from operational activities, particularly traffic.

Faunal surveys of the site have been used in the design of proposed facilities to avoid direct impacts on Malleefowl active mounds. Based on the current design and available survey information, the Proposal would not result in any direct loss of currently known, active Malleefowl mounds.

Management measures have also been proposed to avoid incidental mortalities of Malleefowl to the maximum extent practicable. Management actions to avoid indirect impacts are set out in Section 6.4 and a Fauna Management Plan provided at Appendix 4. Due to the compact nature of the indicative footprint and relatively small area of the Development Envelope, the risk of incidental mortalities to Malleefowl is considered not significant.

9.3.4 Residual impacts and offsets

Within the context of the Coolgardie vegetation region, the Proposal would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Malleefowl that are currently less than 1% cleared and have 17% protected for conservation within the Southern Cross Bioregion. Based on the current design and available survey information, the Proposal would not result in any direct loss of currently known, active Malleefowl mounds.

Management measures have also been proposed to avoid incidental mortalities of Malleefowl and Chuditch to the maximum extent practicable. Due to the compact nature of the indicative footprint and relatively small area of the Development Envelope, the risk of incidental mortalities to terrestrial fauna is considered not significant.

Potentially significant residual impacts associated with the loss of higher quality unburnt habitats used by Malleefowl would remain, even with the application of proposed mitigations.

A formal offset proposal is defined in Section 8, *Offsets*. Covalent proposes to offset potentially significant residual impacts to Malleefowl through undertaking land acquisition of up to 2,000 ha within the wheatbelt to connect remnant patches to the Great Western Woodlands (GWW), assisting with activities complete by Wheatbelt Natural Resource Management (NRM) and providing funding for research programs within the GWW.

9.3.5 Assessment against the Significant Impact Criteria for Vulnerable species

The population within the proposed layout is located within current known distribution of the species. No specific populations of Malleefowl can be described as being of greater importance than any other (Benshemesh 2007). As the population is unlikely to be a population that is necessary for a species' long term survival and recovery, the proposed action is unlikely to:

- lead to a long-term decrease in the size of an important population of the species
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- disrupt the breeding cycle of an important population. \

(a) Adversely affect habitat critical to the survival of a species:

The Proposed Action would result in clearing of a relatively small area of 392 ha of potential Malleefowl habitat. Malleefowl occur in a wide range of habitat types and habitat critical to the survival of the species is known only in broad terms (Benshemesh 2007). The potential habitat to be cleared by the Proposed Action is well represented locally and regionally with less than 1% cleared and 17% protected for conservation (within the Southern Cross Bioregion). Much of the vegetation to be cleared is previously disturbed and substantially crossed by drill lines that have existed for over 20 years. As such, the Proposed action is unlikely to significantly increase the fragmentation of fauna habitats. Given the large extent of habitat both locally and regionally, the proposed action is unlikely to adversely affect habitat critical to the survival of the species.

(b) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline:

The Proposed Action would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Malleefowl that are currently less than 1% cleared and have 17% protected for conservation within the Southern Cross Bioregion. Given this, the Proposed action is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

(c) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat:

The proposed action has the potential to increase the density of feral animals due to increased habitat fragmentation, clearing of native vegetation and attraction to rubbish tips from increased site personnel. The project will implement species feral control measures locally to reduced potential impacts from the development of the Proposal. These measures are detailed in the Fauna Management Plan (Appendix 4). Given these control measures, the proposed action is unlikely to result in invasive species that are harmful to a vulnerable species becoming established in the species' habitat.

(d) Introduce disease that may cause the species to decline:

There is no information on disease in wild Malleefowl populations although the species is susceptible to a range of common diseases in captive situations and may also be susceptible to exotic diseases (Benshemesh 2007). The proposed action has the potential to increase the density of feral animals due to increased habitat fragmentation, clearing of native vegetation and attraction to rubbish tips from increased site personnel. These could act as vectors for disease. The project will implement species feral control measures locally to reduced potential impacts from the development of the Proposal. Given this, the proposed action is unlikely to introduce disease that may cause the species to decline.

