chalice

The Gonneville Project

Environmental Referral Supporting Document

March 2024

Disclaimer and Limitation

This report has been prepared by Chalice Mining Limited (Chalice) (the Proponent), specifically for the Gonneville Nickel-Copper-Platinum Group Element (PGE) Project. Neither the report nor its content may be referred to without the express approval of Chalice, unless the report has been released for referral and assessment of proposals.

Table of Contents

Tables

Figures

Abbreviations and Glossary

Abbreviation	Description
AC	Aboriginal Corporation
AH Act	*Aboriginal Heritage Act 1972*
BC Act	*Biodiversity Conservation Act 2016*
Chalice	Chalice Mining Limited (Proponent)
CHMP	Cultural Heritage Management Plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety
DG Safety Act	Dangerous Goods Safety Act 2004
DMAs	Decision Making Authorities
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DPP	Declared Plant Pests
DWER	Department of Water and Environmental Regulation
EP Act	*Environment Protection Act 1986* (WA)
EPA	Environmental Protection Authority
EPA Services	Environmental Protection Authority Services - division within the DWER
EPBC Act	*Environment Protection and Biodiversity Protection Act 1999* (Cth)
ERD	Environmental Review Document
FRTBC	Forest Red-Tailed Black Cockatoo
FY	Financial Year
GDV	Groundwater Dependent Vegetation
GHG	Greenhouse Gas
GL	Gigalitres
Gonneville Project	Gonneville Nickel-Copper-Platinum Group Element (PGE) Project
IBRA	Interim Biogeographic Regionalisation of Australia
IDE	Infrastructure Development Envelope
ILUA	Indigenous Land Use Agreement

Abbreviation	Description
IPCC	Intergovernmental Panel on Climate Change
JSF	Julimar State Forest
kL	Kilolitres
LCA	Life Cycle Analysis
LGA	Local Government Area
MCP	Mine Closure Plan
MDE	Mine Development Envelope
Mining Act	Mining Act 1978 (WA)
MNES	Matters of National Environmental Significance
MOU	Memorandum of Understanding
Mtpa	Million tonnes per annum
NJF	Northern Jarrah Forest
NSHA	Noongar Standard Heritage Agreement
NVCP	Native Vegetation Clearing Permit
NVIS	Native Vegetation Information System
P1 - P4	Priority status under BC Act/DBCA status
PEC	Priority Ecological Community
PER	Public Environmental Review
PFS	Prefeasibility Study
PGE	Platinum Group Element
PMST	Protected Matters Search Tool
POW	Program of Work
SCP	Swan Coastal Plain
SRE	Short Range Endemic
State	State of Western Australia
SWIS	South West Interconnected System
TCFD	Taskforce on Climate-related Financial Disclosures
TEC	Threatened Ecological Community
WA	Western Australia
WABSI	Western Australian Biodiversity Science Institute
Whadjuk AC	Whadjuk Aboriginal Corporation
WoNS	Weeds of National Significance

1. Introduction

Chalice Mining Limited (Chalice), through its wholly owned subsidiary, CGM (WA) Pty Ltd is the 100% owner of the Gonneville Nickel-Copper-Platinum Group Element (PGE) Project (Gonneville Project, the Proposal).

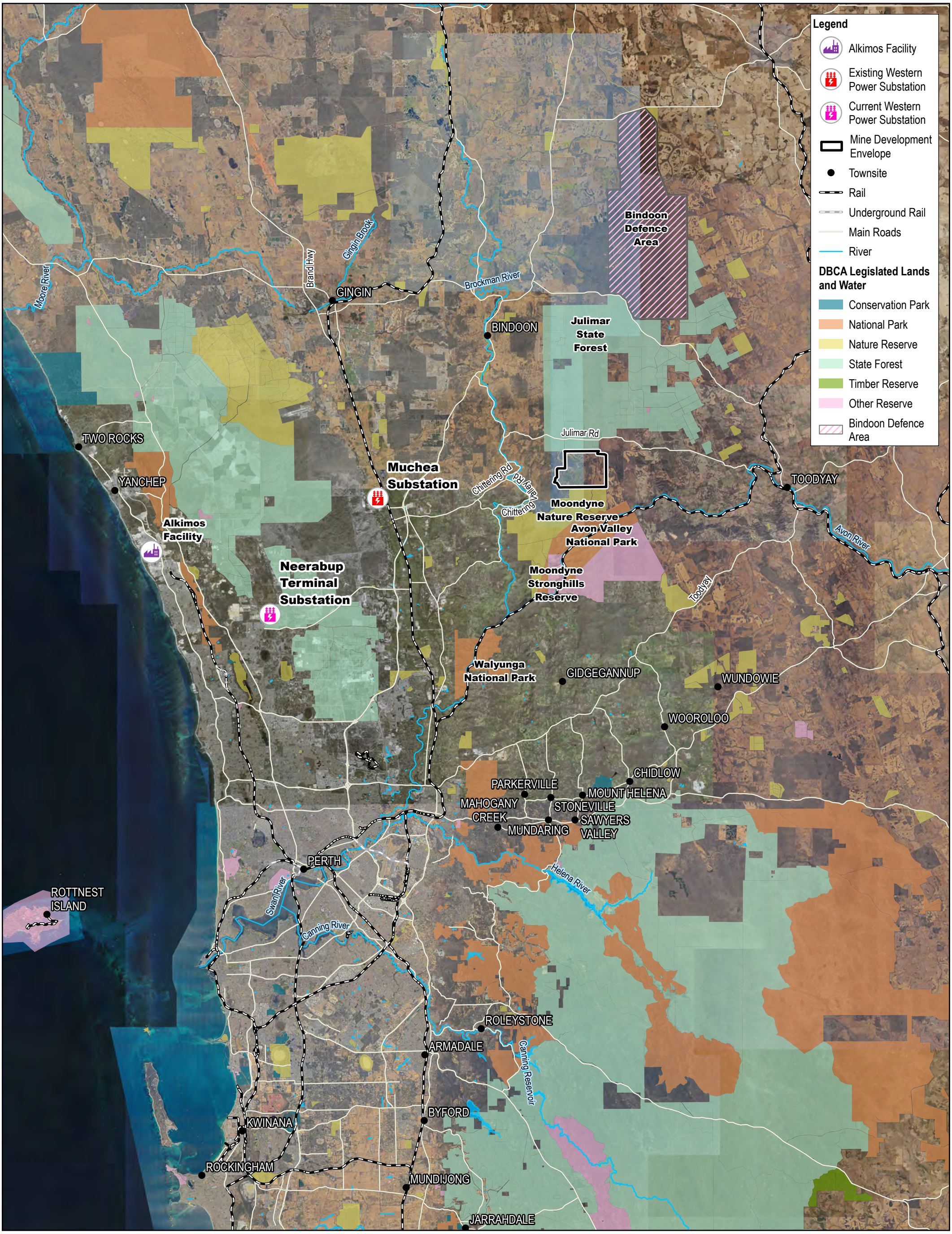
Chalice is proposing to develop the Gonneville Project which is located approximately 70km north-east of Perth in the Wheatbelt region of Western Australia (Figure 1). The mining and processing elements of the Gonneville Project are located on freehold land owned by Chalice, with that land previously used for agriculture.

The Proposal includes an open pit and/or underground mine, waste rock landforms, ore stockpiles, topsoil and subsoil stockpiles, tailings storage, haul roads, borrow pits, ore processing, groundwater abstraction infrastructure (for construction purposes only) and associated site infrastructure. Associated site infrastructure includes offices and ablutions, workshops, temporary accommodation for construction, laydown areas, explosive storage, landfill and waste management, wastewater treatment, fuel storage, water supply and storage infrastructure, power supply infrastructure and communications infrastructure. Figure 2 presents the Mine Development Envelope (MDE) and a conceptual layout for the Gonneville Project.

The Proposal also includes infrastructure corridors for water and power supply to the Gonneville Project from third party suppliers (Figure 3). Supplies and product will be transported to and from site via road and/or existing rail infrastructure.

The conduct of exploration activities in the Julimar State Forest, which is located to the north of the Gonneville Project, is not within the scope of this Proposal. Chalice is not seeking approval to mine in Julimar State Forest as part of this Proposal.

The Gonneville Project is a greenfield project, with no existing mining operations or processing operations within the MDE. Existing land uses include agriculture and mineral exploration, as outlined in Section 1.5, which are excluded from the scope of the Proposal.



Paper Size ISO A3

0 2 4 6 8 10

Kilometers

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

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Chalice Gonneville Project

Regional Location

Project No. **12619855**
Revision No. **0**
Date **25/03/2024**

FIGURE 1

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1.1 Purpose and Scope

Chalice is referring the Gonneville Project under Section 38 of the WA *Environmental Protection Act 1986* which provides for referral and assessment of significant proposals. Chalice is concurrently submitting a referral under the Commonwealth (Cth) *Environment Protection and Biodiversity Protection Act 1999* for assessment of potential impacts to Matters of National Environmental Significance (MNES). It is anticipated that the Proposal will be assessed via Public Environmental Review (PER) by the State and Cth with provision for public review.

This document has been prepared in consideration of the Environmental Protection Authority (EPA) guideline documents, *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures* (EPA2021a), *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual 2021* (EPA,2021b), and the *Instruction: How to prepare an Environmental Review Document* (EPA, 2021c). The intent of the document is to outline the:

- Key operational and infrastructure elements of the Proposal and their extent.
- Local and regional context within which the Proposal would be implemented, drawing upon proposal specific biological studies that have been completed.
- Relevant preliminary environmental factors and potential impacts (including potential impacts to MNES) resulting from the implementation of the Proposal.
- Overarching mitigation strategies the Proponent would use to avoid, minimise, and manage potential adverse impacts.

1.2 Proponent Details

Chalice Mining Limited
Level 3, 46 Colin Street
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Western Australia 6005
ABN 47 1 16 648 956

1.3 Proposal key characteristics

The key characteristics of the Proposal are provided in Table 1.

Table 1. Key Proposal Characteristics

Proposal element	Location / description	Maximum extent, capacity or range
Physical elements		
Mine and mineral processing and associated infrastructure elements including: « open mine pits and/or underground mine access « waste rock landforms « ore stockpiles « topsoil and subsoil stockpiles « tailings storage « haul roads « borrow pits « ore processing, and « groundwater abstraction infrastructure (for construction purposes only).	Figure 2	Clearing of no more than 940 ha of remnant native vegetation within a Mine Development Envelope (MDE) of 2,240 ha.
Associated site infrastructure: « offices and ablutions « workshops « temporary accommodation for construction « laydown areas « explosive storage « landfill and waste management « wastewater treatment « fuel storage « water supply and storage infrastructure « power supply infrastructure, and « communications.		
Infrastructure corridors for:		
« Water supply	Figure 3	**Water Route Option 1:** « Disturbance of no more than 157 ha (which includes native vegetation clearing) within an Infrastructure

		Development Envelope (IDE) of 545 ha. **Water Route Option 2:** « Disturbance of no more than 162 ha (which includes native vegetation clearing) within an Infrastructure Development Envelope (IDE) of 531 ha. **Mid-Route Option:** « Disturbance of no more than 26 ha (which includes native vegetation clearing) within an Infrastructure Development Envelope (IDE) of 86 ha. (this is a mid-route alternative for Water Route Option 2) **Muchea Contingency:** « Disturbance of no more than 11 ha (which includes native vegetation clearing) within an Infrastructure Development Envelope (IDE) of 35 ha. (this is a mid-route alternative linking Water Route Options 1 and 2) **Northern Contingency:** « Disturbance of no more than 42 ha (which includes native vegetation clearing) within an Infrastructure Development Envelope (IDE) of 134 ha. (this is a northern alternative for Water Route Option 1)
« Power supply	Figure 3	**Power Route Option 1:** « Disturbance of no more than 102 ha (which includes native vegetation clearing) within an Infrastructure Development Envelope (IDE) of 259 ha. **Power Route Option 2:** « Disturbance of no more than 106 ha (which includes native vegetation clearing) within an Infrastructure Development Envelope (IDE) of 258 ha. **Northern Contingency:** « Disturbance of no more than 55 ha (which includes native vegetation clearing) within an Infrastructure Development Envelope (IDE) of 134 ha. (this is a northern alternative for Power Route Option 1)
« Site access road	Figure 3	**Site Access Roads:** « Clearing of no more than 3 ha of remnant native vegetation within an

		Infrastructure Development Envelope (IDE) of 52 ha.
Construction elements		
Groundwater abstraction	Figure 2	Groundwater abstraction of up to 0.45 GL/yr where available and sustainable is being investigated.
Operational elements		
Ore/Mineral Processing	Figure 2	Processing of up to 15 million tonnes per annum (staged development over 25 years operational life of mine)
Tailings Storage	Figure 2	Cumulative tailings of up to 300 million tonnes (25-year operational life of mine)
Proposal elements with greenhouse gas emissions		
Construction elements:		
Scope 1	The proposal will generate greenhouse gas emissions predominantly from fuel combustion. Quantity to be determined during the study phase.	
Scope 2	To be determined.	
Scope 3	To be determined.	
Operational elements:		
Scope 1 and 2	Emissions from onsite plant and equipment, and offsite power generation with potential to be > 100,000t$CO_{2\text{-e.}}$ Quantity to be determined during the study phase.	
Scope 3	To be determined.	
Commissioning		
Commissioning of the processing facility will be undertaken subject to 'operational elements' limits above.		
Rehabilitation and Closure		
Progressive rehabilitation will be undertaken over the life of mine and landforms will be constructed to be safe, stable and non-polluting. Stakeholder consultation regarding mine closure and acceptable post-mining land uses will be ongoing during operations. *At the cessation of mining and processing, infrastructure will be decommissioned and removed (unless otherwise agreed with relevant stakeholders), closure earthworks completed, and vegetation re-established.* *An operational mine closure plan will be prepared and submitted to the Department of Energy, Mines, Industry Regulation and Safety prior to construction.*		
Other elements which affect extent of effects on the environment		

Proposal time	Maximum project life	Approximately 30 years, dependent on final closure plan requirements.
	Construction phase	Approximately 24 months.
	Operations phase	Approximately 25 years.
	Decommissioning phase	In accordance with final closure plan.

1.4 Proposal description

Chalice is seeking to develop the Gonneville Project on Chalice owned farmland located approximately 70km north-east of Perth in the Wheatbelt region of Western Australia. The Gonneville Project is centred on the Gonneville deposit; one of the largest recent nickel-copper PGE sulphide discoveries worldwide, and the largest PGE discovery in Australian history to date.

Construction of the Gonneville Project is proposed to commence in 2027, subject to final investment decision and receipt of required regulatory approvals.

The Proposal includes an open pit and/or underground mine, waste rock landforms, ore stockpiles, topsoil and subsoil stockpiles, tailings storage, haul roads, borrow pits, ore processing, groundwater abstraction infrastructure (for construction purposes only) and associated site infrastructure. Associated site infrastructure includes offices and ablutions, workshops, temporary accommodation for construction, laydown areas, explosive storage, landfill and waste management, wastewater treatment, fuel storage, water supply and storage infrastructure, power supply infrastructure and communications infrastructure. Figure 2 presents the MDE and a conceptual layout for the Gonneville Project.

The Proposal also includes infrastructure corridors for water and power supply to the Gonneville Project from third party suppliers (Figure 3). Supplies and product will be transported to and from site via road and/or existing rail infrastructure.

The process plant design is based on conventional crush-grind-float and leaching technologies, with staged production up to 15 million tonnes per annum (Mtpa) producing a range of products that may include concentrate, Mixed Hydroxide Precipitate and Dore. Final products will be transported off site via road and/or potentially existing rail, for sale to third parties.

Throughput staging options are being considered as part of a Prefeasibility Study (PFS), including different mining methodologies (i.e., both open pit and underground). Underground mine development would potentially include access declines and/or shafts and associated infrastructure. Staging options, (for example, an initial design for 2Mtpa processing throughput with subsequent expansions over the life of mine to a maximum of 15Mtpa), will be assessed as part of the PFS and will be presented during the course of the environmental impact assessment.

There is no existing piped water infrastructure at the Gonneville Project site. Several potential water sources have been investigated to date. At this stage the Gonneville Project does not intend to draw process water from local groundwater sources and will likely source water from a third-party supplier via new transmission pipeline and pumping station(s) to the Gonneville Project site.

Construction water supply will be partly sourced from on-site groundwater abstraction, where available and sustainable, and/or from a third-party supplier.

Given the proximity to the existing electricity grid, power is likely to be supplied from the Western Power South West Interconnected System (SWIS grid) via a new transmission line (including power substation(s)). Chalice is working with Western Power to secure operational power supply from the SWIS network. Construction power supply is expected to come from the existing local network supplemented by on-site diesel generation as required.

The construction workforce will be largely drive-in, drive-out, though temporary accommodation facilities may be required on site for the construction phase. The operations workforce is proposed to be largely locally based. As such it is unlikely that there will be a permanent accommodation village.

1.4.1 Disturbance and operational elements

The Gonneville Project will occur within an approximate 2,240 ha MDE (Figure 2), with clearing of no more than 940 ha of remnant native vegetation. The final amount of clearing will be defined during the engineering phase, which takes into consideration the extent required for safe and adequate construction and operation of the mine, and the use of previously disturbed areas to the extent possible. Clearing will be undertaken progressively as the mine develops over the operational life of mine.

Approximately 57% of the MDE has been previously cleared for agricultural use. Of the remaining vegetation within the MDE, ~28% is degraded due to its historic land use for agriculture. Other areas of vegetation (~15%) within the MDE range from good to excellent condition (see Section 4.2.3.4).

The location of mine landforms and infrastructure within the MDE will be determined by further studies and refined during the environmental impact assessment and will be confined to the MDE. Some changes are likely to occur to the conceptual layout presented in Figure 2, as well as addition of mine components not yet designed (e.g., process plant, water storage dams and associated site infrastructure).

The Proposal also includes water and power transmission infrastructure to the Gonneville Project site from third party suppliers. The Proposal will also involve logistics and transport via roads and potential transport via existing rail. Figure 3 presents the Infrastructure Development Envelope (IDE) for the water and power infrastructure and site access roads.

1.5 Proposal Exclusions

The Gonneville Project is a greenfield project, with no existing mining or processing operations within the MDE. Existing land uses include agriculture and mineral exploration.

Existing exploration and agriculture disturbance at the Gonneville Project includes laydown areas, access roads and tracks, core yards, drill pads and sumps, office blocks and temporary accommodation. The exploration activities are authorised and managed via Program of Work (PoWs) issued by Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) in

accordance with the *Mining Act 1978*. The disturbance associated with these activities will either be rehabilitated in accordance with compliance requirements or used for the proposed mining operation.