(e) Interfere substantially with the recovery of the species:

The Proposed Action would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Malleefowl that are currently less than 1% cleared and have 17% protected for conservation within the Southern Cross Bioregion. Much of the vegetation to be cleared is previously disturbed and substantially crossed by drill lines that have existed for over 20 years. As such, the Proposed action is unlikely to significantly increase the fragmentation of fauna habitats. Given this, the proposed action is unlikely to interfere substantially with the recovery of the species.

9.4 Chuditch (Dasyurus geoffroii)

9.4.1 Relevant policies and guidance

Chuditch (*Dasyurus geoffroii)* is listed as vulnerable under the EPBC Act. There is no approved Conservation Advice for the species pursuant to s266B of the EPBC Act. There is an approved National Recovery Plan for Chuditch (Department of Environment and Conservation (2012).

The relevant policies and guidance includes:

- Department of Environment and Conservation (2012). Chuditch (*Dasyurus geoffroii*) Recovery Plan. Wildlife Management Program No. 54. Department of Environment and Conservation, Perth, Western Australia.

9.4.2 Existing environment

As described in Section 6.2.4, Chuditch occur broadly in the region. 28 individual Chuditch were trapped (13 adults and 15 dispersing young), of which 23 were trapped within the Development Envelope.

Individuals are likely to have a core home range of 1,500 ha (males) or 300 ha (females), though they are likely to range even more widely and the core home–ranges are likely to overlap. Chuditch are likely to occur in all habitats in the locality of the Proposal, and may use hollow logs, burrows and old White–browed Babbler nests as den sites, as well as man–made structures such as rocky bund walls. There is nothing notable about the habitats of the Development Envelope compared to the general locality.

Based on the ecology of the Chuditch and the results of the surveys, it is likely the Development Envelope contributes to supporting a small local population of Chuditch at any given time. Chuditch populations are likely to occur broadly across the bioregion with preference to areas not recently burned.

9.4.3 Potential impacts, avoidance and mitigation

The Proposal has potential to impact Chuditch primarily through:

- direct loss of breeding habitat and burrows resulting from clearing
- clearing of up to 392 ha of potential foraging and breeding habitat
- potential incidental mortality from operational activities, particularly traffic.

The Proposal has been designed to minimise clearing to the maximum extent practicable by utilising existing disturbed areas where possible and backfilling the mine pit as far as practicable. The Proposal would result in clearing of a relatively small area of 392 ha within a bioregion which is almost fully vegetated, therefore having limited impact on Chuditch breeding and foraging habitat.

Management measures have also been proposed to avoid incidental mortalities of Chuditch to the maximum extent practicable. Management actions to avoid indirect impacts are set out in Section 6.4 and a Management Plan provided at Appendix 4. Due to the compact nature of the indicative footprint and relatively small area of the Development Envelope, the risk of incidental mortalities is considered not significant.

9.4.4 Residual impacts and offsets

Within the context of the Coolgardie vegetation region, the Proposal would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Chuditch and Malleefowl that are currently less than 1% cleared and have 17% protected for conservation within the Southern Cross Bioregion. Based on the current design and available survey information, the Proposal would result in minor impacts on Chuditch habitat, including potential breeding habitat.

Management measures have also been proposed to avoid incidental mortalities of Chuditch to the maximum extent practicable. Due to the compact nature of the indicative footprint and relatively small area of the Development Envelope, the risk of incidental mortalities to terrestrial fauna is considered not significant.

Potentially significant residual impacts associated with the loss of higher quality unburnt habitats used by both Chuditch would remain, even with the application of proposed mitigations. A formal offset proposal is defined in Section 8, *Offsets*. Covalent proposes to offset potentially significant residual impacts to Chuditch through undertaking land acquisition of up to 2,000 ha within the wheatbelt to connect remnant patches to the Great Western Woodlands (GWW), assisting with activities complete by Wheatbelt Natural Resource Management (NRM) and providing funding for research programs within the GWW.

9.4.5 Assessment against the Significant Impact Criteria for Vulnerable species

(a) Lead to a long-term decrease in the size of an important population of a species:

Within the Proposed Action area, 18 individual Chuditch were trapped during project surveys, 16 of which were within the Development Envelope. The population extends beyond the development envelope, and is likely to extend further to the east, south and north of the surveyed area. Direct impacts to Chuditch associated with clearing will be minimised through a pre-clearing capture and release program. The Proposed Action would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Chuditch that are currently less than 1% cleared and have 17% protected for conservation within the Southern Cross Bioregion. Given this, the proposed action is unlikely to lead to a long-term decrease in the size of an important population of this species.

(b) Reduce the area of occupancy of an important population:

The Population extends over an area of approximately 2,207 ha. Population densities are difficult to determine with available data. As such it is not possible to determine if the reduction of habitat will impact on the area of occupancy of the local population. Given this, the proposed action has the potential to reduce the area of occupancy of the local population.

(c) Fragment an existing important population into two or more populations:

The Population extends over an area of approximately 2,207 ha. The species is highly mobile. The proposed action is located within an area of contiguous vegetation. This ensures the proposed action will not remove connectivity within the population. Given this, the proposed action will not fragment the existing population into two or more populations.

(d) Adversely affect habitat critical to the survival of a species:

The proposed action will clear up to 392 ha of habitat that is considered critical to the survival of the Chuditch. Given this, the proposed action has the potential to adversely affect habitat critical to the survival of the species.

(e) Disrupt the breeding cycle of an important population:

The proposed action will involve staged vegetation clearing over a number of years. Chuditch mating occurs in late April to early July. Vegetation clearing during this period will be minimised as much as practicable to reduce impacts on the breeding cycle of this species. Given this, the proposed action is unlikely to disrupt the breeding cycle of an important population.

(f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline:

The Proposed Action would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Chuditch that are currently less than 1% cleared and have 17% protected for conservation within the Southern Cross Bioregion. Given this, the Proposed action is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

(g) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat:

The proposed action has the potential to increase the density of feral animals due to increased habitat fragmentation, clearing of native vegetation and attraction to rubbish tips from increased site personnel. The project will implement species feral control measures locally to reduced potential impacts from the development of the Proposal. These measures are detailed in the Fauna Management Plan (Appendix 4). Given these control measures, the proposed action is unlikely to result in invasive species that are harmful to a vulnerable species becoming established in the species habitat.

(h) Introduce disease that may cause the species to decline:

There is no information on disease in wild Chuditch populations although the species may be susceptible to a range of common and exotic diseases. The proposed action has the potential to increase the density of feral animals due to increased habitat fragmentation, clearing of native vegetation and attraction to rubbish tips from increased site personnel. These could act as vectors for disease. The project will implement species feral control measures locally to reduced potential impacts from the development of the Proposal. Given this, the proposed action is unlikely to introduce disease that may cause the species to decline.

(i) Interfere substantially with the recovery of the species:

The Proposed Action would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Chuditch that are currently less than 1% cleared and have 17% protected for conservation within the Southern Cross Bioregion. Much of the vegetation to be cleared is previously disturbed and substantially crossed by drill lines that have existed for over 20 years. As such, the Proposed action is unlikely to significantly increase the fragmentation of fauna habitats. Given this, the proposed action is unlikely to interfere substantially with the recovery of the species.

9.5 Economic and Social Matters

The Proposal is expected to provide economic and social benefits to the Western Australian community and economy.

The Proponent will consult with any future Native Title Claimants and the Goldfields Land and Sea Council Ranger Program, to ensure sustainable operations in alignment with stakeholder expectations. It is hoped the Ranger Program will identify opportunities to collaboratively deliver rehabilitation programs and landscape scale conservations programs. In addition, contract services, local employment and participation in local and regional education and conservation programs is planned. These initiatives will benefit the local community which includes the town of Southern Cross.