The following activities do not form part of the scope of the Project proposal being referred for assessment:

- Existing, ongoing and future exploration activities and supporting infrastructure.
- Resource definition drilling of the Gonneville deposit.
- Engineering (PFS and Feasibility) related studies including, but not limited to, ongoing test work, geotechnical and geophysical assessments, water monitoring and management trials/activities.
- Heritage, environmental and geotechnical surveys.
- Any rehabilitation associated with existing on-site activities.

Agricultural activities will continue to occur in the area.

Legend
- Conceptual Disturbance Footprint
- Chalice freehold properties
- Mine Development Envelope
- Road

Julimar Rd
Julimar Rd
Plunkett Rd
Rd No. 14748
Jenjoda Rd
Stockpiles
Resource
Processing Plant
Waste Rock Landform
Beach Rd
Keating Rd
Davis Rd
Rd No. 10825
Tailings Storage Facility
Chittering Valley Rd
Keating Rd
Unknown Rd

Paper Size ISO A3
0 0.5 1
Kilometers
Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

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Chalice Gonneville Project

Mine Development Envelope and Conceptual Layout

Project No. 12619855
Revision No. 0
Date 26/03/2024

FIGURE 2

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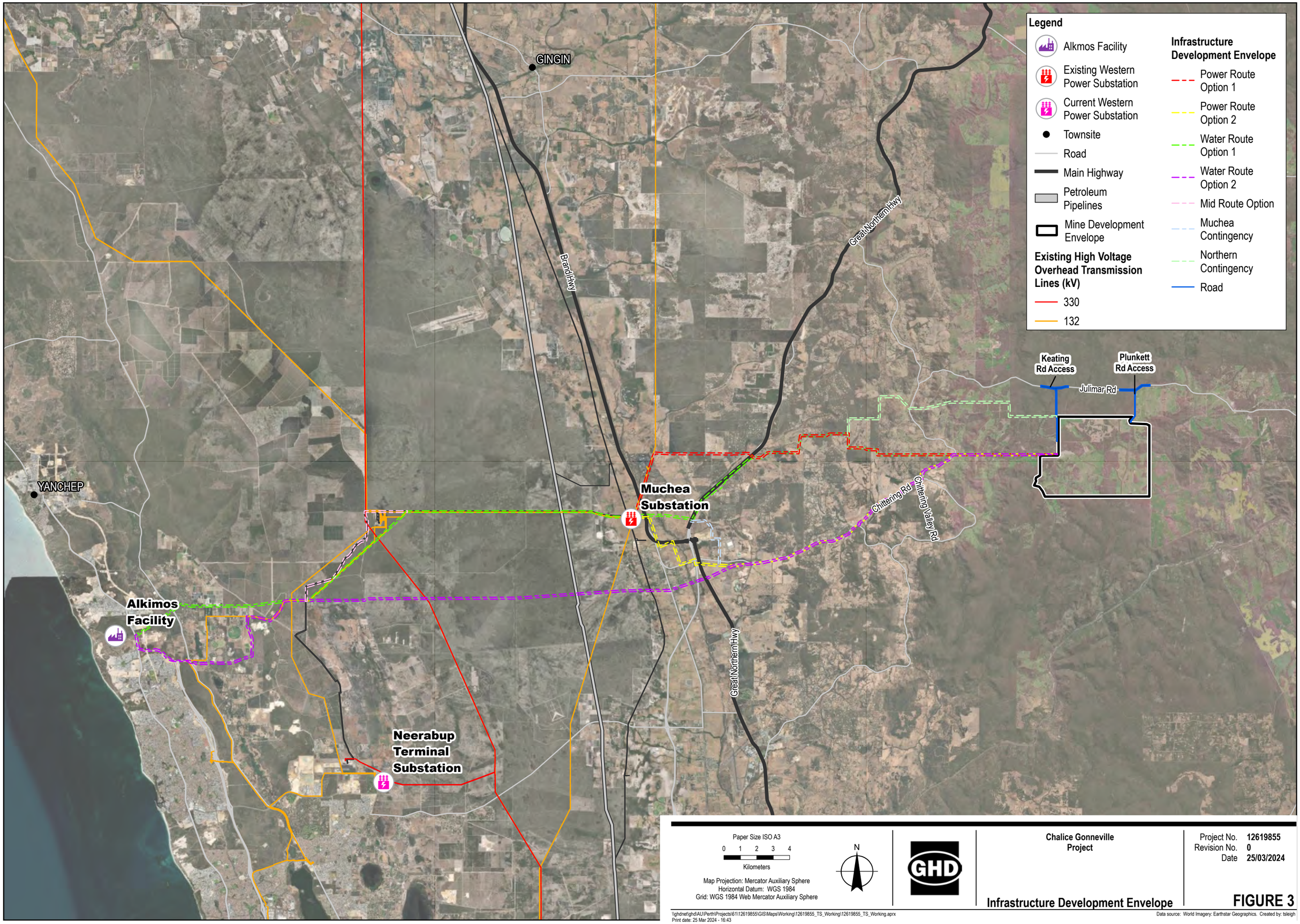

Paper Size ISO A3

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Kilometers

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

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Chalice Gonneville Project

Infrastructure Development Envelope

Project No. 12619855
Revision No. 0
Date 25/03/2024

FIGURE 3

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1.6 Proposal alternatives

The design of the MDE and conceptual disturbance footprint has been influenced by the location of the Resource, land tenure and initial findings from baseline surveys and early stages of PFS. Chalice has confined the MDE to Chalice-owned farmland.

The design of the IDE was undertaken through an iterative approach, the final options selection based on the outcomes of a multi criteria evaluation (MCE). This evaluation considered the following:

- Technical Considerations
  - Deliverability
  - Integration with the wider service network
  - Impact on wider development potential
- Environmental and Societal Factors
  - Environmental impact - delivery, operation and closure, inclusive of identifying potential alignments within existing disturbed areas
  - Social (including cultural heritage) impact – delivery, operation and closure
- Cost and Schedule
  - Capital Expenditure
  - Operational Expenditure
  - Project Schedule Risk

As additional surveys (both biological and cultural heritage) and investigations for the PFS progress, the conceptual disturbance footprint will be subject to change to avoid, and to minimise potential impacts to identified significant environmental and cultural heritage values.

1.7 Options to be assessed

Chalice is progressing the environmental impact assessment and approvals process in parallel with PFS, allowing for proactive integration of environmental considerations and stakeholder feedback into early engineering studies.

Consequently, in developing the Proposal, a number of potential options are being assessed, which may require changes in layouts or logistics and supply elements. These options are outlined in Table 2 below. Additional options may be considered throughout the PFS and environmental assessment process.

Table 2. Proposal Element: Options to be assessed

Element within the MDE	Potential options for considerationOptions to be assessed
Mining methodology	• Open pit/s and/or • Underground mining – development would include access declines and/or shafts and associated infrastructure

Element within the MDE	Potential options for considerationOptions to be assessed
Production throughput	« Staging options are being considered. For example, an initial design of 2Mtpa processing throughput with subsequent expansions over the life of mine to a maximum of 15Mtpa.
Construction water supply	« On-site groundwater abstraction for construction purposes only. Quantity to be determined if studies indicate availability and sustainability and/or « From a third-party supplier, via road transport (e.g., water tanker to site storage)
Conceptual Disturbance Footprint	« The mine layout continues to be developed as part of the PFS, therefore changes are likely to occur to the conceptual mine layout presented in Figure 2, as well as addition of mine components not yet designed (e.g., process plant, water storage dams and associated site infrastructure).
Element within the IDE	**Options to be assessed**
Operations water supply (IDE)	« Water Route Option 1 (inclusive of contingency) « Water Route Option 2 (inclusive of contingency and mid-route alternative)
Operations power supply (IDE)	« Power Route Option 1 (inclusive of contingency) « Power Route Option 2
Site access roads (IDE)	« Access via Keating Road, off Julimar Road « Access via Plunkett Road, off Julimar Road
Element (Other)	
Logistics – road and rail	« Logistics and transport are being investigated utilising the road network and potential transport via existing rail.

1.8 Proposal Justification

The Gonneville Project is a globally significant critical minerals discovery which contains a rare mix of minerals - palladium, nickel, platinum, copper and cobalt. These critical minerals are required in large quantities for technologies that will help address climate change.

The minerals at Gonneville are critical inputs for batteries, electric vehicles (nickel and cobalt), the hydrogen fuel cycle (platinum and palladium) and electrification (copper).

The production of these minerals in Western Australia is strongly aligned to State Government policy objectives, including:

- The development of battery and critical minerals as outlined in *Western Australia's Future Battery Industry Strategy*[1];
- The development of a renewable hydrogen industry as outlined in the WA Renewable Hydrogen Strategy[2]. The PGE minerals are essential parts of the hydrogen fuel cycle used in both electrolysers and fuel cells.
- Regional economic diversification. The Wheatbelt Development Strategic Plan (2024 – 2026)[3] places a high priority on finding new industries in the region.

The Gonneville Project also aligns with the objectives of the Commonwealth's Critical Minerals Strategy 2023 – 2030[4]. Gonneville will produce minerals defined as critical (palladium, platinum, nickel, cobalt) and strategic (copper) by this strategy.

1.8.1 Social and economic benefits

An economic impact assessment[5] has been conducted by ACIL Allen to estimate the impact of developing the Gonneville Project on the economies of Western Australia and Australia.

The economic impact assessment indicated that a future mine at Gonneville has the potential to deliver economic diversification and job creation:

- The Gonneville Project is expected to directly create around 1,200 jobs during peak construction and around 500 jobs per year in operation. These jobs will be unique given their commute proximity to Perth and the lifestyle values of the surrounding region.
- Modelling shows that the Gonneville Project will add more than A$18 billion to Western Australia's Gross State Product and more than A$20 billion to Australia's Gross Domestic Product over its modelled life.

Alongside employment, the Gonneville Project has the potential to provide opportunities for local businesses and suppliers to provide goods and services required by the mine and the people it employs.

1.8.2 Sustainable development

Chalice recognises the need to develop the Gonneville Project sustainably and responsibly, with an industry best practice approach to environmental and cultural heritage management, and by ensuring long term positive impacts for local communities. Our approach to sustainability reflects this commitment, and is based on four pillars to:

- minimise our environmental footprint through use of existing disturbed areas, where possible,

[1] Future Battery Industry Strategy Western Australia (www.wa.gov.au)

[2] Western Australian Renewable Hydrogen Strategy and Roadmap (www.wa.gov.au)

[3] https://www.wheatbelt.wa.gov.au/files/3917/0545/0396/WDC_Strategic_Plan_FINALISED_V_2024.pdf

[4] Critical Minerals Strategy 2023–2030 | Department of Industry Science and Resources

[5] Forecasts are based on the ACIL Allen Economic Impact Assessment, August 2023.

- contribute to managing climate change risk through the responsible supply of minerals critical to decarbonisation,
- create value for our stakeholders through active and transparent engagement with stakeholders and Traditional Owners with the intent to build respectful and collaborative relationships, and
- provide a healthy and safe workplace for our employees and contractors.

1.8.3 Strong environmental stewardship

Chalice is committed to rigorous standards and governing frameworks to ensure responsible environmental practices are followed in all our activities.

Extensive work has been undertaken by Chalice to develop environmental baselines and define predictive environmental studies (e.g., air and noise modelling) required to support formal environmental assessment during the PFS phase of the Project. This program of work has considered key environmental factors such as flora and vegetation, terrestrial and aquatic fauna, and surface and groundwater within and adjacent to the MDE. All surveys undertaken for the Gonneville Project are in accordance with WA EPA and Cth government technical guidelines for environmental impact assessment.

Chalice is progressing the environmental impact assessment and approvals process in parallel with our PFS, allowing us to proactively integrate environmental considerations and stakeholder feedback into early engineering studies.

1.8.4 Biodiversity strategy and offsets

Chalice has developed a Biodiversity Strategy for the Gonneville Project that seeks to deliver on two key biodiversity goals:

- To ensure a science-based no net loss of species or habitat diversity as a result of any mining operations at the Gonneville Project; and,
- To strive towards a net positive legacy for significant species and the local community.

The Biodiversity Strategy also aims to accord with State and Commonwealth regulatory expectations for environmental offsets.

The Biodiversity Strategy and goals will be delivered through on-the-ground restoration projects that increase habitat availability and connect remnant areas of habitat on farmland and adjacent areas of the conservation estate that are currently fragmented. Implementation of the Biodiversity Strategy is underway with a site for a pilot restoration project already identified adjacent to the Julimar State Forest. An additional restoration site has also recently been identified adjacent to the Moondyne Nature Reserve. The pilot restoration project will test different restoration techniques, develop success measures, and evaluate performance to inform large-scale restoration efforts.

Chalice has signed a memorandum of understanding (MOU) with the Western Australian Biodiversity Science Institute (WABSI) to collaborate on the delivery of the Biodiversity Strategy and

associated restoration projects. An MOU has also been established with the University of New South Wales to progress studies on the ecology of the Chuditch in the Julimar region.

1.8.5 Managing climate change risk

Chalice believes in being part of the solution to manage climate change by responsibly discovering and developing new mineral deposits that provide the minerals that are essential for decarbonisation. Supporting a low carbon emissions future is central to our purpose and strategy as an organisation.

The Gonneville Project is positioned to be one of the lowest carbon nickel projects once in production (on a tonne of CO_2 equivalent per tonne of Ni equivalent basis), due to the Gonneville Project's nickel sulphide mineralogy and potential supply of electricity through the South West Interconnected System (SWIS grid). An initial forecast of the carbon intensity of the Gonneville Project estimates that the Project would benchmark well (approximately 10-12 tCO2Eq/tNiEq) compared to operations globally (>20 tCo2Eq/tNiEq).[6]

The electricity requirement associated with processing would be the most carbon intensive stage of operations and is likely to further reduce beyond the current assessment as the SWIS grid moves toward increased renewable energy sources. The WA Government is targeting at least a 40% reduction in carbon emissions associated with the SWIS grid primarily due to the retirement of state-owned coal power stations by 2030. [7]

During PFS, the carbon emissions from a mine development will be assessed in further detail using Life Cycle Analysis (LCA) methods. Low carbon technologies such as low-emissions vehicle fleets, and tailings carbon capture have not been considered yet but will be evaluated as part of engineering studies.

Chalice has recently engaged ARCA Climate Technologies to investigate the carbon mineralisation potential of mine tailings and to understand the potential technology options to accelerate carbon mineralisation at the Gonneville Project.

1.9 Local and regional context

The MDE for the Gonneville Project is located approximately 70 km northeast of Perth, 25 km west of Toodyay and 25 km south-east of Bindoon (Figure 1). The MDE is located in the Wheatbelt region, within the Shire of Toodyay which has a population of approximately 4,600 (2021 census).

The MDE is located within the Northern Jarrah Forest IBRA subregion and lies on the Darling Plateau east of the Darling Scarp. The MDE falls within the catchments of un-named tributaries to the Brockman River and of Julimar Brook, both of which flow south into the Avon River. The MDE is

[6] Chalice Mining - Gonneville Project Scoping Study, August 2023

[7] Source: https://www.wa.gov.au/government/announcements/state-owned-coal-power-stations-be-retired-2030-move-towards-renewable-energy

bounded by Julimar State Forest to the north, Moondyne Nature Reserve to the south, and freehold rural and/or vegetated properties to the west and east (Figure 1).

The proximity of the Gonneville Project to the Perth metropolitan region enables access to existing infrastructure, including highways, freight rail, power, water and port, and a highly skilled local workforce.

Infrastructure corridors have been planned for water and power services for the Gonneville Project. The options currently being assessed are shown in Figure 3. Two options for each of the power and water routes has been provided, with a final design to be developed during the assessment phase.

The IDE to enable access to power sourced from the SWIS covers a distance of 26.5 km for Power Route Option 1 and 26.2 km for Power Route Option 2, facilitating connection from the Muchea Substation in the west to the MDE in the east. These routes have been designed to minimise impacts on environmental, social and cultural heritage values.

The IDE also includes access to water sourced from the Water Corporation Alkimos Facility, located approximately 48km west of the MDE. Water Route Option 1 covers a distance of 53.6 km and Water Route Option 2 covers a distance of 53.8 km. These routes have been designed to minimise impacts on environmental, social and cultural heritage values.

Two site access roads aligned with the existing Keating and Plunkett Roads are also proposed as part of the IDE. These routes will incorporate the existing road reserve of Keating, Plunket and Julimar Roads, as well as adjoining portions of the Julimar State Forest required to meet road safety requirements.

2. Legislative Context

2.1 Environmental Impact Assessment Process

The Proposal will be subject to assessment under both the Western Australian (WA) *Environmental Protection Act 1986* (EP Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.1.1 Environmental Protection Act 1986

The EP Act is the primary environmental legislation governing environmental protection and impact assessment in WA. Part IV of the EP Act provides for the referral and assessment of proposals that may significantly impact the environment. The Environmental Protection Authority Services (EPA Services) division within the Department of Water and Environmental Regulation (DWER) administers the impact assessment process in accordance with the relevant policies and guidelines.

2.1.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the primary Commonwealth environmental legislation and is administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The Proposal will be referred to DCCEEW concurrently with referral under the (WA) EP Act. The Proposal has the potential to impact two Matters of National Environmental Significance (MNES) - nationally threatened species and ecological communities, and migratory species. Refer to Section 4.10 for potential environmental impacts to MNES.

It is anticipated that DCCEEW will determine that the Proposal may have a significant impact on protected matters, and that a detailed assessment is required. In making this determination, DCCEEW will likely declare the Gonneville Project a 'Controlled Action' with the subsequent assessment undertaken in accordance with instructions issued by the DCCEEW under the EPBC Act.

2.2 Other Approvals and Regulation

2.2.1 Land Tenure

The Gonneville Project is currently located on freehold land subject to exploration tenure granted under the *Mining Act 1978* (WA) (Mining Act), being E70/5118, E70/5119 and E70/5353 (Table 3). Chalice has purchased freehold land under tenements E70/5118, E70/5119 and E70/5353.

Table 3. Chalice Exploration Licences across the MDE

Exploration Licence	Area (ha)	Holder	Granted	Expiry	Nature of Interest
E70/5118	1,750	CGM (WA) Pty Ltd	3/09/2018	02/09/2028	100%
E70/5119	13,750	CGM (WA) Pty Ltd	30/08/2019	29/08/2024	100%
E70/5353	18,700	CGM (WA) Pty Ltd	04/10/2021	03/10/2026	100%

Exploration licences have a five-year term with a possible extension of five years with a compulsory 40% relinquishment due at the end of year six if the tenement is greater than 10 blocks in size. Extensions of exploration licenses are routine and in almost all circumstances are approved, especially if there is evidence that exploration will continue within the tenement.