Economic benefits shall be contributed through construction and operational activities. The Proposal is the third largest hard rock lithium deposit globally with a modelled 40 year life of mine. Opportunities for residential employment and local contracting services will be investigated, supplemented by a fly-in, fly-out workforce. Approximately 700 full time equivalent jobs are expected during construction and approximately 300 full time equivalent jobs during operations. Significant royalties will be paid to the Western Australia Government over the life of project.

In addition to the Proposal, a lithium hydroxide refinery is planned in Kwinana which will contribute further economic and social benefits.

The Proponent will continue to develop an economic and social strategy with key stakeholders.

10. Holistic impact assessment

The Proposal has been designed to, as much as possible, avoid clearing of native vegetation and associated loss of terrestrial fauna habitat. The design of the Proposal maximises the reuse of existing disturbance with approximately 40% of the Proposal located on previously disturbed areas (as shown in Figure 2-3). As the site is previously disturbed and substantially crossed by drill lines that have existed for over 20 years, additional fragmentation of habitats and cumulative impacts on faunal habitats are not considered residually significant.

The timescale for clearing places more emphasis on existing disturbed areas in the early years of work, with the new mine pit and airstrip being the primary areas of native vegetation clearing in the early years of the proposal. Progressive clearing is anticipated to reach 270 ha by the 20-year mark of the project, as shown in Table 5-20, and would still be below 150 ha at the 10-year mark. This slow and relatively minor clearing progression on local habitat in the context of greater than 98% of regional vegetation remaining and local conservation areas such as Jilbadji Nature Reserve less than 5 km north of the Development Envelope ensures that overall habitat impacts are not residually significant in the regional context.

Survey work has been used to identify and confirm the range and condition of the environmental factors within and surrounding the Proposal Development Envelope. Based on the survey work, the Proposal has been further re-designed to minimise impacts to Malleefowl, Chuditch and *Banksia sphaerocarpa* var. *dolichostyla* and other conservation significant flora species. Further, the Proposal would not substantially reduce the extent of any vegetation type or habitat within the Southern Cross area. The regional impacts to *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA2397) are not considered to be significant, particularly when the management mitigation actions are taken into account. Whilst the *Banksia sphaerocarpa* var. *dolichostyla* has been determined a good candidate for rehabilitation, no research or trials have occurred to date, therefore uncertainty exists for the effectiveness of the rehabilitation strategy and the achievement of no net loss of *Banksia sphaerocarpa* var. *dolichostyla* individuals to the known local population.

The Proposal can be implemented without significant impacts on the health, diversity or productivity of the environment. With the application of the environmental management plans the Proposal would avoid or minimise impacts on identified environmental values.

The application of the proposed offset is anticipated to address the potential for Significant Residual Impacts associated with the Proposal particularly in relation to significant fauna habitat impacted. With all other aspects of the Proposal manageable within the mitigation hierarchy, the predicted outcome is that remaining residual significance to State and Commonwealth Vulnerable species can be effectively managed. Management will occur through the application of the offset and address potentially Significant Residual Impacts on habitat availability for significant fauna species during the life of the mine. Whilst the impacts to *Banksia sphaerocarpa* var. *dolichostyla* have been determined as a Significant Residual Impact, the scale of the impact is such that an offset is not proposed.

Overall, the Project is considered to pose a relatively low risk to significant fauna and flora species and offers environmental gains associated with rehabilitation of historic disturbance, contribution of knowledge on the species through implementation of monitoring programs, and opportunities to enhance conservation efforts through feral animal monitoring and control.

Stakeholder engagement has been undertaken throughout planning for the Proposal (see Table 3-2). Consultation will continue to develop as the Proposal progresses into the detailed design, construction and operational phases of the Proposal.