Chalice intends to apply for a Mining Lease to support the development of the Gonneville Project. The Mining Lease will interact with portions of all three Exploration Licences. As an interim step, an application to extend E70/5119 for another five-year period will be made prior to expiry on 29 August 2024. E70/5353 expires on 3 October 2026 and a decision will be made prior to this date to either extend the licence or apply for a Mining Lease. The indicative timing for a Mining Lease application is dependent on the progress and predicted receipt of environmental regulatory approvals.

The IDE is located within both freehold land and crown land.

2.2.2 Native Title

The Proposal is situated in the Whadjuk People Indigenous Land Use Agreement[8] (ILUA) area as part of the South West Native Title Settlement between the WA Government and the Noongar people[9]. The ILUA establishes Whadjuk Aboriginal Corporation as the representative body for the Whadjuk People, and the Whadjuk Cultural Advice Committee as having specific responsibilities to Whadjuk Aboriginal Corporation, particularly in relation heritage and land matters.

The South West Native Title Settlement resolves native title in the southwest of Western Australia through the establishment of six ILUAs between Noongar people and the Western Australian Government. As a result of the Settlement, grant of mining tenure for the Project will not be subject to the requirements of the Native Title Act 1993.

Chalice entered into an Aboriginal heritage agreement with the Whadjuk People Agreement Group in the form of a Noongar Standard Heritage Agreement (NSHA) in 2018. The NSHA prescribes the process for the preparation, undertaking, and reporting of cultural heritage surveys, and how Chalice notifies the Whadjuk People of the company's activities.[10]

Chalice has been engaging and working with Traditional Owner representatives since mid-2021 to establish strong, collaborative relationships and understand cultural values in the Project Area.

2.2.3 Decision Making Authorities and Other Approvals

The relevant Decision-Making Authorities (DMAs) identified by Chalice are listed in Table 4. Additional DMAs may be identified during the EPA's assessment of the Proposal.

Table 4. Decision Making Authorities and relevant statutory decision-making processes and approvals.

Decision-making authority	Legislation or Agreement regulating the activity	Approval required	Proposal Element
Department of Mines, Energy, Industry Regulation and Safety (DEMIRS)	*Mining Act 1978*	Mining Proposal and Mine Closure Plan Miscellaneous Licence	Mining-related disturbance within tenements. Infrastructure Corridors
	Dangerous Goods Safety Act 2004 (DG Safety Act)	Dangerous Goods Licence	Storage and handling of hazard materials during construction and operations
Department of Water and Environmental Regulation (DWER) – Industry Licensing Branch	*Environmental Protection Act 1986*, Part V, Licences and Works Approvals	Works Approval and Environmental Licence	Construct, commission and operate a Prescribed Premise

[8] https://www.wa.gov.au/system/files/2021-05/AH-Whadjuk-People-ILUA.pdf

[9] https://www.wa.gov.au/organisation/department-of-the-premier-and-cabinet/south-west-native-title-settlement

[10] https://www.wa.gov.au/system/files/2021-11/HER-Annexure-C-Noongar-Standard-Heritage-Agreement.pdf

Decision-making authority	Legislation or Agreement regulating the activity	Approval required	Proposal Element
DWER – Water Branch	*Rights in Water and Irrigation Act 1914*	5C Licence to Take Water 26D Licence to construct dewatering and water supply bores. 11/17/21A Permit to interfere or obstruct bed or banks	Groundwater Abstraction Alteration of surface water flows
Department of Planning, Lands and Heritage (DPLH)	*Aboriginal Heritage Act 1972*	Application for a permit under Section 18 of the AH Act	Impact any Aboriginal Heritage sites
Minister for the Environment (Cth)	*Environment Protection and Biodiversity Conservation Act 1999*	s.133 Approval	Impacts on Matters of National Environmental Significance
Department of Biodiversity, Conservation and Attractions (DBCA)	*Biodiversity Conservation Act 2016 (BC Act)*	S. 40 Authorisation	To take and/or disturb threatened flora and/or fauna species Management of State Forest

3. Stakeholder Engagement

3.1 Create Value for Stakeholders

Since the discovery of the Gonneville deposit in 2020, Chalice has sought to actively and transparently engage with local communities to keep stakeholders informed about the Project, to build relationships and better understand issues most relevant to the community. This has included landowners, local community groups and representatives, local shires, local businesses and government in the Chittering, Toodyay, Goomalling and Northam local government areas.

Communication and direct engagement have occurred through meetings and briefings, site visits, participation in community events, quarterly community newsletters, monthly advertising in three local newspapers, and distribution of project information sheets. In 2022, Chalice also opened an office in Toodyay to better service community enquires about the Gonneville Project through direct engagement with Chalice staff. Refer to Table 5 for a summary of this stakeholder engagement.

Whadjuk Traditional Owners have unique rights and interests to those of other stakeholders. Chalice recognises their rights, acknowledges their connection and responsibilities to their lands and waters, and respects their obligation to maintain culture, traditions and customs, and care for country. This has guided Chalice's engagement with Whadjuk Traditional Owners about the Gonneville Project over the past three years as we aim to establish a strong and collaborative relationship (see Section 3.5).

Table 5. Summary of stakeholder engagement

Key Stakeholder	Interest	Engagement Activities
Local Communities: « Groups and Individuals in close proximity to or impacted by potential future operations	Employment, business opportunities, environmental, cultural heritage and land access management, economic and social contribution, social licence to operate	« Attendance at local community events « Face to face meetings « Group presentations « Stakeholder site tours « Community investment « Newsletters and information sheets « Dedicated community email « Stakeholder engagement process for feedback or concerns « Local media and advertising « Chalice office located in Toodyay « Regular e-news and mail distribution
Traditional Owners « Whadjuk People « Yued People « South West Aboriginal Land and Sea Council	Cultural heritage, environment, employment, business opportunities, economic and social contribution, social licence to operate	« Meetings and briefings « Formal and informal correspondence « Site visits « Cultural heritage surveys and monitoring « Environmental surveys « Cultural awareness and cultural safety training
Government and Regulatory Agencies: « State, Federal and Local	Regulatory compliance, regulatory approvals, social and economic impacts, employment, environmental and land management, strategic policies	« Meetings « Formal and informal correspondence « Site visits and inspections « Compliance reporting « ASX announcements
Employees and Contractors	Employment, remuneration, professional development, safety, culture, job satisfaction and general wellbeing	« Meetings « Company representation and participation in community events e.g. school career nights « Face to face performance discussions « Social events « Briefing notes and posters « Safety training

Shareholders	Returns to shareholders, sustainability and corporate governance performance	« ASX announcements « Financial reporting « Annual/general meetings « Investor calls/webinars « Conferences « Roadshows « Site visits « Media « Social platforms

3.2 Local Voices Community Survey

Chalice engaged Voconiq in 2022 to commence an independent three-year community survey program about the Gonneville Project called Local Voices. The Local Voices program is based on research developed over a decade by Australia's national research agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

The first Local Voices survey took place in March 2023 and a subsequent second survey in February 2024 (which remains ongoing at the time of reporting). These surveys are designed to provide a baseline understanding of community sentiment toward the Gonneville Project across the Toodyay, Chittering, Goomalling and Northam local government areas. In the initial survey, a large number of the 283 respondents see the Gonneville Project providing significant economic opportunity for local communities, including job creation and investment in local infrastructure.

Key issues for the community are potential impacts to biodiversity and local water resources, noise levels and impacts to local roads.

Results from the Local Voices program will inform Chalice's ongoing community engagement and investment programs and will be an important input to social impact assessment and environmental approval processes through the next stages of the Project.

Chalice will continue an increased program of communication and engagement during the next phase of the Gonneville Project. Chalice understands that there is a need to communicate development, construction and operations options (including multiple alternatives where applicable), for local community members to stay informed, provide feedback and consider impacts.

3.3 Community investment

Chalice has established a Community Investment Program, which provides sponsorship opportunities to support education, community, environmental and sporting initiatives. These contributions have been carefully considered to make sure the benefit is broad and results in an immediate return for the local community.

Chalice has contributed ~A$230,000 across 40 local community groups through our Community Investment Program and a further ~A$3 million in expenditure with local businesses for goods and

services (during FY2021-2023). There was an estimated additional ~A$5 million of local spend by direct Chalice contractors.

In addition to existing community investment, Chalice has signed a Heads of Agreement with the Shire of Toodyay in August 2023 that is aimed at providing additional funding to local communities once the Gonneville Project reaches commercial production. Eligible projects will demonstrate community development and social investment priorities that are aligned with and preserve and promote the Shire of Toodyay's Council Plan, with a focus on local employment and training outcomes as well as other initiatives that contribute to community sustainability. Any beneficiaries of a future Community Fund will be determined in consultation with the local community.

3.4 Pre-Referral Meetings

Chalice has held pre-referral meetings with the DCCEEW, EPA Services and Industry Regulation and Water Licensing at the DWER regarding the Gonneville Project.

The Department of Jobs, Tourism, Science and Innovation (DJTSI) are currently providing Case Management support through the Green Energy Major Projects team. DJTSI facilitated an intergovernmental case conference pre-referral meeting with DWER, DBCA, DEMIRS and DPLH.

Chalice has also held pre-referral consultation with the local governments, surrounding landholders and other community stakeholders. Table 6 provides a summary of the Gonneville Project pre-referral consultation.

Table 6. Summary of pre-referral consultation

Stakeholder	Date of consultation	Objective of consultation
DWER -EPA Services	4 August 2023	Introduction to Chalice and project briefing
	4 October 2023	Gonneville Project site visit
	15 February 2024	Pre-referral meeting
Whadjuk Cultural Heritage Survey Team	5 March 2024	Overview of environmental approval process and relevant factors.
DWER, DBCA, DEMIRS, DPLH, DJTSI	6 March 2024	Intergovernmental Case Conference pre-referral briefing facilitated and chaired by DJTSI
Shire of Toodyay	6 March 2024	Pre-referral briefing
DCCEEW	7 March 2024	Pre-referral meeting
Surrounding landholders	March 2024	Direct mail to landholders advising of Gonneville Project referral and opportunity for briefing
Community groups	March 2024	Direct engagement and opportunity for Gonneville Project briefings.

3.5 Cultural Heritage and Traditional Owner engagement

Chalice has been engaging and working with Whadjuk Traditional Owner representatives since mid-2021 with a view to establishing strong, collaborative relationships and to understand the cultural values of the Project area.

There are no Registered Aboriginal Sites or Other Heritage Places listed on the DPLH Aboriginal Cultural Heritage Inquiry System (ACHIS) within the MDE. Whadjuk representatives, independently of Chalice and in accordance with the NSHA, have undertaken cultural heritage surveys over the MDE. Chalice is awaiting receipt of the heritage survey findings and report. Cultural heritage surveys will be undertaken across the IDE, in accordance with NSHAs and further engagement will be undertaken with Whadjuk Aboriginal Corporation.

Whadjuk Aboriginal Corporation has a good awareness of the Proposal through undertaking heritage surveys, and project briefings, including visiting the Gonneville Project area to discuss location of infrastructure, participating in environmental surveys, monitoring aspects of Chalice's work program, and generally through a collaborative working relationship between Whadjuk and Chalice since 2021.

Whadjuk representatives have also been involved in Chalice's work program through business and employment, and through preparing and issuing to Chalice a Cultural Heritage Management Plan (CHMP) for Chalice's regional exploration activities.

This is a strong foundation from which Chalice and Whadjuk Aboriginal Corporation will continue to consult about the Project, to facilitate Whadjuk Aboriginal Corporation's formal comment on the Proposal, and to plan how Whadjuk Aboriginal Corporation and Chalice will seek to work together during all phases of the Project.

4. Assessment of Environmental Impacts

4.1 Preliminary Environmental factors

The Statement of *Environmental Principles, Factors and Objectives* (EPA, 2020) identifies 14 environmental factors, organised into five themes: Sea, Land, Water, Air and People.

Table 7. lists preliminary environmental factors identified as potentially relevant to the Proposal. The seven preliminary environmental factors have been identified through initial baseline studies, project planning and consultation processes.

Table 7. Preliminary environmental factors

Theme	Preliminary environmental factor
Land	Flora and vegetation
	Terrestrial environmental quality
	Terrestrial fauna
Water	Inland waters
Air	Air quality
	Greenhouse gas emissions
People	Social surroundings

An overview of the receiving environment and potential environmental impacts for the Proposal are presented for each preliminary environmental factor in Sections 4.2 to 4.8.

4.2 Flora and Vegetation

4.2.1 EPA Objective

The EPA objective for flora and vegetation is '*To protect flora and vegetation so that biological diversity and ecological integrity are maintained*' (EPA 2016a).

4.2.2 EPA policy and guidance

- Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2023a)
- Environmental Factor Guideline – Flora and Vegetation (EPA, 2016a)
- EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016c)
- Statutory Guidelines for Mine Closure Plans (DMIRS 2020)

4.2.3 Receiving environment – Mine Development Envelope

4.2.3.1 Regional vegetation

The MDE is located within the Jarrah Forest bioregion, as described by the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995). This bioregion is described as duricrusted plateau of the Yilgarn Craton and is characterised by jarrah (*Eucalyptus marginata*) –

marri (*Corymbia calophylla*) forest on laterite gravels and, in eastern parts, by wandoo (*Eucalyptus wandoo*) – marri woodlands on clayey soils. Eluvial and alluvial deposits support Agonis shrublands, and in areas of Mesozoic sediments, jarrah forests occur in a mosaic with a variety of species rich shrublands (Biologic 2024).

The Jarrah Forest bioregion is classified into two subregions, Northern Jarrah Forest (NJF) (JAF01) and Southern Jarrah Forest (JAF02), of which the MDE is located within the Northern Jarrah Forest subregion. The Northern Jarrah Forest subregion is characterised by jarrah – marri forest on laterite gravels in the west, with bullich (*Eucalyptus megacarpa*) and blackbutt (*Eucalyptus patens*) in the valleys, grading to wandoo – marri woodlands on clayey soils in the east, with powder bark (*Eucalyptus accedens*) on breakaways (Williams and Mitchell, 2003). There are also extensive, but localised, sand sheets with Banksia low woodlands, and heath is found on granite rocks and as a common understory of forests and woodlands in the north and east (Williams and Mitchell, 2003).

Pre-European vegetation

Pre-European vegetation mapping was originally undertaken by Beard (1975) at various scales (predominantly 1:1,000,000) across the State and has since been updated to be consistent with Native Vegetation Information System (NVIS) descriptions at a scale of 1:250,000 (ESCAVI, 2003; Shepherd *et al.*, 2002). This update also accounts for extensive clearing since the Beard (1975) mapping. Shepherd *et al.* (2002) created a series of 'systems' to assist in removing mosaic vegetation associations originally mapped by Beard (1975); however, some mosaics still occur.

The MDE is located within the East Darling System, and under Shepherd *et al.* (2002) comprises the following vegetation system associations:

- East Darling 968 (1,483 ha / 66 %); and
- East Darling 4 (756 ha / 34 %).

Both vegetation associations consist of jarrah (*Eucalyptus marginata*), marri (*Corymbia calophylla*) and wandoo (*Eucalyptus wandoo*) woodland.

Vegetation complexes

Mattiske and Havel (1998) mapped vegetation complexes across the south-west forest region at a scale of 1:50,000 as part of the Regional Forest Agreement (RFA). More recently this dataset has been reviewed to correct errors while the mapping along the Whicher Scarp has been updated to ensure a continuation of complexes defined by Mattiske and Havel (1998) (see Webb *et al.*, 2016). The MDE intersects with six different vegetation complexes, with the most dominant being Yalanbee (Y5) (868 ha / 39 %) (Webb *et al.*, 2016) (Table 8).

Table 8. Vegetation complexes within MDE

Vegetation Complex	Description	Extent within MDE (ha; %)	Remaining extent within NJF (ha; % of pre-European extent))
Valleys			
Michibin (Mi)	Open woodland of *Eucalyptus wandoo* over *Acacia acuminata* with some *Eucalyptus loxophleba* on valley slopes, with low woodland of *Allocasuarina huegeliana* on or near shallow granite outcrops in arid and peri-arid zones.	861 (38%)	42,996 (26%)
Pindalup (Pn)	Open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones.	448 (20%)	128,358 (77%)
Coolakin (Ck)	Woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens*, *Eucalyptus marginata* subsp. *thalassica* and *Corymbia calophylla* on the valley slopes in arid and peri-arid zones.	2 (<1%)	64,205 (39%)
Uplands			
Yalanbee (Y5)	Woodland of *Eucalyptus wandoo-Eucalyptus accedens*, less consistently open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* on lateritic uplands and breakaway landscapes in arid and peri-arid zones.	868 (39%)	83,829 (66%)
Yalanbee (Y6)		47 (2%)	92,081 (47%)
Dwellingup (D4)	Open forest to woodland of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* on lateritic uplands in semiarid and arid zones.	13 (1%)	115,662 (87%)

4.2.3.2 Baseline surveys

Chalice have commissioned a number of studies to gain an understanding of the flora and vegetation values within and surrounding the MDE. These have included desktop studies, reconnaissance and targeted vegetation and flora surveys in accordance with relevant EPA guidance.

Vegetation and flora surveys that have been undertaken across the MDE are outlined in Table 9. Surveys undertaken to date within the MDE meet the requirements of EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016c).

Table 9. Flora and vegetation studies undertaken within the MDE.