'Key' and 'other' environmental factors have been considered against EPA objectives and relevant guidelines. The key environmental factors, impacts of the Proposal, and mitigation actions to address potential residual impacts are summarised in Table 10-1. Based on the mitigation measures proposed and the continuation of existing management measures, the Proposal is considered to meet the EPAs objective for each environmental factor.

Table 10-1: Assessment of preliminary key environmental factors.

Flora and vegetation - To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Context The Development Envelope is located in the Southern Cross subregion of the Coolgardie IBRA Bioregion (Figure 2-5). The bioregion is characterised by subdued relief, comprising gently undulating uplands dissected by broad valleys with bands of low greenstone hills and numerous saline playa lakes. The vegetation is dominated by Eucalyptus woodlands, shrublands of *Allocasuarina* and *Acacia*, and mixed heath of *Melaleuca* and *Acacia*. The Coolgardie Bioregion within which the Proposal is located is also largely geographically congruent with the boundary of the Great Western Woodlands. The Development Envelope is situated within the designated area and buffer for Ironcap Hills Vegetation Complexes (Mt Holland, Middle, North and South Ironcap Hills, Digger Rock and Hatter Hill) (banded ironstone), a Priority 3 ecological community. Key Survey Findings Extensive flora and vegetation surveys of the Development Envelope were conducted in 2016 to 2018. Twenty-six local vegetation communities were identified in surveys of the vicinity of the Proposal, as listed in Table 5 4. Of these, twenty-three communities were identified within the Development Envelope. 10 significant taxa have been recorded in the Development Envelope (Mattiske 2017a, Blueprint 2017, Mattiske 2018b, Mattiske 2018d). Of those surveyed, 16,503 individual records of *Banksia sphaerocarpa* var. *dolichostyla* were recorded during targeted surveys. 8,353 *Microcorys* sp. Mt Holland (D. Angus DA 2397) individuals were recorded and the currently known local population estimated at 41,492 individuals. 2,343 *Acacia* sp. Mt Holland (B. Ellery BE1147) individuals were recorded and the currently known local population estimated at 109,426 individuals. 212 *Labichea rossii* individuals were recorded and the currently known local population estimated at 2,254 individuals. 21 *Acacia undosa* individuals were recorded and the currently known local population estimated at 265 individuals. 225 *Hakea pendens* individuals were recorded. No banded ironstone formations or vegetation associated with such formations was identified during surveys of the Development Envelope and surrounding areas. Potential impacts The Proposal may have the following effects: • Direct loss of flora and native vegetation due to clearing. • indirect impacts on flora and vegetation from operation of mine and support infrastructure. • dust deposition on vegetation from mining and related activities. • impact to flora and vegetation from overspray of hypersaline water used for dust suppression. • impact to flora and vegetation from spillage of tailings, hypersaline water and hydrocarbons. • changes to vegetation structure and composition through altered surface drainage flow patterns.	Avoidance: • A 50 m protective buffer for the remaining individuals will be implemented. • Avoid accidental clearing though implementation of an internal clearing permit procedure and preclearance surveys. • Implement *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) specific measures that include avoidance, buffers, and monitoring protocols. Minimisation: • Dust suppression measures that include maintenance practices for vehicles, cleared areas, and active stockpiles. • Implement *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) specific measures that include use of dribble bars in roadway dust suppression, construction of earthen bunds on road sides and implementation of demarcated buffers adjacent to disturbed areas. • Weed control measures that include vehicle hygiene procedures, stockpiling of on-site topsoil for reuse, and annual monitoring. • Implementation of fire management procedures and regional coordination on prescribed burns. Rehabilitate: • *Banksia sphaerocarpa* var. *dolichostyla* seeds and/or cuttings will collected and stored appropriately for rehabilitation (where seed is present). *Banksia sphaerocarpa* var. *dolichostyla* will be considered as part of the plant mix for rehabilitation areas near existing populations.	A requirement to maintain an approved Environmental Management Plan (EMP) covering significant flora and *Banksia sphaerocarpa* var. *dolichostyla*. This EMP will specify the methods, procedures and management to avoid and minimise the impacts on vegetation and flora. Outcomes: • No more than 0.56% of the known population (equates to 92 of 16,503 individuals) of *Banksia sphaerocarpa* var. *dolichostyla* or 18.07% or 18.017% of the known population (equates to 7,498 of 41,492 individuals) of *Microcorys* sp. Mt Holland (D. Angus DA 2397) directly impacted from clearing. • No more than 392 ha of native vegetation to be cleared within the Development Envelope. • No more than 50% mortality of *Banksia sphaerocarpa* var. *dolichostyla* or *Microcorys* sp. Mt Holland (D. Angus DA 2397) from indirect impacts that is statistically different from changes observed at analogue sites. • No unauthorised clearing of native vegetation. • No unauthorised clearing of native vegetation, *Banksia sphaerocarpa* var. *dolichostyla* or *Microcorys* sp. Mt Holland (D. Angus DA 2397). • No reduction in health of *Banksia sphaerocarpa* var. *dolichostyla* or *Microcorys* sp. Mt Holland (D. Angus DA 2397) that is statistically different from analogue measurements. • Avoid incidence and minimise intensity of accidental spill events. • Minimise new weeds introduced to site. • Prevent fires attributed to mining and associated Project activities. Assessment against EPA objective: The Proposal has the potential to impact one Declared Rare Flora, *Banksia sphaerocarpa* var. *dolichostyla*. The proposal would result in direct impact of less than 0.56% to the currently known local population (92 individuals of the currently known local population of 16,503). Indirect impacts have the potential to impact individuals that are located within 50 m of Proposed Layout, with an additional indirect impact to 17.12% of the currently known local population (2,826 individuals of the currently known local population of 16,503). Mitigating actions will reduce the potential for indirect impacts to this species. The Proposal has the potential to impact nine Priority Flora species, with the most significant risk to *Microcorys* sp. Mt Holland