Date of survey Author	Report title	Survey/ Report findings
2020 June Glevan Consulting	*Phytophthora* dieback occurrence assessment – version 2.0: Julimar exploration project	Assessment conducted June 19-June 23, 2020. No dieback infestations were observed. 109 ha of survey area was excluded due to degradation or being devoid of vegetation.
2020 July Biologic Environmental Survey	Reconnaissance and Targeted Flora Survey Julimar Exploration Project (report August 2020)	Study area of 131 ha (65 ha remnant native vegetation, 66 ha cleared agricultural land). No threatened or priority listed flora were recorded. Two priority taxa only considered possible to occur (*Drosera sewelliae* (P2) and *Schoenus natans* (P4)). No Weeds of Nationals Significance (WoNS) were recorded. One Declared Plant Pest (DPP) (*Gomphocarpus fruticosus)* was recorded. No Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC) recorded. Vegetation condition across survey area ranged from very good to completely degraded.
2021 July and August Glevan Consulting	*Phytophthora* Dieback Occurrence Assessment Julimar Exploration Project (report September 2021)	Single *Phytophthora* infestation comprising 21 ha was observed within farmland section of study area. Remainder of survey area (127.5 ha) uninfested.
2021 December Glevan Consulting	*Phytophthora* Dieback Occurrence Assessment V 2.0: McLoughlin and Gypsy Hills	Assessment of 367 ha of vegetation within MDE. No *Phytophthora* dieback infestations were observed during the assessment.
2022 February Biologic Environmental Survey	Chalice farmland reconnaissance flora and vegetation survey: Julimar exploration project (report June 2022)	Vegetation condition ranged from completely degraded to excellent, with over half (56%) of the study area degraded or completely degraded. One TEC/PEC was identified as occurring in the Study Area (Banksia woodlands of the Swan Coastal Plain). A total of 13 vegetation types from five broad landforms were described.

Date of survey Author	Report title	Survey/ Report findings
2022 May Glevan Consulting	*Phytophthora* Dieback Occurrence Assessment V 2.0: Remainder of Chalice farmlands (report June 2022)	Covered sections of remnant vegetation across Chalice farmlands not previously surveyed. No *Phytophthora* Dieback infestations were observed during the assessment.
2022 October (spring survey) Biologic Environmental Survey	Single season detailed flora and vegetation survey: Chalice Gonneville Project (report September 2023)	Detailed field survey over 2,267.6 ha of farmlands. Field survey conducted 10-1 October 2022. No listed threatened flora identified? Three DBCA Priority taxa recorded: *Stylidium vinosum* (P1), *Drosera sewelliae* (P2), *Acacia drummondii* subsp. *affinis* (P3). A total of 13 vegetation types from five broad landforms. Two patches of federal 'Banksia Woodlands of the Swan Coastal Plain' TEC were recorded, of which there is one sub-community listed as a P3 PEC by Department of Biodiversity, Conservation and Attractions DBCA. Vegetation condition ranged from completely degraded to excellent with over half (55%) of vegetated areas being degraded or completely degraded.
2023 November (spring survey) Biologic Environmental Survey	Two-phase detailed flora and vegetation survey: Chalice Gonneville Project (report February 2024)	Detailed field survey over 2,332 ha of farmland. Field surveys conducted across 2022 and 2023. No listed threatened flora identified. Three DBCA Priority flora recorded: *Stylidium vinosum* (P1), *Drosera sewelliae* (P2), *Acacia drummondii* subsp. *affinis* (P3). A total of 13 vegetation types from five broad landforms. One patch of federal 'Banksia Woodlands of the Swan Coastal Plain' TEC was recorded, of which there is one sub-community listed as a P3 PEC by DBCA. Vegetation condition ranged from completely degraded to excellent with over half (55%) of vegetated areas being degraded or completely degraded.

Date of survey Author	Report title	Survey/ Report findings
2023 December Glevan Consulting	*Phytophthora* Dieback occurrence assessment– Version 1.1: Area 665 (report January 2024)	Survey of 340.5 ha in south-west of MDE. Single section of uninfested vegetation (11.4 ha). Two sections (21.8 ha) uninterpretable due to lack of indicator species. Remaining 307.3 ha excluded unprotectable due to being degraded or devoid of vegetation.

4.2.3.3 Vegetation types

Sixteen native vegetation types from five broad landforms (Hills, Deep Sandplains, Valleys, Drainage Lines, and Wetlands) were mapped across the MDE (Figure 4; Table 10). Three non-vegetation mapping units were also recorded (Farmland, Planted, and Cleared). The dominant landforms were Hills (26.1 %; vegetation types denoted with a 'H') and Valleys (12.9 %; vegetation types denoted with a 'V'), with the most common vegetation type being H1.

Biologic (2024) noted the potential for the Drainage Line/Wetland vegetation types D7, W3 and W4 to be groundwater dependent vegetation (GDV), based on topography, landforms, soils, flora assemblages and vegetation types. Further investigations are underway to determine if the area is containing GDV.

Table 10. Vegetation types within the MDE

Vegetation Code and Description	Approximate area (ha / %)
Hills	
H1 EmtCc BssXpBses HhhSrBds *Eucalyptus marginata* subsp. *thalassica, Corymbia calophylla* mid open forest over *Banksia squarrosa* subsp. *squarrosa*, *Xanthorrhoea preissii*, *B. sessilis* subsp. *sessilis* mid-tall open shrubland over *Hibbertia hypericoides* subsp. *hypericoides*, *Styphelia retrorsa*, *Banksia dallanneyi* subsp. *sylvestris* low open shrubland on lateritic sandy loams along mid-upper hill slopes and hill crests	401 / 18%
H5 EwwEc Xp HhhHlBbb *Eucalyptus wandoo* subsp. *wandoo*, *E. accedens* mid woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* subsp. *hypericoides*, *Hakea lissocarpha*, *Banksia bipinnatifida* subsp. *bipinnatifida* low sparse shrubland on lateritic sandy clay loams along hill slopes and hill crests	150 / 7%
H10 EwwEmtCc BssXp HlBspsHcHlHhhLb *Eucalyptus wandoo* subsp. *wandoo*, *Eucalyptus marginata* subsp. *thalassica*, *Corymbia calophylla* mid open forest over *Banksia squarrosa* subsp.	11 / 1%

Vegetation Code and Description	Approximate area (ha / %)
squarrosa, *Xanthorrhoea preissii* tall open shrubland over *Hakea lissocarpha*, *B. sphaerocarpa* var. *sphaerocarpa*, *Hibbertia commutata*, *Hibbertia lasiopus*, *Hibbertia hypericoides* subsp. *hypericoides*, *Lechenaultia biloba* mid to low open shrubland on lateritic brown sandy clay loam along gentle slopes of undulating low hills	
Deep Sandplains	
S1 CcEmtNf Ba AccBgBses XpMf HhhCaCss LiSb Associated with Banksia woodland of the Swan Coastal Pain (TEC/PEC) *Corymbia calophylla*, *Eucalyptus marginata* subsp. *thalassica*, *Nuytsia floribunda* mid isolated trees over *Banksia attenuata* low woodland over *Adenanthos cygnorum* subsp. *cygnorum*, *B. grandis*, *B. sessilis* var. *sessilis* tall open shrubland over *Xanthorrhoea preissii*, *Macrozamia riedlei* mid isolated shrubs over *Hibbertia hypericoides* subsp. *hypericoides*, *Calytrix angulata*, *Conospermum stoechadis* subsp. *stoechadis* low open shrubland over *Lyginia imberbis*, *Schoenus brevisetis* low isolated sedges on lateritic sand along gentle hillslopes	2 / <1%
S2 EmtCc Bses CpXp StSiCa *Eucalyptus marginata* subsp. *thalassica*, *Corymbia calophylla* mid open woodland over *Banksia sessilis* var. *sessilis* tall open shrubland over *Conostephium preissii*, *Xanthorrhoea preissii* mid sparse shrubs over *Stirlingia latifolia*, *Scholtzia involucrata*, *Calytrix angulata* low open shrubland on lateritic sand along gentle hillslopes and low plateaus	56 / 2%
Valleys	
V1 EaEmtCc XpMr BeHlBcBbb *Eucalyptus accedens*, *E. marginata* subsp. *thalassica*, *Corymbia calophylla* Low open woodland over *Xanthorrhoea preissii*, *Macrozamia riedlei* tall sparse shrubland over *Bossiaea eriocarpa*, *Hakea lissocarpha*, *Babingtonia camphorosmae*, *Banksia bipinnatifida* subsp. *bipinnatifida* low open shrubland on laterite/ mica-schist sandy loams along steeper lower-mid hill slopes	7 / <1%
V3 EmtCcEww BsesBssLe DaXp BcMtSrHhh *Eucalyptus marginata* subsp. *thalassica*, *Corymbia calophylla* mid open woodland with *Eucalyptus wandoo* subsp. *wandoo* isolated trees over *Banksia sessilis* subsp. *sessilis*, *Banksia squarrosa* subsp. *squarrosa*, *Leptospermopsis erubescens* tall open shrubland over *Daviesia angulata*, *Xanthorrhoea preissii* mid shrubland over *Babingtonia camphorosmae*, *Melaleuca trichophylla*, *Styphelia retrorsa*, *Hibbertia hypericoides* subsp. *hypericoides* low shrubland on lateritic sandy loams along broad valley floors and lower slopes	13 / 1%
V5 EwwCcEmt BssLeAcc Xp BeBcSrLc *Eucalyptus wandoo* subsp. *wandoo*, *Corymbia calophylla*, *E. marginata* subsp. *thalassica* mid open woodland to isolated trees over *Banksia squarrosa* subsp. *squarrosa*, *Leptospermopsis erubescens*, *Adenanthos cygnorum* subsp. *cygnorum* tall open shrubland over *Xanthorrhoea preissii* mid sparse shrubland over *Bossiaea eriocarpa*, *Babingtonia camphorosmae*,	221 / 10%

Vegetation Code and Description	Approximate area (ha / %)
Styphelia retrorsa, *Lysiandra calycina* low open shrubland on lateritic sandy loams along broad valley floors	
V7 EwwCc TooXp GcBeHl *Eucalyptus wandoo subsp. wandoo, Corymbia calophylla mid open forest over Trymalium odoratissimum* subsp. *odoratissimum, Xanthorrhoea preissii* mid-*tall open shrubland* over *Gastrolobium calycinum, Bossiaea eriocarpa, Hakea lissocarpha* low open shrubland	4 / <1%
V12 EwwCc BpAhXp HiCsLe HhtBffHhh *Eucalyptus wandoo* subsp. *wandoo*, *Corymbia calophylla* mid-low isolated trees over *Allocasuarina huegeliana*, *Acacia acuminata* low woodland over *Xanthorrhoea preissii*, *Leptospermopsis erubescens* tall open shrubland over *Hypocalymma angustifolium* low isolated shrubs over *Desmocladus asper* low isolated rushes and low grassland of mixed introduced grasses on sandy clay loams with granite outcropping along valley slopes, hillslopes, and hillcrests	41 / 2%
V13 EwwEmtCc Xp HlBd *Eucalyptus wandoo* subsp. *wandoo* mid woodland with *E. marginata* subsp. *thalassica*, *Corymbia calophylla* mid isolated trees over *Xanthorrhoea preissii* tall isolated shrubs over *Hakea lissocarpha*, *Banksia dallanneyi* low isolated shrubs on sandy loams along valleys, lower slopes, and drainage line edges	8 / <1%
Drainage Lines	
D2 EwwCc TooXp BeHlLcHs *Eucalyptus wandoo* subsp. *wandoo*, *Corymbia calophylla* mid forest over *Trymalium odoratissimum* subsp. *odoratissimum*, *Xanthorrhoea preissii* tall shrubland over *Bossiaea eriocarpa*, *Hakea lissocarpha*, *Lysiandra calycina*, *Hibbertia semipilosa* low shrubland over low mixed sedges and forbs on laterite/ mica-schist sandy clay loams along minor drainage lines	31 / 1%
D7 ErrEwwCc Mvv JaaTdJp Pm LaRt ***Potential GDV.*** *Eucalyptus rudis* subsp. *rudis*, *E. wandoo* subsp. *wandoo*, *Corymbia calophylla* mid to low open forest over *Melaleuca viminea* subsp. *viminea* tall open shrubland over **Juncus acutus* subsp. *acutus*, *Typha domingensis*, *Juncus pallidus* tall open rushland over **Polypogon monspeliensis* tall open grassland over *Lobelia anceps*, *Rytidosperma tenuiflorum* low open forbland/ grassland on sandy clay loams along minor to medium drainage lines and floodplains	26 / 1%
D8 EwwCc TooMr Sr HcBcBdd *Eucalyptus wandoo* subsp. *wandoo*, *Corymbia calophylla* mid woodland over *Trymalium odoratissimum* subsp. *odoratissimum*, *Melaleuca radula* mid shrubland over *Styphelia retrorsa* mid isolated shrubs over *Hibbertia commutata*, *Babingtonia camphorosmae*, *Banksia dallanneyi* subsp. *dallanneyi* var. *dallanneyi* low sparse shrubland on clayey sands along minor drainage lines/ drainage areas	2 / <1%

Vegetation Code and Description	Approximate area (ha / %)
Wetlands	
W3 Err Mr TdJkJp Pm ***Potential GDV.*** *Eucalyptus rudis* subsp. *rudis* low open woodland over *Melaleuca rhaphiophylla* tall shrubland over *Typha domingensis*, *Juncus kraussii*, *Juncus pallidus* tall rushland over **Polypogon monspeliensis* isolated grasses on clays along drainage lines and drainage areas/ floodplains	8 / <1%
W4 Eww Mr JpTdJk PmSa ***Potential GDV.*** *Eucalyptus wandoo* subsp. *wandoo* trees mid isolated trees over *Melaleuca rhaphiophylla* tall open shrubland over *Juncus pallidus*, *Typha domingensis*, *Juncus kraussii* tall rushland over **Polypogon monspeliensis*, *Schenkia australis* isolated grasses/ forbs on clays along drainage lines and drainage areas/ floodplains	5 / <1%
Non-native vegetation mapping units	
Farmland (pasture)	1,231 / 55%
Planted	8 / <1%
Non-vegetated (e.g., existing tracks)	14 / 1%
Total	**2,240 / 100**

4.2.3.4 Vegetation condition

The MDE is predominantly (approximately 1916 ha or 86%) in a cleared, Completely Degraded or Degraded condition (Table 11), due to its historic land use for agriculture, with clearing, introduced pasture and heavy grazing and a paucity of a native understorey (Biologic 2024).

Table 11. Vegetation condition within the MDE

Vegetation Condition	Description and comments	Approximate area (ha / %)
Excellent	Vegetation structure completely intact with species diversity consisted with undisturbed. Only minor non-aggressive weeds present.	161 / 7%
Very Good	Occurred in larger remnant bushland patches, supporting a vegetation structure that was consistent with undisturbed ecosystems (i.e. upper, mid and lower strata with native species dominating the stratus). Weeds are present but in low densities, and there is evidence of grazing, trampling and rabbits.	82 / 4%
Good	Coincided with areas closer to roads and fences and some drainage lines that had weeds encroaching, as well as larger areas that have been grazed. There are a few native species in each layer (overstorey, mid storey, understorey)	81 / 4%

Vegetation Condition	Description and comments	Approximate area (ha / %)
	but species diversity is adversely impacted from disturbance and edge effects.	
Degraded	Generally coincided with smaller remnant patches, and larger areas that had been heavily grazed. Only the overstorey layer of Eucalypts was intact, with the understorey consisting of introduced grasses and herbs, as well as the occasional native shrub, sedge, or herb.	618 / 28%
Completely Degraded	Coincided with areas that were almost devoid of native vegetation, containing isolated native trees over introduced flora. Also included Farmland and Planted mapping units.	1284 / 57%
Cleared	Coincided with the cleared informal tracks and firebreaks along fence lines, and roads.	14 / <1%
Grand Total		**2240 / 100%**

4.2.3.5 Conservation significant vegetation

Table 12 presents an assessment of the occurrence of Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) within the MDE, based on database searches and the findings of baseline surveys (Biologic 2024). As presented, there is one EPBC Act listed TEC (WA listed PEC) identified within the MDE, with no other TECs or PECs occurring within the MDE.

Baseline surveys (Biologic 2024) have identified one 1.86 ha patch of the EPBC Act listed Banksia woodlands of the Swan Coastal Plain TEC within the MDE, mapped as the Deep Sandplains vegetation type S1, which is in Excellent condition (see Figure 4). The structure of the TEC is of low-mid open *Banksia attenuata* woodland, either with scattered trees of *Eucalyptus marginata* subsp. *Thalassica* and *Nuytsia floribunda* or co-dominant with *Corymbia calophylla* and *Eucalyptus marginata* subsp. *Thalassica*.

The EPBC Act listed Banksia woodlands of the Swan Coastal Plain TEC is a WA listed Priority 3 (P3) PEC. The 1.86 ha patch of S1 may also be representative of the Swan Coastal Plain Banksia attenuata – Banksia menziesii woodlands (FCT23b) WA listed P3 PEC, as it has a shared affinity with the floristic community type (FCT) 23b. The FCT23b PEC is a component of the EPBC Act listed TEC.

Table 12. Occurrence of conservation significant ecological communities within the MDE

Community	BC Act / DBCA status	EPBC Act status	Description	Closest recorded occurrence outside from MDE	Occurrence within the MDE	Rationale
Banksia woodlands of the Swan Coastal Plain IBRA region (*Banksia* WL SCP)	P3	EN	Canopy is most commonly dominated or co-dominated by *Banksia attenuata* and/or *B. menziesii*. Other *Banksia* species that can dominate are *B. prionotes* or *B. ilicifolia*. Typically occurs on sandplain landforms, particularly Bassendean and Spearwood sands and occasionally Quindalup sands; also common on sandy colluvium and aeolian sands of Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau.	10.9 km W	**Confirmed**	**Identified in baseline survey**
Swan Coastal Plain Banksia attenuata – Banksia menziesii woodlands (FCT 23b)	P3	EN[1]	A component of the EPBC listed Banksia Woodlands of the Swan Coastal Plain TEC. These woodlands occur in the Bassendean system, from Melaleuca Park to Gingin. Occurs in reasonably extensive	16.9 km W	Potential	VT S1 has shared affinity for FCT23B.

Community	BC Act / DBCA status	EPBC Act status	Description	Closest recorded occurrence outside from MDE	Occurrence within the MDE	Rationale
			Banksia woodlands north of Perth.			
York Gum Woodlands of the wheatbelt	P3	CR	*Eucalyptus loxophleba* (York gum) woodlands	12.2 km NE	No	Indicator taxon not present (York Gum)
Eucalypt woodlands of the Western Australian Wheatbelt	P3	CR	Eucalypt-dominated woodlands in the Western Australian Wheatbelt region (including outlying patches in the eastern parts of the Northern Jarrah Forest subregion adjacent to the Avon Wheatbelt IBRA region that are off the Darling Range and have annual rainfall <600 mm). Structure is a mature woodland with crown cover of the tree canopy >10%.	15.2 km E	No	Key diagnostic eucalypts not present. MDE outside of rainfall range.
Corymbia calophylla - *Kingia australis* woodlands on heavy soils (floristic community type 3a as originally described in Gibson et al. 1994) (SCP3a)	CR	EN	Typical native taxa in the community are the tree *Corymbia calophylla,* the shrubs *Banksia dallanneyi*, *Philotheca spicata, Kingia australis* and *Xanthorrhoea preissii* and the herbs, rushes and sedges	15.4 km SSW	No	*C. calophylla* and *K. australis* not recorded together as dominant taxa.