• spread of weeds and alteration of fire regimes.	• rehabilitation trials and research programs (in consultation with DBCA and Kings Park and Botanical Gardens) will be undertaken to increase translocation and rehabilitation success. • Directly impacted individuals will be attempted to be translocated into an area of suitable soils. • Rehabilitation of areas will occur to provide suitable habitat for *Banksia sphaerocarpa* var. *dolichostyla.* • Seeding of areas with suitable soils within the Development Envelope with *Banksia sphaerocarpa* var. *dolichostyla* seeds will occur. • Monitoring of translocated individuals and rehabilitated areas will be undertaken.	(D. Angus DA 2397). The Proposal potentially directly impacts 18.07% of the currently known population of *Microcorys* sp. Mt Holland (D. Angus DA 2397) and has the potential to indirectly impact on 3.68%. Mitigating actions will reduce the potential for indirect impacts, therefore the potential indirect impacts are considered conservative maximums. The Proposal has been designed to minimise direct impacts on remaining *Banksia sphaerocarpa* var. *dolichostyla* local population to the maximum extent practicable, however direct loss will occur. During the detailed design stage of the Proposal, further attempts to minimise direct loss to individuals shall be implemented. Any direct loss of individuals will result in rehabilitation and translocation attempts to achieve no net loss of individuals in the currently known local population (16,503). Indirect impacts on *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) would be avoided through the placement of new infrastructure away from the existing populations and the management of driving to facilities within 50 m of existing individuals. It is therefore not expected that the Proposal would have any significant residual impacts on flora and vegetation. Cumulative impacts are expected to be low for *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397) due to the potential for additional populations outside the Development Envelope and low pressures to the species as discussed in Section 5.3.9. Overall, the Project is considered to pose a relatively low risk to *Banksia sphaerocarpa* var. *dolichostyla* and *Microcorys* sp. Mt Holland (D. Angus DA 2397), as less than 0.56% and 18.07% respectively of the currently known local population would be directly impacted by the proposed action. Given the size and extent of the local population outside of the Development Envelope and the mitigation measures, the Proposal is not expected to cause significant impact to flora and vegetation. However, uncertainty exists for the rehabilitation strategy proposed for the *Banksia sphaerocarpa* var. *dolichostyla* (if required) to achieve no net loss of individuals from the currently known local population (16,503 individuals). Whilst field observations have determined the species is a good candidate for rehabilitation, no research or trials have occurred to date, therefore uncertainty exists for effectiveness of the rehabilitation strategy and this presents a potential for significant impacts. Accordingly, it is expected that the Proposal will meet the EPA's objective for the flora and vegetation factor based on the mitigation measures and scale of impact, however there is the potential for significant impacts to the *Banksia sphaerocarpa* var. *dolichostyla* due to uncertainty associated with the rehabilitation program effectiveness.