Community	BC Act / DBCA status	EPBC Act status	Description	Closest recorded occurrence outside from MDE	Occurrence within the MDE	Rationale
			Cyathochaeta avenacea, Dampiera linearis, Haemodorum laxum, Desmocladus fasciculatus, Mesomelaena tetragona and *Morelotia octandra.*			
Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs	P1	CR	Claypans (predominantly basins) usually dominated by a shrubland of *Melaleuca lateritia* occurring both on the coastal plain and the adjacent plateau. These claypans are characterized by aquatic (*Hydrocotyle lemnoides* – Priority 4) and amphibious taxa (e.g., *Glossostigma diandrum, Villarsia capitata* and *Eleocharis keigheryi* - DRF).	16.4 km N	No	*Melaleuca lateritia* not present.
Banksia woodland of the Gingin area restricted to soils dominated by yellow to orange sands	P2	EN[1]	The vegetation is described as scattered *Eucalyptus todtiana* and *C. calophylla* over *B. menziesii* and *B.*	16.6 km WWN	No	Banksia woodlands lacking *B. menziesii* and *E. todtiana* have white sandy soils.

Community	BC Act / DBCA status	EPBC Act status	Description	Closest recorded occurrence outside from MDE	Occurrence within the MDE	Rationale
			attenuata low open woodland over *Jacksonia sternbergiana* and *Adenanthos cygnorum* high open shrubland over *Allocasuarina humilis* and *Chamelaucium lullfitzii* (DRF) open shrubland over *Eremaea pauciflora* and *Astroloma xerophyllum* low shrubland over *Mesomelaena pseudostygia* open sedgeland.			
Herb rich saline shrublands in clay pans (floristic community type 7 as originally described in Gibson et al. 1994 (SCP07))	EN	CR	The community is generally dominated by *Melaleuca viminea, M. osullivanii, M. cuticularis* or *Casuarina obesa* or a mixture of these species.	16.6 km SSW	No	Key indicator taxa not present.
Banksia attenuata woodlands over species rich dense shrublands (floristic community type 20a as originally described in	CR	EN[1]	This community is generally very species rich. It is usually dominated by *B. attenuata* occasionally with *E. marginata* with	16.8 km NW	No	Quadrats in Banksia woodland did not group with any FCT20a regional sites.

Community	BC Act / DBCA status	EPBC Act status	Description	Closest recorded occurrence outside from MDE	Occurrence within the MDE	Rationale
Gibson et al. 1994) (SCP20a)			*Bossiaea eriocarpa*, *Conostephium pendulum*, *Hibbertia huegelii*, *Hibbertia hypericoides*, *Petrophile linearis*, *Scaevola repens*, *Stirlingia latifolia*, *Mesomelaena pseudostygia* and *Alexgeorgea nitens* being common in the understorey.			
Corymbia calophylla – *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in Gibson et al. 1994) (SCP3c)	EN	EN	The community is usually dominated by *C. calophylla* and *Xanthorrhoea preissii*. It also occasionally includes *Eucalyptus wandoo*. The more common shrubs include *Gompholobium marginatum*, *Hypocalymma angustifolium* and *Banksia dallanneyi*, with herbs, grasses and sedges including *Burchardia congesta*, *Cyathochaeta avenacea*, *Neurachne alopecuroidea*,	17.9 km SSW	No	*C. calophylla* and *X. preissii* occurred with taxa which are not part of FCT23c.

Community	BC Act / DBCA status	EPBC Act status	Description	Closest recorded occurrence outside from MDE	Occurrence within the MDE	Rationale
			Caesia micrantha, Mesomelaena tetragona, Morelotia octandra, Desmocladus flexuosus, Opercularia vaginata, Sowerbaea laxiflora, Lepidosperma spp. And *Drosera menziesii* also common.			
Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain	EN	EN	Typical and common native species in areas of best developed limestone are: the tree *Casuarina obesa* the mallees *Eucalyptus decipiens* and *Eucalyptus foecunda,* the shrubs *Melaleuca huegelii, Alyogyne huegelii, Grevillea curviloba* (endangered), *Grevillea evanescens* (priority 1) and *Melaleuca systena* and the herb *Thysanotus arenarius*.	18.3 km W	No	Indicator taxa not present.
Communities of Tumulus Springs (Organic Mound Springs, Swan	CR	EN	The habitat of the mound springs is characterised by	19.1 km WWS	No	Mound springs not recorded.

Community	BC Act / DBCA status	EPBC Act status	Description	Closest recorded occurrence outside from MDE	Occurrence within the MDE	Rationale
Coastal Plain)(Mound Springs SCP)			continuous discharge of groundwater in raised areas of peat. Typical and common native vascular plant species associated with the tumulus springs are the trees *Banksia littoralis*, *Melaleuca preissiana* (moonah) and *Eucalyptus rudis* and the shrubs Taxandria linearifolia, *Pteridium esculentum*, *Astartea scoparia* and *Cyclosorus interruptus.*			
Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson et al. 1994) (SCP08)	EN	CR	The vegetation can be dominated by *Viminaria juncea, Melaleuca viminea), Melaleuca lateritia* or *Melaleuca osullivanii* but also occasionally by Eucalyptus wandoo. Commonly occurring flora include *Hypocalymma angustifolium,* Acacia lasiocarpa var. 49racteolate and *Verticordia huegelii*, and aquatic annuals.	19.3 km SW	No	Drainage and wetland vegetation types lack species rich herb layer.

Community	BC Act / DBCA status	EPBC Act status	Description	Closest recorded occurrence outside from MDE	Occurrence within the MDE	Rationale
Southern Swan Coastal Plain *Eucalyptus gomphocephala – Agonis flexuosa* woodlands (floristic community type 25) (SCP25)	P3	EN[1]	Can be a component of the Endangered Banksia Woodlands of the Swan Coastal Plain EPBC listed TEC, or Tuart woodlands and forests of the Swan Coastal Plain EPBC listed TEC. Recorded from the Karrakatta, Cottesloe and Vasse units.	19.7 km WWS	No	*E. gomphocephala* not present. *A. flexuosa* not dominant.
Wooded wetlands that support colonial waterbird nesting areas	P2		This type differs from the listed 'Perched wetlands of the Wheatbelt region with extensive stands of *Casuarina obesa* and *Melaleuca strobophylla*' ('Toolibin-type' wetlands) in that the Wheatbelt type is *Casuarina*, rather than *Melaleuca* dominated. Also, Toolibin Lake type is now brackish-saline (formerly fresh-brackish), whereas this type are currently fresh-brackish	21 km WWN	No	No extensive stands of either *C. obesa* or *M. strobophylla* were observed.

Note: 1 – Commonly a component of 'Banksia Woodlands of the Swan Coastal Plain ecological community' (Endangered)

4.2.3.6 Conservation significant flora

No threatened listed species under the Cth EPBC Act or WA Biodiversity Conservation Act 2016 (BC Act) were recorded during baseline flora surveys within the MDE.

Four species listed on the DBCA Priority Flora List have been recorded within the MDE (Biologic 2024)(Table 13):

- *Stylidium vinosum* (P1) – 295 individuals from 49 point-locations;
- *Drosera sewelliae* (P2) – 8,471 individuals from 91 point-locations;
- *Poranthera ?moorokatta* (P2) – one individual from one point location; and
- *Acacia drummondii* subsp. *affinis* (P3) – 23 individuals from four point-locations.

Database searches (Biologic 2024) indicated that a further four Priority flora species may possibly occur within the MDE, as presented in Table 13.

Table 13. Occurrence of conservation significant flora within the MDE

Taxon	BC Act / DBCA status	EPBC Act status	Occurrence within the MDE	Rationale
Stylidium vinosum	**P1**	**-**	**Confirmed**	**Recorded in baseline survey**
Conostylis caricina subsp. *elachys*	P1	-	Possible	Recently recorded 2.1 km to north. Not likely to be flowering during baseline survey.
Schoenus sp. Toodyay (G.J. Keighery and N. Gibson 2918)	P1	-	Possible	Areas of suitable habitat in good condition. Taxon is small and inconspicuous, may have been present.
Poranthera moorokatta	**P2**	**-**	**Confirmed**	**Recorded in baseline survey**
Drosera sewelliae	**P2**	**-**	**Confirmed**	**Recorded in baseline survey**
Millotia tenuifolia var. *laevis*	P2	-	Possible	Taxon is small and inconspicuous, may have been present.
Acacia drummondii* subsp. *affinis	**P3**	**-**	**Confirmed**	**Recorded in baseline survey**
Oxymyrrhine coronata	P4	-	Possible	DBCA record in MDE. Record area surveyed multiple times and taxon not found.

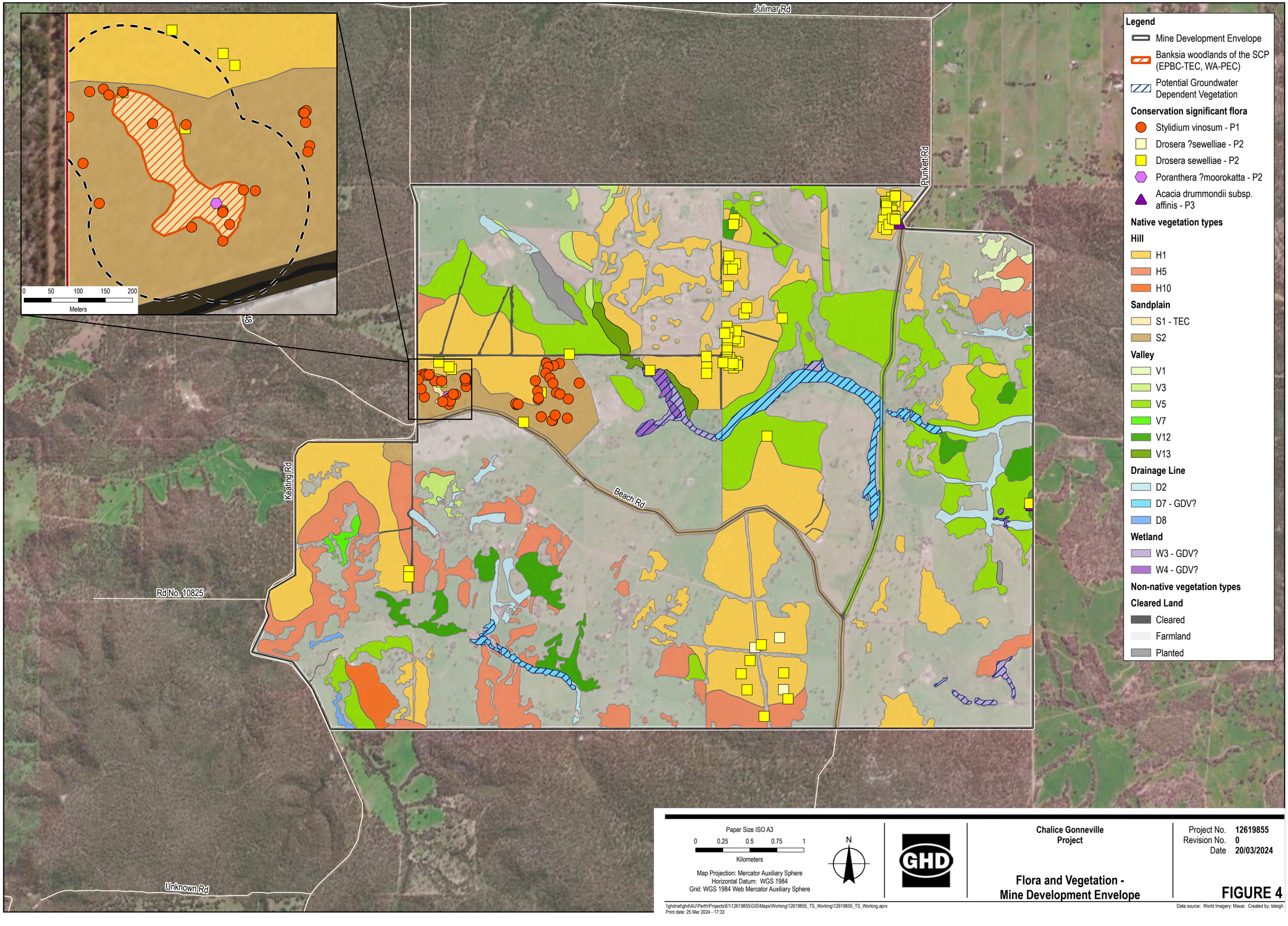
4.2.3.7 Weeds

Baseline surveys recorded a total of 70 introduced taxa within the MDE. None are listed as a Weed of National Significance (WoNS), three are Declared Pests listed under the *Biosecurity and Agriculture Management Act 2007*:

- **Echium plantagineum* – (Paterson's curse) recorded opportunistically in five locations totalling approximately 130 individuals within vegetation types H1, D7 and V12
- **Gomphocarpus fruticosus* – (narrowleaf cottonbush) recorded in minor drainage line vegetation type D7
- **Moraea flaccida* (one-leaf cape tulip) 10 specimens were recorded during targeted survey and 40 specimens recorded opportunistically.

4.2.3.8 Dieback

Glevan Consulting (2021) identified a single area of *Phytophthora* Dieback infestation comprising 21 ha within the MDE. Four separate surveys covering the MDE and surrounding areas were undertaken by Glevan Consulting (2021, 2022). The dieback status of the MDE as currently mapped is shown in Figure 5.



Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometers

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

N

GHD

Chalice Gonneville Project

Flora and Vegetation - Mine Development Envelope

Project No. **12619855**
Revision No. **0**
Date **20/03/2024**

FIGURE 4

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Print date: 25 Mar 2024 - 17:33

Data source: World Imagery: Maxar. Created by: tsleigh

Julimar Rd

Plunkett Rd

Rd No. 14748

Keating Rd

Beach Rd

Rd No. 10825

Unknown Rd

Legend

Mine Development Envelope

Dieback Status

Infested

Uninterpretable

Uninfested

Excluded

Road

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometers

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

N

GHD

Chalice Gonneville Project

Dieback Status - Mine Development Envelope

Project No. 12619855
Revision No. 0
Date 21/03/2024

FIGURE 5

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Print date: 21 Mar 2024 - 15:24

Data source: World Imagery: Maxar. Created by: aridgard

4.2.4 Receiving environment – Infrastructure Development Envelope

4.2.4.1 Regional vegetation

The IDE is located across both the Jarrah Forest (refer section 4.3.3.1), and the Swan Coastal Plain (SCP) bioregions as described by the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995). The SCP bioregion is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, Casuarina obesa on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland (Mitchell et al. 2002).

The Swan Coastal Plain bioregion is classified into two subregions, Perth (SCP2) and Dandaragan Plateau (SCP1), of which the IDE is located within the Perth subregion. The Perth subregion is characterised by colluvial and aeolian sands, alluvial river flats and costal limestone. Heath and/or Tuart woodlands occur on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvial soils. The subregion also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

Pre-European vegetation

The IDE intersects 15 vegetation system associations as shown in Table 14.

Table 14. Vegetation system associations within the IDE

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
Bassendean 51	Sedgeland: Cyperaceae, Restionaceae, Juncaceae (mainly in the South-West)	0 (0%)	0 (0%)	0 (0%)	2 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	756 (49%)
Bassendean 949	Low woodland or open low woodland: York gum Acacia spp., Banksia spp., *Agonis flexuosa*, Callitris spp., *Allocasuarina* spp., Eucalyptus loxophleba.	0 (0%)	0 (0%)	120 (22%)	170 (32%)	0 (0%)	76 (88%)	0 (0%)	0 (0%)	69,992 (61%)
Bassendean 965	Woodland southwest: *Eucalyptus marginata*, *Corymbia calophylla*, E. wandoo.	0 (0%)	0 (0%)	52 (10%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,334 (98%)
East Darling 3	Forest: Mainly *Eucalyptus marginata*, *Corymbia calophylla*	51 (20%)	71 (27%)	51 (9%)	71 (13%)	0 (0%)	0 (0%)	0 (0%)	22 (16%)	241,923 (80%)
East Darling 4	Woodland southwest: *Eucalyptus marginata*, *Corymbia calophylla*, E. wandoo.	99 (38%)	71 (28%)	99(18%)	71 (13%)	0 (0%)	0 (0%)	0 (0%)	58 (43%)	31,185 (66%)
East Darling 968	Woodland southwest: *Eucalyptus marginata*, *Corymbia calophylla*, E. wandoo.	9 (3%)	9 (3%)	9 (2%)	9 (2%)	52 (100%)	0 (0%)	0 (0%)	55 (41%)	9,767 (77%)

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
Gingin 1020	Forest: Mainly *Eucalyptus marginata*, *Corymbia calophylla*	23 (9%)	34 (13%)	56 (10%)	34 (6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,613 (29%)
Gingin 1027	Low forest, woodland or low woodland with scattered trees: *Eucalyptus marginata*, Banksia spp., Allocasuarina spp.	20 (8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	23,462 (59%)
Guilderton 1007	Scrub-heath / Thicket	0 (0%)	0 (0%)	14 (3%)	11 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	17,332 (68%)
Guilderton 949	Low woodland or open low woodland: York gum Acacia spp., Banksia spp., *Agonis flexuosa*, Callitris spp., Allocasuarina spp., *Eucalyptus loxophleba*.	0 (0%)	0 (0%)	9 (2%)	19 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,114 (33%)
Pinjarra 1018	Woodland / Low woodland / Low forest or Woodland	0 (0%)	0 (0%)	12 (2%)	5 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,250 (21%)
Pinjarra 4	Woodland southwest: *Eucalyptus marginata*, *Corymbia calophylla*, E. wandoo.	57 (22%)	74 (29%)	49 (9%)	43 (8%)	0 (0%)	0 (0%)	35 (100%)	0 (0%)	1,238 (12%)
Spearwood 6	Woodland southwest: *Eucalyptus marginata*, *Corymbia calophylla*, E. wandoo.	0 (0%)	0 (0%)	29 (5%)	29 (5%)	0 (0%)	10 (12%)	0 (0%)	0 (0%)	13,288 (24%)

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
Spearwood 949	Low woodland or open low woodland: York gum Acacia spp., Banksia spp., *Agonis flexuosa*, Callitris spp., *Allocasuarina* spp., *Eucalyptus loxophleba*.	0 (0%)	0 (0%)	23 (4%)	39 (7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6,797 (51%)
Spearwood 998	Woodland southwest: *Eucalyptus marginata*, *Corymbia calophylla*, E. wandoo.	0 (0%)	0 (0%)	22 (4%)	27 (5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	17,667 (36%))
Total		**259 (100%)**	**258 (100%)**	**545 (100%)**	**531 (100%)**	**52 (100%)**	**86 (100%)**	**35 (100%)**	**134 (100%)**	**-**

Vegetation Complexes

Regional vegetation complexes have been mapped by Heddle *et al*. (1980) with updates from Webb et al. (2016) based on major geomorphic units on the SCP. The IDE intersects the following vegetation complexes as shown in Table 15.

Table 15. Vegetation complexes within IDE

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
SCP										
Bassendean Complex-Central and South Transition	Woodland of Eucalyptus marginata (Jarrah) - Corymbia calophylla (Marri) with well defined second storey of *Allocasuarina fraseriana* (Sheoak) and *Banksia grandis* (Bull Banksia) on the deeper soils and a closed scrub on the moister sites. The understorey species reflect similarities with the adjacent vegetation complexes.	0 (0%)	0 (0%)	55 (13%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2,143 (98%)
Bassendean Complex-North	Vegetation ranges from a low open forest and low open woodland of Banksia species *Eucalyptus todtiana* (Pricklybark) to low woodland of Melaleuca species and sedgelands which occupy the moister sites.	0 (0%)	0 (0%)	30 (7%)	78 (19%)	0 (0%)	12 (14%)	0 (0%)	0 (0%)	56,660 (72%)
Bassendean Complex-North Transition	A transition complex of low open forest and low woodland of Banksia species - *Eucalyptus todtiana* (Pricklybark) on a series of	0 (0%)	0 (0%)	0 (0%)	43 (11%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	18,553 (89%)

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
	high sand dunes. The understorey species reflect similarities with both the Bassendean-North and Karrakatta-North vegetation complexes.									
Coonambidgee Complex	Vegetation ranges from a low open forest and low woodland of *Eucalyptus todtiana* (Pricklybark) - *Banksia attenuata* (Slender Banksia) - *Banksia menziesii* (Firewood Banksia) - *Banksia ilicifolia* (Holly-leaved Banksia) with localised admixtures of *Banksia prionotes* (Acorn Banksia) to an open woodland of *Corymbia calophylla* (Marri) - Banksia species.	3 (2%)	12 (9%)	9 (2%)	10 (2%)	0 (0%)	0 (0%)	0 (0%)	14 (19%)	2,851 (46%)
Cottesloe Complex-Central and South	Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops.	0 (0%)	0 (0%)	75 (18%)	76 (19%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	14,568 (32%)

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
Herdsman Complex	Sedgelands and fringing woodland of *Eucalyptus rudis* (Flooded Gum) - Melaleuca species.	0 (0%)	0 (0%)	0 (0%)	8 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3,104 (32%)
Karrakatta Complex-Central and South	Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) - Eucalyptus marginata (Jarrah) - *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) - Banksia species. *Agonis flexuosa* (Peppermint) is co-dominant south of the Capel River.	0 (0%)	0 (0%)	15 (4%)	24 (6%)	0 (0%)	12 (14%)	0 (0%)	0 (0%)	12,467 (23%)
Karrakatta Complex-North	Predominantly low open forest and low woodland of Banksia species *Eucalyptus todtiana* (Pricklybark), less consistently open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus todtiana* (Pricklybark) - Banksia species.	0 (0%)	0 (0%)	43 (10%)	0 (0%)	0 (0%)	57 (67%)	0 (0%)	0 (0%)	10,437 (48%)
Karrakatta Complex-North Transition	A transition complex of low open forest and low woodland of Banksia species - *Eucalyptus todtiana* (Pricklybark) on the transition zone of a series of high sand dunes between	0 (0%)	0 (0%)	43 (10%)	51 (13%)	0 (0%)	5 (6%)	0 (0%)	0 (0%)	4,684 (89%)

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
	Bassendean-North and Karrakatta-North.									
Mogumber Complex-South	Open woodland of Eucalyptus calophylla, with some admixture of Eucalyptus marginata (Jarrah) and a second storey of Eucalyptus todtiana (Pricklybark) - Banksia attenuata - Banksia menziesii (Firewood Banksia) - Banksia ilicifolia (Holly-leaved Banksia).	42 (33%)	37 (29%)	31 (7%)	37 (9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5,721 (39%)
Moondah Complex	Low closed to low open forest of Banksia attenuata (Slender Banksia) - Banksia menziesii (Firewood Banksia) - Eucalyptus todtiana (Pricklybark) - Banksia prionotes (Acorn Banksia) on slopes, open woodland of Corymbia calophylla (Marri) - Banksia species in valley.	24 (19%)	0 (0%)	39 (9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	7,233 (41%)
Quindalup Complex	Coastal dune complex consisting mainly of two alliances - the strand and fore-dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest	0 (0%)	0 (0%)	6 (2%)	17 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	33,012 (60%)

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
	of Melaleuca lanceolata (Rottnest Teatree) - Callitris preissii (Rottnest Island Pine), the closed scrub of Acacia rostellifera (Summer-scented Wattle) and the low closed Agonis flexuosa (Peppermint) forest of Geographe Bay.									
Reagan Complex	Vegetation ranges from low open woodland of Banksia species Eucalyptus todtiana (Pricklybark) to closed heath depending on the depth of soil.	9 (7%)	22 (17%)	19 (5%)	24 (6%)	0 (0%)	0 (0%)	0 (0%)	16 (23%)	3,107 (34%)
Yanga Complex	Predominantly a closed scrub of Melaleuca species and low open forest of Casuarina obesa (Swamp Sheoak) on the flats subject to inundation. On drier sites the vegetation reflects the adjacent vegetation complexes of Bassendean and Coonambidgee.	49 (39%)	59 (45%)	49(12%)	49 (12%)	36 (9%)	0 (0%)	0 (0%)	6 (8%)	4,269 (16%)
NJF - Uplands										
Yalanbee (Y6)	Open woodland of *Eucalyptus wandoo* over *Acacia acuminata* with some *Eucalyptus loxophleba*	49 (16%)	28 (9%)	49 (8%)	28 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	92,081 (47%)

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
	on valley slopes, with low woodland of *Allocasuarina huegeliana* on or near shallow granite outcrops in arid and peri-arid zones.									
Yalanbee (Y5)	Mixture of open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* and woodland of *Eucalyptus wandoo* on lateritic uplands in semiarid to peri-arid zones.	0 (0%)	0 (0%)	0 (0%)	0 (0%)	43 (83%)	0 (0%)	0 (0%)	73 (54%)	92,081 (47%)
NJF – Valley Floors and Swamps										
Williams (Wi)	Mixture of woodland of Eucalyptus rudis-Melaleuca rhaphiophylla, low forest of Casuarina obesa and tall shrubland of Melaleuca spp. on major valley systems in arid and peri-arid zones.	7 (2%)	32 (11%)	7 (1%)	32 (5%)	0 (0%)	0 (0%)	0 (0%)	7 (5%)	7,517 (26%)
NJF – Valleys										
Coolakin (Ck)	Woodland of Eucalyptus wandoo with mixtures of Eucalyptus patens, Eucalyptus marginata subsp. thalassica and Corymbia calophylla on the valley slopes in arid and peri-arid zones.	21 (7%)	37 (12%)	21 (3%)	37 (6%)	9 (17%)	0 (0%)	0 (0%)	11 (8%)	64,205 (39%)

Vegetation Complex	Description	Extent within IDE (ha; %)								Remaining extent (ha; % of pre-European extent)
		Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route Option	Northern Contingency	Muchea Contingency	
Michibin (Mi)	Open woodland of *Eucalyptus wandoo* over *Acacia acuminata* with some *Eucalyptus loxophleba* on valley slopes, with low woodland of *Allocasuarina huegeliana* on or near shallow granite outcrops in arid and peri-arid zones.	20 (7%)	20 (7%)	20 (3%)	20 (3%)	0 (0%)	0 (0%)			42,996 (26%)
Murray 2 (My2)	Open forest of Eucalyptus marginata subsp. thalassica-Corymbia calophylla-Eucalyptus patens and woodland of Eucalyptus wandoo with some Eucalyptus accedens on valley slopes to woodland of Eucalyptus rudis-Melaleuca rhaphiophylla on the valley floors in semiarid and arid zones.	59 (19%)	34 (11%)	59 (9%)	34 (5%)	0 (0%)	0 (0%)		44 (33%)	40,952 (69%)
Total		**259 (100%)**	**258 (100%)**	**545 (100%)**	**531 (100%)**	**52 (100%)**	**86 (100%)**	**35 (100%)**	**134 (100%)**	**-**

4.2.4.2 Conservation significant vegetation

No field surveys have been conducted across the IDE. Occurrence of conservation significant ecological communities and their potential to occur based on desktop assessment within the IDE are summarised in Table 16. Four TECs and three PECs are identified as potentially occurring within the IDE as outlined in Table 16. These communities will be the subject of targeted flora surveys across the IDE to confirm presence or absence.

Table 16. Conservation significant communities with potential to occur within the IDE

Community	BC Act / DBCA status	EPBC Act status	Description	Occurrence within the IDE	Rationale
Banksia woodlands of the Swan Coastal Plain IBRA region (*Banksia* WL SCP)	P3	EN	Canopy is most commonly dominated or co-dominated by *Banksia attenuata* and/or *B. menziesii*. Other *Banksia* species that can dominate are *B. prionotes* or *B. ilicifolia*. Typically occurs on sandplain landforms, particularly Bassendean and Spearwood sands and occasionally Quindalup sands; also common on sandy colluvium and aeolian sands of Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau.	Likely	Within known distribution of the community and vegetation composition likely to support this community
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	CR	CR	Woodlands or forests or other structural forms where the primary defining feature is the Eucalyptus gomphocephala (Tuart) in the uppermost canopy layer. Occur on the SCP strongly associated with calcareous soils of the western part of the plain, including those very close to the coast. Mainly occurs where soils are sandy and well drained.	Likely	Within known distribution of the community and vegetation composition likely to support this community
Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion	-	CR	Assemblage of plants and animals and other organisms associated with warm temperate shrubland or heath, dominated by *Melaleuca huegelii* (chenille honeymyrtle), M. systena (coastal honeymyrtle), and/ or *Banksia sessilis* (parrot bush).	Potential	Within known distribution of the community
Swan Coastal Plain Banksia attenuata – Banksia menziesii woodlands (FCT 23b)	P3	EN[1]	A component of the EPBC listed Banksia Woodlands of the Swan Coastal Plain TEC. These woodlands occur in the Bassendean system, from Melaleuca Park to Gingin. Occurs in reasonably extensive Banksia woodlands north of Perth.	Potential	Within known distribution of the community
York Gum Woodlands of the wheatbelt	P3	CR	*Eucalyptus loxophleba* (York gum) woodlands	Unlikley	Outside known distribution of the community

Community	BC Act / DBCA status	EPBC Act status	Description	Occurrence within the IDE	Rationale
Eucalypt woodlands of the Western Australian Wheatbelt	P3	CR	Eucalypt-dominated woodlands in the Western Australian Wheatbelt region (including outlying patches in the eastern parts of the Northern Jarrah Forest subregion adjacent to the Avon Wheatbelt IBRA region that are off the Darling Range and have annual rainfall <600 mm). Structure is a mature woodland with crown cover of the tree canopy >10%.	Unlikely	Outside known distribution of the community
Corymbia calophylla - *Kingia australis* woodlands on heavy soils (floristic community type 3a as originally described in Gibson et al. 1994) (SCP3a)	CR	EN	Typical native taxa in the community are the tree *Corymbia calophylla,* the shrubs *Banksia dallanneyi*, *Philotheca spicata, Kingia australis* and *Xanthorrhoea preissii* and the herbs, rushes and sedges *Cyathochaeta avenacea, Dampiera linearis, Haemodorum laxum, Desmocladus fasciculatus, Mesomelaena tetragona* and *Morelotia octandra.*	Unlikely	Outside known distribution of the community
Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs	P1	CR	Claypans (predominantly basins) usually dominated by a shrubland of *Melaleuca lateritia* occurring both on the coastal plain and the adjacent plateau. These claypans are characterized by aquatic (*Hydrocotyle lemnoides* – Priority 4) and amphibious taxa (e.g., *Glossostigma diandrum, Villarsia capitata* and *Eleocharis keigheryi* - DRF).	Unlikely	Outside known distribution of the community
Banksia woodland of the Gingin area restricted to soils dominated by yellow to orange sands	P2	EN[1]	The vegetation is described as scattered *Eucalyptus todtiana* and *C. calophylla* over *B. menziesii* and *B. attenuata* low open woodland over *Jacksonia sternbergiana* and *Adenanthos cygnorum* high open shrubland over *Allocasuarina humilis* and *Chamelaucium lullfitzii* (DRF) open shrubland over *Eremaea pauciflora* and *Astroloma xerophyllum* low shrubland over *Mesomelaena pseudostygia* open sedgeland.	Potential	Within known distribution of the community

Community	BC Act / DBCA status	EPBC Act status	Description	Occurrence within the IDE	Rationale
Banksia attenuata woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson et al. 1994) (SCP20a)	CR	EN[1]	This community is generally very species rich. It is usually dominated by *B. attenuata* occasionally with *E. marginata* with *Bossiaea eriocarpa*, *Conostephium pendulum*, *Hibbertia huegelii*, *Hibbertia hypericoides*, *Petrophile linearis*, *Scaevola repens*, *Stirlingia latifolia*, *Mesomelaena pseudostygia* and *Alexgeorgea nitens* being common in the understorey.	Potential	Within known distribution of the community
Corymbia calophylla – Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in Gibson et al. 1994) (SCP3c)	EN	EN	The community is usually dominated by *C. calophylla* and *Xanthorrhoea preissii*. It also occasionally includes *Eucalyptus wandoo*. The more common shrubs include *Gompholobium marginatum, Hypocalymma angustifolium* and *Banksia dallanneyi,* with herbs, grasses and sedges including *Burchardia congesta, Cyathochaeta avenacea, Neurachne alopecuroidea, Caesia micrantha, Mesomelaena tetragona, Morelotia octandra, Desmocladus flexuosus, Opercularia vaginata, Sowerbaea laxiflora, Lepidosperma* spp. And *Drosera menziesii* also common.	Unlikely	Outside known distribution of the community
Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)(Mound Springs SCP)	CR	EN	The habitat of the mound springs is characterised by continuous discharge of groundwater in raised areas of peat. Typical and common native vascular plant species associated with the tumulus springs are the trees *Banksia littoralis*, *Melaleuca preissiana* (moonah) and *Eucalyptus rudis* and the shrubs Taxandria linearifolia, *Pteridium esculentum*, *Astartea scoparia* and *Cyclosorus interruptus.*	Unlikely	No mound springs are known to occur within the IDE.
Herb rich shrublands in clay pans (floristic community type 8 as originally described in	EN	CR	The vegetation can be dominated by *Viminaria juncea, Melaleuca viminea), Melaleuca lateritia* or *Melaleuca osullivanii* but also occasionally by Eucalyptus wandoo. Commonly occurring flora include *Hypocalymma angustifolium,* Acacia	Unlikely	Outside known distribution of the community

Community	BC Act / DBCA status	EPBC Act status	Description	Occurrence within the IDE	Rationale
Gibson et al. 1994) (SCP08)			lasiocarpa var. 71racteolate and *Verticordia huegelii*, and aquatic annuals.		
Southern Swan Coastal Plain *Eucalyptus gomphocephala – Agonis flexuosa* woodlands (floristic community type 25) (SCP25)	P3	EN[1]	Can be a component of the Endangered Banksia Woodlands of the Swan Coastal Plain EPBC listed TEC, or Tuart woodlands and forests of the Swan Coastal Plain EPBC listed TEC. Recorded from the Karrakatta, Cottesloe and Vasse units.	Unlikely	Outside known distribution of the community

Note: 1 – Commonly a component of 'Banksia Woodlands of the Swan Coastal Plain ecological community' (Endangered)

4.2.4.3 Conservation significant flora

Desktop investigations indicated that 11 threatened listed species under the EPBC Act or BC Act and a further eight Priority (DBCA Priority List) flora species may possibly occur within the IDE, as presented in Table 17. This list is based on desktop assessment only, and baseline flora and vegetation studies conducted during the assessment period will provide greater certainty of occurrence.

Table 17. Potential occurrence of conservation significant flora within the IDE

Taxon	BC Act / DBCA status	EPBC Act status	Likelihood of occurrence	Rationale
Acacia anomala	VU	VU	Possible	Within known range and suitable habitat present
Andersonia gracilis	VU	EN	Unlikely	Outside of known range and suitable habitat
Anigozanthos viridis subsp. *terraspectans*	VU	VU	Unlikely	Outside of known range
Banksia mimica	VU	EN	Unlikely	Outside of known range and suitable habitat
Caladenia huegelii	CR	EN	Unlikely	Outside of known range and suitable habitat
Caleana dixonii	VU	EN	Unlikely	Outside of known range and suitable habitat
Chamelaucium lullfitzii	VU	EN	Possible	Within known range
Conospermum densiflorum subsp. *unicephalatum*	EN	EN	Unlikely	Outside of known range and suitable habitat
Darwinia carnea	CR	EN	Unlikely	Outside of known range and suitable habitat
Darwinia foetida	EN	CR	Possible	Within known range
Diplolaena andrewsii	EN	EN	Unlikely	Outside of known range
Diuris micrantha	VU	VU	Unlikely	Outside of known range
Diuris purdiei	EN	EN	Unlikely	Outside of known range
Drakaea elastica	CR	EN	Unlikely	Outside of known range and suitable habitat
Eleocharis keigheryi	VU	VU	Possible	Within known range

Taxon	BC Act / DBCA status	EPBC Act status	Likelihood of occurrence	Rationale
Eucalyptus argutifolia	VU	VU	Possible	Within known range
Eucalyptus leprophloia	EN	EN	Unlikely	Outside of known range and suitable habitat
Grevillea corrugata	VU	EN	Possible	Within known range and suitable habitat present
Grevillea curviloba	EN	EN	Possible	Within known range and suitable habitat present
Grevillea flexuosa	VU	VU	Possible	Within known range and suitable habitat present
Hypocalymma sylvestre	EN	EN	Possible	Within known range and suitable habitat present
Macarthuria keigheryi	EN	EN	Unlikely	Outside of known range
Melaleuca sciotostyla	EN	EN	Unlikely	Outside of known range and suitable habitat
Melaleuca sp. Wanneroo (G.J. Keighery 16705)	EN	EN	Possible	Within known range and suitable habitat present
Synaphea sp. Fairbridge Farm (D.Papenfus 696)	CR	CR	Unlikely	Outside of known range
Thelymitra dedmaniarum	CR	EN	Unlikely	Outside of known range and suitable habitat
Thelymitra stellata	EN	EN	Possible	Within known range and suitable habitat present
Stylidium vinosum	P1	-	Possible	Within known range and suitable habitat present
Conostylis caricina subsp. elachys	P1	-	Possible	Within known range and suitable habitat present
Schoenus sp. Toodyay (G.J. Keighery & N. Gibson 2918)	P1	-	Possible	Within known range and suitable habitat present
Poranthera moorokatta	P2	-	Possible	Within known range and suitable habitat present

Taxon	BC Act / DBCA status	EPBC Act status	Likelihood of occurrence	Rationale
Drosera sewelliae	P2	-	Possible	Within known range and suitable habitat present
Millotia tenuifolia var. laevis	P2	-	Possible	Within known range and suitable habitat present
Acacia drummondii subsp. affinis	P3	-	Possible	Within known range and suitable habitat present
Oxymyrrhine coronata	P4	-	Possible	Within known range and suitable habitat present

4.2.5 Potential impacts and mitigations

An environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts to flora and vegetation along with proposed measures to mitigate potential impacts within the MDE and IDE are summarised below in Table 18.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Mitigations will be presented in the Environmental Review Document (ERD).