Terrestrial fauna - *To protect terrestrial fauna so that biological diversity and ecological integrity are maintained*		
Context Three broad fauna habitats were identified across the Development Envelope: • Mallee woodland (with patches of shrubland). • Open woodland. • Shrubland. These habitats were also represented in the Regional study area, along with additional habitats such as sandplain. Habitats that are uncommon in the Bioregion, such as granite outcrops, salt lakes or freshwater wetlands, were absent from the study areas. The habitats identified in the study areas are regionally important, in that they form part of the Great Western Woodlands, a 16 million hectare area of woodlands of which a key feature is its relative intactness. On a local scale, unburnt habitats in the study area are important refuges for fauna in a landscape that has been subject to widespread fires. Key survey findings Habitat for Chuditch (*Dasyurus geoffroii*) and Malleefowl (*Leipoa ocellata*) listed as Vulnerable (EPBC Act, BC Act) identified within the Development Envelope. Malleefowl was sighted and active mounds were recorded in the Development Envelope during 2016/2017 surveys. In 2016 surveys, 18 individual Chuditch were trapped (ten adults and eight dispersing young) and Chuditch were recorded on 44 of the 101 camera trap locations showing a preference for unburnt habitats. In 2017 surveys, 10 individual Chuditch were trapped (three adults and seven dispersing young) and Chuditch were recorded on 52 of the 136 camera trap locations. Both species were observed both within and outside of the Development Envelope. Significant parts of the regional study area were recently burnt prior to the time of surveys. Potential SRE species are likely to be widespread, but current records are insufficient to accurately predict their distributions. No listed invertebrate species has been recorded in the search area and it is highly unlikely that any occur. Potential impacts • Further loss and fragmentation of habitat from vegetation clearing. • Death, injury and displacement from construction and mining operations, vehicle strikes and changed fire regimes. • Increased feral fauna from increased access into areas from new tracks and roads, and attraction to rubbish tips. • Secondary impact from dust, noise and vibration during construction and mining operations.	Avoidance: • Avoid clearing of vegetation within 100 m of active Malleefowl mounds and accidental clearing of faunal habitat though implementation of an internal clearing permit procedure. • Avoid removal of active nest mounds during the operational life of the project. Minimisation: • Fauna specialist present during clearing to ensure timely identification, avoidance, and relocation, if necessary. • Chuditch relocation into bushland adjacent to the Development Envelope before nightfall or within the same day. • Traffic management measures including speed limits and driving restrictions at dusk and dawn. • Dust suppression measures that include maintenance practices for vehicles, cleared areas, and active stockpiles. • To prevent entrapment of animals, all excavations, steep–walled holes or trenches more than one meter deep will be secured against animal entry at the close of each day or escape ramps will be installed. • Feral species control measures. Rehabilitate: • If Malleefowl eggs are present and the mound is essential for removal, then with the approval of DBCA, eggs may be removed and incubated in a place approved by DBCA (e.g. Perth Zoo, Yongergnow Malleefowl Centre) with hatched chicks to be released on site unless otherwise approved by DBCA. • If a target is exceeded, the proponent will contribute to regional recovery programs or other offsets in consultation with DBCA.	A requirement to maintain an approved Environmental Management Plan (EMP). This EMP will specify the methods, procedures and management to avoid and minimise the impacts on terrestrial fauna. Outcomes: • Avoid clearing of vegetation within 100 m of active Malleefowl mounds. • Total vegetation clearing not to exceed 392 ha within Development Envelope. • Avoid removal of any active nest mounds. • Minimise mortality of Malleefowl or Chuditch from clearing activity, entrapment, vehicle strike or mining related fire. • Minimise decline in population health due to predation from feral fauna. • Minimise decline in population health due to dust, noise, light, vibration and displacement. • Minimise decline in fauna habitat condition due to dust or change fire regime. Assessment against EPA objective At a regional level, the Proposal would result in clearing of a relatively small area of 392 ha, impacting regional vegetation associations providing faunal habitat for Chuditch and Malleefowl that currently have less than 1% cleared and have 17% protected for conservation. The Proposal has the potential to affect two vulnerable species, Malleefowl and Chuditch, at a local scale. The Proposal has the potential to affect the size and viability of the local Malleefowl and Chuditch populations principally through disturbance of breeding habitat and potential incidental mortality from operational activities, particularly traffic movement. Based on the current design and available survey information, the Proposal would not result in any direct loss of currently known, active Malleefowl mounds. Given the presence of suitable fauna habitat throughout site significant, minor impacts on Chuditch breeding habitat and breeding habitat for other terrestrial fauna assemblages is anticipated. Management measures have also been proposed to avoid incidental mortalities of Malleefowl and Chuditch to the maximum extent practicable. Due to the compact nature of the indicative footprint and relatively small area of the Development Envelope, the risk of incidental mortalities to terrestrial fauna is considered not significant. Once the mitigation measures and offset are taken into account, it is expected that the Proposal will meet the EPA's objective for the terrestrial fauna factor.