4.2.6 Proposed studies

Investigations associated with the MDE have been ongoing since 2020 and will continue in 2024 to inform the preparation of the ERD.

Studies for the IDE are planned for H2 2024.

4.2.7 Assessment and significance of residual impacts and environmental outcomes

An assessment of potential residual impacts and environmental outcomes resulting from the implementation of the Proposal, and their significance, will be undertaken during the assessment process and will be presented in the ERD.

Table 18. Flora and Vegetation – potential environmental impacts and proposed mitigations

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Avoid:** « The MDE is contained to Chalice-owned farmland. « The conceptual disturbance footprint within the MDE has been designed to avoid a patch of EPBC Act listed TEC (WA listed PEC) (Banksia Woodlands of the Swan Coastal Plain). « The disturbance footprint within the IDE will be refined pending the outcome of baseline flora and vegetation surveys, with avoidance of threatened ecological communities and threatened species as far as practicable. **Minimise:** « Minimise clearing within the MDE and IDE to the extent required for safe and adequate construction and operation. « Prioritise use of previously disturbed areas to the extent possible. « Manage the potential degradation of vegetation by dust deposition through development of dust suppression and management techniques. « Limit the spread of Phytophthora dieback by implementing dieback management controls specific to the MDE and IDE. « Limit the spread of existing weeds by implementing a Weed Management Strategy specific to the MDE and IDE. « Manage the potential degradation of vegetation as a result of increased fire risk by implementing fire prevention and management measures. « Maintain existing surface water flow regimes as much as possible with the installation and maintenance of surface water/drainage infrastructure across the MDE and IDE. **Rehabilitate:** « Chalice will prepare and implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020), for the Proposal. « Inclusion of offsets to mitigate any significant residual impact from the Proposal via restoration and connection of fragmented habitat in the vicinity of the MDE.
Clearing of up to 940 ha of remnant native vegetation	
Potential direct disturbance of DBCA Priority flora species including: « *Stylidium vinosum* (P1) « *Drosera sewelliae* (P2) « *Poranthera ?microkatal* (P2) « *Acacia drummondii* subsp. *affini* (P3)	
Introduction and/or spread of invasive species	
Smothering of vegetation by dust	
Fire and alteration of fire regimes	
Introduction and/or spread of *Phytophthora* dieback	
Changes to hydrological regimes	
IDE	
Clearing of remnant native vegetation	
Potential direct disturbance of significant flora or communities	
Introduction and/or spread of invasive species	
Introduction of Phytophthora dieback	
Disturbance of acid sulfate soils causing impacts to health of flora and vegetation	
Impacts to water dependent vegetation from changes to construction dewatering	
Impacts to vegetation condition from sediment discharges or accidental discharges of hydrocarbons, chemicals and wastes	

4.3 Terrestrial environmental quality

4.3.1 EPA Objective

The EPA objective for terrestrial environmental quality is '*To maintain the quality of land and soils so that environmental values are protected*' (EPA 2016b).

4.3.2 EPA policy and guidance

- Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2023a)
- Environmental Factor Guideline – Terrestrial Environmental Quality (EPA, 2016b)
- Statutory Guidelines for Mine Closure Plans (DEMIRS 2020)
- Contaminated Sites Guidelines: Assessment and Management of Contaminated Sites (DWER 2021)
- Draft Guidance – Material Characterisation Baseline Data Requirements for Mining Proposals (DMP 2016)

4.3.3 Receiving environment – Mine Development Envelope

4.3.3.1 Surficial geology and soils

The MDE lies on the Darling plateau, which comprises an undulating landform of lateritic regolith over Archean age granitic rocks. The 1:250,000 geological mapping (Perth sheet) indicates that the surficial geology of the MDE comprises laterite (Czl), with sand sheets overlying laterite (Czs) and alluvium (Qa) in headwaters of drainage areas, and granitic rocks (Age) exposed or at shallow depth in drainage areas on the south-west and east sides.

Soil landscape mapping (DPIRD-064 [GoWA 2024]) indicates that the MDE primarily lies over the Wundowie land system, with the eastern portion of the MDE lying over the Clackline land system and the western portion over the Bindoon land system. These systems are described as follows:

- Wundowie: Intact undulating lateritic terrain with minor rock outcrops in the northeastern Darling Range. "Buckshot" gravels, duricrust and some deep sands.
- Clackline: Moderately dissected areas with gravelly slopes and ridges and minor rock outcrop on the eastern side of the Darling Plateau over weathered granite and granitic gneiss. Loamy gravels, shallow duplexes and pale deep sands common.
- Bindoon: Gentle to steep hills with gentle valleys on metamorphic gneiss and schist, and dolerite. Variable soils.

Drilling investigations over the MDE indicate that the laterite is approximately 5-25 m thick over granite bedrock.

4.3.3.2 Deposit geology

The Gonneville Deposit is located within an approximate 1.9km x 0.9km x 0.8km section of the Julimar Complex, known as the Gonneville Intrusion, which has a north-north-east strike, a maximum thickness of approximately 650m, and a 45° dip to the west-north-west.

Within the MDE the Gonneville Deposit lies at varying depths from near surface down to approximately 1,200 m. The Deposit comprises a shallow oxidised deposit over a deeper sulphide deposit.

Tailings characterisation studies have been undertaken with initial results indicating tailings to be classified as medium plasticity sandy/silt clay, with a hydraulic conductivity of settled tailings in the range of 10^{-8} to 10^{-9} m/s. Tailings geochemistry tests on high grade ore samples indicate that any potential acid rock drainage is likely to be mitigated through buffering by the gangue mineralisation and/or the use of sub-aqueous disposal.

Waste rock characterisation completed to date suggests a low risk of acid rock drainage generation due to low sulphide content in the waste rock.

4.3.4 Receiving environment – Infrastructure Development Envelope

The IDE corridor options run east to west and intersect both the SCP and the Darling Plateau. In the east, The Darling Plateau overlies Archaen granite rocks and has an average elevation of about 300 m. The Swan Coastal Plain extends west from the Darling Scarp to the Indian Ocean, ranging in elevation from 75m to sea level. The Darling Scarp is the surface expression of the Darling Plateau and is the slope that splits this SCP and the Darling Plateau. Water routes Option 1 and Option 2 traverse this Darling Scarp. Specific geology that occurs within the IDE is listed and described in Table 19. Within both power routes, Option 1 and Option 2, the dominant geology type present is described as "Laterite-chiefly massive, but includes overlying pisolithic gravel and laterized sand". The dominant geology type within the Water Route Options, is the Bassendean Sands complex, described as Quartz sand (fixed dunes).

Soil Land Systems that are present within the IDE options are listed in Table 20. Amongst the two power route options, the two similarly dominant soil landscape systems are:

- The Bindoon System, described as a gentle to steep hills with gentle valleys on metamorphic gneiss and schist, and dolerite. Variable soils and wandoo woodland with some Casuarina huegeliana in rocky areas and marri woodland on sandy areas, minor York gum woodland
- The Gabbla System, described as the western boundary of the Darling Pateau to the east of the Dandaragan plateau. This system has gentle to moderate slopes with yellow, red and grey loams and clays, and gravel common and sand pockets. E. wandoo and loxophleba on clay

The dominant soil landscape system present within the Water Route Options is:

- The Bassendean System, described as sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Banksia-paperbark woodlands and mixed heaths.

The majority of the Swan Coastal Plain is mapped as having a moderate to low risk of ASS, with particular "hotspots" having a higher risk. The IDE does not overlap with any higher ASS risk areas. The Power Route Options have between 10-15% of their areas with moderate to low-risk of ASS. The Water Route Options, have between 35-40% of their extents being mapped as moderate to low risk of ASS.

Table 19. Geology units within the IDE

Geological Unit		Extent within IDE (ha; %)							
Code	Description	Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route option	Northern Contingency	Muchea Contingency
Alb	Quartz-mica schist, biotite generally in excess of muscovite	12 (5%)	11 (4%)	12 (2%)	11 (2%)	0 (0%)	0 (0%)	0 (0%)	7 (5%)
Am	Migmatite-banded and nebulitic, often strongly contorted	6 (2%)	6 (2%)	6 (1%)	6 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Anb	Quartz-feldspar-biotite gneiss, generally well-banded, may contain garnet	39 (15%)	23 (9%)	39 (7%)	23 (4%)	0 (0%)	0 (0%)	0 (0%)	13 (9%)
Anf	Quartz-feldspar-biotite granofels,melanocratic and poorly banded	15 (6%)	0 (0%)	15 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	29 (21%)
Czl	Laterite-chiefly massive, but includes overlying pisolithic gravel and laterized sand	74 (29%)	90 (35%)	105 (19%)	91 (17%)	48 (86%)	48 (92%)	0 (0%)	75 (56%)
Czs	Sand overlying laterite-yellow, white or grey and often associated with drainage courses	1 (0%)	1 (0%)	1 (0%)	1 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (2%)
Ko	Osbourne formation: glauconitic siltstone, claystone, shale and sandstone	0 (0%)	6 (2%)	0 (0%)	6 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Qa	Alluvium and minor colluvium developed on laterite of the Darling Range	19 (7%)	4 (2%)	22 (4%)	4 (1%)	0 (0%)	0 (0%)	0 (0%)	2 (2%)
Qm	Sandy colluvium from Cretaceous rocks, variably laterized	6 (2%)	6 (2%)	2 (0%)	7 (1%)	0 (0%)	0 (0%)	25 (71%)	0 (0%)

Geological Unit		Extent within IDE (ha; %)							
Code	Description	Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route option	Northern Contingency	Muchea Contingency
Qpa	Guildford Formation: alluvium (clay, loam, sand, gravel) variably lateritized and podsolized	44 (17%)	64 (25%)	45 (8%)	32 (6%)	0 (0%)	0 (0%)	10 (29%)	0 (0%)
Qpb	BASSENDEAN SAND: quartz sand (fixed dunes)	4 (2%)	3 (1%)	135 (25%)	186 (35%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Qpck	Coastal Limestone: predominantly calcarenite and kankar	0 (0%)	0 (0%)	53 (10%)	74 (14%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Qpcs	Coastal Limestone: predominantly quartz sand	0 (0%)	0 (0%)	32 (6%)	33 (6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Qpm	Muchea Limestone: lacustrine limestone	3 (1%)	2 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Qpo	Colluvium, soil and undifferentiated sand over laterite of Coastal Plain includes minor alluviated areas	18 (7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Qra	Alluvium-clay, sand and loam	4 (1%)	24 (9%)	4 (1%)	24 (4%)	0 (0%)	0 (0%)	0 (0%)	3 (2%)
Qrc	Colluvium, including valley-fill deposits, variably lateritized and podsolized	14 (5%)	16 (6%)	14 (3%)	16 (3%)	4 (14%)	4 (8%)	0 (0%)	4 (3%)
Qrs	Safety Bay Sand: eolian and beach lime sand, slightly lithified	0 (0%)	0 (0%)	8 (1%)	15 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Qrw	Swamp and lacustrine deposits-peat, peaty sand and clay	0 (0%)	0 (0%)	51 (9%)	2 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
TOTAL		**259 (100%)**	**258 (100%)**	**545 (100%)**	**531 (100%)**	**52 (100%)**	**86 (100%)**	**35 (100%)**	**134 (100%)**

Table 20. Soil and Land Systems occurring within the IDE options

Geological Unit		Extent within IDE (ha; %)							
Code	Description	Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route option	Northern Contingency	Muchea Contingency
Bassendean System	Swan Coastal Plain from Busselton to Jurien. Sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Banksia-paperbark woodlands and mixed heaths.	0 (0%)	0 (0%)	179 (33%)	181 (34%)	0 (0%)	86 (100%)	0 (0%)	0 (0%)
Bindoon System	Gentle to steep hills with gentle valleys on metamorphic gneiss and schist, and dolerite. Variable soils. Wandoo woodland with some Casuarina huegeliana in rocky areas and marri woodland on sandy areas, minor York gum woodland	74 (29%)	57 (22%)	74 (14%)	57 (11%)	0 (0%)	0 (0%)	0 (0%)	56 (41%)
Coonambi-dgee System	Footslopes of sand, on the western margin of the Dandaragan Plateau. Low woodland and shrubland with occasional trees. Species include Banksia prionotes, low and occasional stunted E. marginata with Adenanthos spp.,	7 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Geological Unit		Extent within IDE (ha; %)							
Code	Description	Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route option	Northern Contingency	Muchea Contingency
Dandaragan System	Subdued dissected lateritic plateau, undulating low hills and rises with narrow alluvial plains. Variable deep sands and sandy gravels plus minor earths, duplexes and clays. Marri woodlands and shrublands	0 (0%)	6 (2%)	0 (0%)	6 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Gabbla System	Western boundary of the Darling Pateau to the east of the Dandaragan plateau. Gently to moderately slopes. Yellow, red and grey loams and clays, with gravel common and sand pockets. E. wandoo and loxophleba on clay	63 (24%)	63 (25%)	63 (12%)	63 (12%)	0 (0%)	0 (0%)	0 (0%)	20 (15%)
Julimar System	Moderately dissected areas with gravelly slopes and ridges and minor rock outcrop on the eastern side of the Darling Plateau over weathered granite and granitic gneiss, loamy gravel, shallow duplexes and pale deep sand common.	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (12%)	0 (0%)	0 (0%)	7 (5%)

Geological Unit		Extent within IDE (ha; %)							
Code	Description	Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route option	Northern Contingency	Muchea Contingency
Mogumber System	Gentle to moderate sloping sandplain, varying from pale to yellow clayey sand with gravel and laterised ridges. Low woodland and shrubland of, E. calophylla, Banksia and Acacia spp.. Some tall E.calophylla and marginata.	27 (10%)	15 (6%)	0 (0%)	15 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Nooning System	Brockman river valley flattish valley floors of the upper that is prone to salinity. Loams, clays and gleyed salty sandy clays and gravelly soils are present. E. rudis, camaldulensis and melaleucas Casuarina obesa in the most salty areas.	4 (2%)	6 (2%)	4 (1%)	6 (1%)	0 (0%)	0 (0%)	0 (0%)	3 (3%)
Quindalup South System	Coastal dunes, of the Swan Coastal Plain, with calcareous deep sands and yellow sands. Coastal scrub.	0 (0%)	0 (0%)	5 (1%)	13 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Geological Unit		Extent within IDE (ha; %)							
Code	Description	Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route option	Northern Contingency	Muchea Contingency
Reagan System	Gentle slopes from the Dandaragan plateau to the Pinjarra plain. Brown, yellow and pale sands that may be shallow to very deep with clay or duricrust underlying. Variable low woodland and shrubland of Eucalypts, Banksia, Acacia.	25 (10%)	52 (20%)	78 (114%)	44 (8%)	0 (0%)	0 (0%)	28 (78%)	0 (0%)
Spearwood System	Sand dunes and plains. Yellow deep sands, pale deep sands and yellow/brown shallow sands.	0 (0%)	0 (0%)	80 (15%)	100 (19%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Wundowie System	Intact undulating lateritic terrain with minor rock outcrops in the north eastern Darling Range. "Buckshot" gravels, duricrust and some deep sands vegetated by Jarrah forest.	11 (4%)	11 (4%)	11 (2%)	11 (2%)	49 (92%)	0 (0%)	0 (0%)	48 (36%)
Yanga System	Poorly drained plain with pale sands and deep sandy duplex, wet, semi-wet and saline wet soils. Banksia-pricklybark-marri-swamp sheoak-paperbark woodlands.	48 (19%)	48 (19%)	51 (9%)	36 (7%)	0 (0%)	0 (0%)	8 (22%)	0 (0%)

Geological Unit		Extent within IDE (ha; %)							
Code	Description	Power Route Option 1	Power Route Option 2	Water Route Option 1	Water Route Option 2	Site Access Roads	Mid-Route option	Northern Contingency	Muchea Contingency
TOTAL		259 (100%)	258 (100%)	545 (100%)	531 (100%)	52 (100%)	86 (100%)	35 (100%)	134 (100%)

4.3.5 Potential impacts and mitigations

A detailed environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts to terrestrial environmental quality along with proposed measures to mitigate potential impacts within the MDE and IDE are summarised below in Table 21.

Further mitigation measures will be developed during the environmental impact assessment process, which is running parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phase. Mitigations will be presented in the ERD.

Table 21. Terrestrial Environmental Quality – Potential environmental impacts and proposed mitigations

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Avoid:** « The MDE is contained to Chalice-owned farmland. **Minimise:** « Minimise clearing within the MDE and IDE to the extent required for safe and adequate construction and operation. « Appropriate drainage design to manage run-off and surface water flow to prevent sediment discharges and erosion. « Identify and manage acid sulfate soils (if present). « Identify and manage contaminated sites (if present). « Geochemical assessment will be undertaken to determine if any materials are expected to result in acid and/or metalliferous drainage and develop management strategies for such material as required. **Rehabilitate:** « Chalice will prepare and implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020), for the Proposal.
Erosion due to vegetation clearing and changes to surface water regimes	
Erosion of rehabilitated landforms post-closure	
Acid, saline and/or metalliferous drainage in waste rock landforms and tailings storage	
Contamination due to accidental discharges of hydrocarbons, chemicals and wastes.	
Disturbance of existing site contamination from agricultural land use	
IDE	
Erosion due to vegetation clearing	
Disturbance of acid sulfate soils	
Contamination due to accidental discharges of hydrocarbons, chemicals and wastes	
Disturbance of existing site contamination	

4.3.6 Proposed studies

Investigations associated with the MDE have been ongoing since 2020 and will continue in 2024 to inform the preparation of the ERD.