		As discussed in Section 8.1, Significant Residual Impacts are anticipated for Chuditch and Malleefowl fauna habitat impacts, therefore an offset is proposed. An offset proposal is defined in Section 8, *Offsets*. Covalent proposes to offset potentially Significant Residual Impacts through DBCA consultation to undertake land acquisition and management of up to 2,000 ha of similar or better quality land.

11. Acronyms and short titles

Abbreviation	Full Description
BC Act	*Biodiversity Conservation Act 2016*
CAR	Compliance Assessment Report
DAA	Department of Aboriginal Affairs
DAFWA	Department of Agriculture and Food Western Australia
DER	Department of Environment Regulation
DFES	Department of Fire and Emergency Services
DMP	Department of Mines and Petroleum
DMS	Dense Media Separation
DoEE	Department of the Environment and Energy
DoH	Department of Health
DoW	Department of Water
DBCA	Department of Parks and Wildlife
DWER	Department of Water and Environment Regulation
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERD	Environmental Review Document
ESA	Environmentally Sensitive Area
ESD	Environmental Scoping Document
GWW	Great Western Woodlands
IBRA	Interim Biogeographic Regionalisation for Australia
IWL	Integrated Waste Landform
LGA	Local Government Agency
LCM	Loose Cubic Metres
LOM	Life of Mine
MCMPR	Ministerial Council on Mineral and Petroleum Resources
MCP	Mine Closure Plan
Mining Act	*Mining Act 1978*
MRF	Mining Rehabilitation Fund
MRWA	Main Roads Western Australia
NAF	Non-acid forming
NVS	Native Vegetation Solutions
OEPA	Office of the Environmental Protection Authority
PAF	Potentially acid forming
PER	Preliminary Environmental Review
RIWI Act	*Rights in Water and Irrigation Act 1914*
ROM	Run of Mine
TSF	Tailings Storage Facility
WRD	Waste Rock Dump

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