Studies for the IDE are planned for H2 2024.

4.3.7 Assessment and significance of residual impacts and environmental outcomes

An assessment of potential residual impacts and environmental outcomes resulting from the Proposals implementation, and their significance, will be undertaken during the assessment process and will be presented in the ERD.

4.4 Terrestrial fauna

4.4.1 EPA Objective

The EPA objective for terrestrial fauna is '*To protect terrestrial fauna so that biological diversity and ecological integrity are maintained*' (EPA 2016e).

4.4.2 EPA policy and guidance

- Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2023a)
- Environmental Factor Guideline – Terrestrial Fauna (EPA, 2016e)
- Technical Guidance – Sampling of shortrange endemic invertebrate fauna (EPA, 2009)
- Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA, 2020a)

4.4.3 Receiving environment – Mine Development Envelope

4.4.3.1 Baseline surveys

Terrestrial fauna surveys that have been undertaken for the Proposal are outlined in Table 22.

Table 22. Terrestrial fauna studies undertaken for the MDE

Date of survey Author	Report title	Survey/ Report findings
2020 July Western Wildlife	Basic vertebrate fauna survey, targeted Chuditch survey and cockatoo habitat	Three fauna habitats identified,
2021 November Biologic Environmental Survey Pty Ltd	Chalice Farmland Basic Vertebrate Fauna Survey: Julimar Exploration Project (report February 2022)	Desktop study undertaken prior to field survey in November 2021. Field survey recorded 44 vertebrate fauna; 9 mammal, 28 birds, 5 reptiles and 2 amphibians. Two threatened species recorded – Carnaby's and Forest Red-tailed Black Cockatoo (FRTBC). Previous studies (see above) recorded western brush wallaby, chuditch and quenda in project area
2022 June Biologic Environmental Survey Pty Ltd	Chalice farmland targeted vertebrate fauna survey: Julimar Exploration Project (report October 2022)	Seven fauna habitats occur over study area with 'woodland' habitats (Mixed Wandoo Woodland and Jarrah and Marri Woodland) being of greatest significance (see Table 22 below). Chuditch recorded and breeding confirmed with six pouch young. Population size estimated at 4 females and 9 males. Also recorded western brush wallaby (DBCA P4) and quenda (DBCA P4).

Date of survey Author	Report title	Survey/ Report findings
2022 June and November Biologic Environmental Survey	Black Cockatoo Habitat Assessment: Chalice Gonneville Project (report October 2023)	Targeted survey for black cockatoo habitat. Two trees were considered suitable for black cockatoo breeding and an additional 14 considered possible. Overall, study area is of high habitat value for Carnaby's and FRTBC, namely; high-quality foraging value, nearby water sources, potential night roosting habitat and breeding habitat
2022 September Biologic Environmental Survey	Chalice farmland and Julimar exploration targets aquatic survey Spring 2022 (report March 2023)	Aquatic survey of five farm dams within MDE. Survey recorded 118 macroinvertebrates, two freshwater crayfish species, one native freshwater fish; one species of frog and three waterbirds. No listed threatened species recorded. Of note was a syncarid Bathynellidae 'sp Biologic-BATH024' from a farm dam within the MDE, as only two records documented across the southwest of WA.
2022 – October and May 2023 Biologic Environmental Survey	Short-range Endemic Invertebrate Fauna and Bee Survey: Chalice Gonneville Project (report October 2023)	Desktop assessment followed by two SRE surveys (October 2022 and May 2023). Bee survey was conducted in Oct/ Nov 2022 survey. One priority species was collected - Julimar shield-backed trapdoor spider (P2). Forty-four bee species within 12 genera were collected. Two likely new species were recorded in the area.
2023 June, July and August Biologic Environmental Survey	Targeted vertebrate fauna survey Chalice Gonneville Project (report December 2023)	Targeted vertebrate fauna survey across project area. The primary objective was to investigate the role of the project area within the local habitat matrix for Chuditch (*Dasyurus geoffroii*).

4.4.3.2 Terrestrial fauna habitats

Baseline surveys identified six broad fauna habitat types within the MDE (Biologic, 2023b) (Table 23). All habitats recorded are considered common and widespread in the surrounding region and therefore likely to support typical fauna assemblages and species of the region (Biologic, 2023b).

Table 23. Fauna habitat types within the MDE

Fauna habitat and Description	Extent within the MDE (ha / %)
Pasture Open areas of pasture grasses and introduced species with isolated trees, usually marri, jarrah, wandoo, flooded gum, or small areas of horticultural species (e.g., olives). There is a lack of mid or understory vegetation present.	1,122 (50%)
Jarrah and Marri Woodland Tall, open woodland habitat dominated by marri *Corymbia calophylla* and jarrah *Eucalyptus marginata* trees, with occasional small patches of wandoo. The mid and lower story is a tall shrubland of *Banksia attenuata, B. squarrosa*, *Xanthorrhoea preissii, B. sessilis,* over *Hibbertia sp.*	532 (24%)
Mixed Wandoo Woodland Tall, open woodland habitat with a canopy dominated by wandoo over mid and understory of *Banksia* species (*B. sessilis* and *B. squarrosa*) and grasstree *Xanthorrhoea preissii*. The habitat type includes small patches of marri *Corymbia calophylla* and jarrah *Eucalyptus marginata*, or flooded gum *Eucalyptus rudis* in damper areas.	291 (13%)
Minor Drainage Line Minor Drainage Line comprises small naturally (i.e., rainfall or spring) or artificially (i.e., dam) fed drainage lines which often occur in lower lying areas of the landscape. Vegetation comprises open riparian patches with mixed tree and shrub species occasionally occurring along the drainage line edges.	23 (1%)
Dam/ Waterbody Dam/Waterbody habitat consists of open water areas and adjacent banks. These water bodies are predominantly associated with the farmland pasture present, but also within some areas of woodland and Minor Drainage Lines. These water bodies are likely permanent. Dense, fringing vegetation is often lacking, however mixed tree and shrub species occur along the water edges.	9 (<1%)
Sedgeland Degraded wetland area. Vegetation is comprised primarily of sedge species such as *Juncus acutus, *Watsonia meriana, and Cenchrus clandestinus. There is no defined upper canopy; however, scattered Melaleuca viminea trees are present. Water was present during the field surveys within the habitat; however, it is expected to be ephemeral (non-permanent).	2 (<1%)
Non-vegetated Existing cleared and/or disturbed areas without naturally occurring native vegetation cover. Includes bitumen roads and roadside clearings, dam infrastructure, and historic clearings where rehabilitation or natural revegetation has not occurred.	47 (2%)

Surveys in progress – results pending	214 (11%)
Total	**2240**

4.4.3.3 Conservation significant fauna

Baseline surveys have confirmed the presence of the following conservation significant fauna:

- Chuditch (*Dasyurus geoffroii*) (Vulnerable)
- Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) (*Vulnerable*)
- Carnaby's cockatoo (*Zanda latirostris*) (*Endangered*)
- Western brush wallaby (*Notamacropus irma*) (P4)
- Quenda (*Isoodon fusciventer*) (P4).

Further information is presented below (Table 24) for species recorded within the MDE and those identified as potentially occurring based on desktop assessment.

Table 24. Occurrence of conservation significant fauna within the MDE

Taxon	BC Act / DBCA status	EPBC Act status	Occurrence within the MDE	Rationale
Carnaby's cockatoo *(Zanda latirostris)*	**EN**	**EN**	**Confirmed**	**Recorded in baseline survey**
Woylie *(Bettongia penicillate)*	CR	EN	Possible	Potential to occur in remnant vegetation where a dense understorey is present.
Chuditch *(Dasyurus geoffroii)*	**VU**	**VU**	**Confirmed**	**Recorded in baseline survey**
Forest red-tailed black cockatoo *(Calyptorhynchus banksii naso)*	**VU**	**VU**	**Confirmed**	**Recorded in baseline survey**
Black-flanked rock wallaby (*Petrogale lateralis lateralis*)	EN	EN	Possible	Unconfirmed - occasional visitor (foraging/ dispersal)
Barking owl *(Ninox connivens connivens)*	P3	-	Possible	Potential to occur as a resident or a foraging visitor.
Western brush wallaby *(Notamacropus irma)*	**P4**	**-**	**Confirmed**	**Recorded in baseline survey**
Quenda *(Isoodon fusciventer)*	**P4**	**-**	**Confirmed**	**Recorded in baseline survey**
Tammar wallaby *(Notamacropus eugenii derbianus)*	P4	-	Likely	Present in areas surrounding MDE. Suitable habitat present.
Blue-billed duck *(Oxyura australis)*	P4	-	Possible	Potential as irregular visitor in dams/waterbodies

Taxon	BC Act / DBCA status	EPBC Act status	Occurrence within the MDE	Rationale
				during foraging/dispersal.
Dell's skink *(Ctenotus delli)*	P4	-	Possible	Potential resident in woodland habitat, limited dispersal ability.
Fork-tailed swift *(Apus pacificus)*	MI	MI	Possible	Potential to occur infrequently while foraging in the airspace.
Peregrine falcon *(Falco peregrinus)*	OS	-	Possible	Potential to occur infrequently as a resident while foraging, particularly in pasture/farmland.
Wambenger, south-western brush-tailed phascogale *(Phascogale tapoatafa wambenger)*	CD	-	Possible	Has been previously recorded in the region (date of last record – I think it may have been quite a while ago). Potential habitat for residents or during dispersal.

4.4.3.3.1 Chuditch

The Chuditch (Vulnerable EPBC and BC Act) is patchily distributed throughout the jarrah forests and mixed karri, marri, jarrah forest of south west Western Australia. The species also occurs in very low numbers in the Midwest, Wheatbelt and South Coast regions (Biologic 2023).

Chuditch were consistently recorded within the MDE and likely form part of broader regional population (Biologic 2023b).

4.4.3.3.2 Carnaby's Cockatoo

Carnaby's Cockatoo (Endangered EPBC and BC Act) is endemic to south west Western Australia and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale, 2003). Carnaby's Cockatoo are highly associated with the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (TSSC, 2016).

Carnaby's Cockatoo has been recorded from all baseline surveys in the MDE and Chalice Exploration Areas in the Julimar State Forest, from direct observation and foraging evidence (Biologic, 2022a, 2022b, 2023b; Western Wildlife, 2020, 2021a, 2021b). No active breeding hollows were identified within the MDE.

4.4.3.3.3 Forest Red-Tailed Black Cockatoo FRTBC

The forest red-tailed black cockatoo (FRTBC, Vulnerable EPBC and BC Act) is distributed throughout the south west of Western Australia inhabiting dense jarrah, marri and karri forests that

receive more than 600 mm average annual rainfall (DoEE, 2017) and breed between October and November (Biologic 2023a).

This species has been recorded from all previous surveys in the MDE and in the Julimar State Forest in Chalice exploration areas from direct observation and foraging evidence (Biologic 2023b). No active nests have been recorded within the MDE.

4.4.3.1 Short range endemic invertebrates

Baseline surveys identified six SRE habitat types within the MDE (Biologic, 2023a) (Table 25). All habitats were primarily in Poor condition due to the grazing pressure and the presence of weeds. (Biologic, 2023a).

Table 25. SRE habitat types within the MDE

Fauna habitat and Description	Extent within the MDE (ha / %)
Boulders/ Rockpiles This habitat is characterised by areas with a high concentration of granite or other rocky outcropping or rockpiles. The primary feature of the habitat is the abundance of rocky cracks and crevices. This habitat type was generally found within the open woodland habitat dominated by marri *Corymbia calophylla* and jarrah *Eucalyptus marginata* trees, with occasional small patches of wandoo. The mid and lower story was generally dominated by *Xanthorrhoea preissii*,. **SRE suitability: Moderate**	6 (<1%)
Banksia Woodland Within the tall, open woodland habitat, there was a section of the Study Area that was dominated by Conospermum shrubland. It was often an understory to a variety of plants such as Banksia (B. sessilis and B. squarrosa) and grasstree Xanthorrhoea preissii. The area is considered part of the priority and threatened ecological community "Banksia woodlands of the Swan Coastal Plain" (Biologic, 2023). **SRE suitability: Moderate**	50 (2%)
Jarrah and Marri Woodland Tall, open woodland habitat dominated by marri Corymbia calophylla and jarrah Eucalyptus marginata trees, with occasional small patches of wandoo. The mid and lower story is a tall shrubland of Banksia attenuata, B. squarrosa, Xanthorrhoea preissii, B. sessilis, over Hibbertia sp. **SRE suitability: Moderate-Low**	434 (19%)
Mixed Wandoo Woodland Tall, open woodland habitat with a canopy dominated by wandoo over mid and understory of Banksia species (B. sessilis and B. squarrosa) and grasstree Xanthorrhoea preissii. The habitat type includes small patches of marri Corymbia calophylla and jarrah Eucalyptus marginata, or flooded gum Eucalyptus rudis in damper areas. **SRE suitability: Moderate-Low**	445 (20%)
Minor Drainage Line Minor Drainage Line comprises small naturally (i.e. rainfall or spring) or artificially (i.e. dam) fed drainage lines which often occur in lower lying	25 (1%)

areas of the landscape. Vegetation comprises open riparian patches with mixed tree and shrub species occasionally occurring along the drainage line edges. **SRE suitability: Low**	
Sedgelands Degraded wetland area. Vegetation is comprised primarily of sedge species such as *Juncus acutus, *Watsonia meriana, and Cenchrus clandestinus. There is no defined upper canopy; however, scattered Melaleuca viminea trees are present. Water was present during the field surveys; however, it is expected to be ephemeral (non-permanent). **SRE suitability: Low**	3 (<1%)
Pasture Open areas of pasture grasses and introduced species with isolated trees, usually marri, jarrah, wandoo, flooded gum, or small areas of low orchard trees (e.g. olive). There is a lack of mid or understory vegetation present. **SRE suitability: Nil**	1219 (54%)
Cleared and Dam/Waterbody Existing cleared and/or disturbed areas without naturally occurring native vegetation cover. Includes bitumen roads and roadside clearings, dam infrastructure, and historic clearings where rehabilitation or natural revegetation hasn't occurred. **SRE suitability: Nil**	27 (1%)
Surveys in progress – results pending	33 (11%)
Total	**2240**

Thirteen potential SRE taxa have been recorded across the MDE. These taxa were recorded across multiple habitat types.

One of the confirmed SRE species is also listed as Priority 2 by DBCA, being Julimar shield-backed trapdoor spider (*Idiosoma mcclementsorum*). This species was recorded in one location in Jarrah and Marri woodland habitat, within the central portion of the MDE.

4.4.3.2 Aquatic fauna

Survey within the MDE (four farm dams) identified a range of aquatic fauna, including 118 macroinvertebrates, two freshwater crayfish species (one native and one introduced), one native freshwater fish. No conservation significant aquatic fauna were recorded from the MDE or the surveyed sites in Julimar State Forest and no conservation significant aquatic fauna were considered likely to occur at either location.

Aquatic fauna habitats are expected to occur in the seasonally flowing streams within and downstream of the MDE. Farm dams within the MDE provide perennial water bodies as dry season refugia for aquatic fauna. No natural perennial water bodies are identified within the MDE.

4.4.4 Receiving environment – Infrastructure Development Envelope

The IDE intersects a broad range of fauna habitats, as derived from vegetation complex mapping (section 4.2.4.1). Within the NJF portion of the IDE, habitats are dominated by Jarrah and Marri

Woodland interspaced by Mixed Wandoo Woodland, on occasional intersections of minor drainage lines, lower in the landscape. These habitats potentially support a range of conservation significant fauna species, including:

- Chuditch (*Dasyurus geoffroii*) (Vulnerable)
- Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) (*Vulnerable*)
- Carnaby's cockatoo (*Zanda latirostris*) (*Endangered*)
- Carter's freshwater mussel (*Westralunio carteri*) (Vulnerable)
- Western brush wallaby (*Notamacropus irma*) (P4)
- Quenda (*Isoodon fusciventer*) (P4).

Within the SCP portion of the IDE, habitats are dominated by Banksia and Eucalyptus woodlands, low shrublands and heaths, and wetlands and riparian vegetation. These habitats potentially support a range of conservation significant fauna species, including:

- Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) (*Vulnerable*)
- Carnaby's cockatoo (*Zanda latirostris*) (*Endangered*)
- Western brush wallaby (*Notamacropus irma*) (P4)
- Quenda (*Isoodon fusciventer*) (P4)
- Black-striped burrowing snake (*Neelaps calonotos*) (P3)
- Swan Coastal Plain shield-backed trapdoor spider (*Idiosoma sigillatum*) (P3).

A preliminary assessment of likelihood is presented below (Table 24) for species identified as potentially occurring based on desktop assessment.

Table 26. Potential occurrence of conservation significant fauna within the IDE

Taxon	BC Act / DBCA status	EPBC Act status	Occurrence within the IDE
Carnaby's cockatoo *(Zanda latirostris)*	EN	EN	Likely
Woylie *(Bettongia penicillate)*	CR	EN	Possible
Chuditch *(Dasyurus geoffroii)*	VU	VU	Likely
Forest red-tailed black cockatoo *(Calyptorhynchus banksii naso)*	VU	VU	Likely
Black-flanked rock wallaby (*Petrogale lateralis lateralis*)	EN	EN	Possible
Australian Painted Snipe (*Rostratula australis*)	EN	EN	Possible
Carter's freshwater mussel (*Westralunio carteri*)	VU	VU	Possible
Barking owl *(Ninox connivens connivens)*	P3	-	Possible
Western brush wallaby *(Notamacropus irma)*	P4	-	Likely
Quenda *(Isoodon fusciventer)*	P4	-	Likely
Tammar wallaby *(Notamacropus eugenii derbianus)*	P4	-	Possible
Blue-billed duck *(Oxyura australis)*	P4	-	Possible
Dell's skink *(Ctenotus delli)*	P4	-	Possible
Fork-tailed swift *(Apus pacificus)*	MI	MI	Possible

Taxon	BC Act / DBCA status	EPBC Act status	Occurrence within the IDE
Peregrine falcon *(Falco peregrinus)*	OS	-	Possible
Wambenger, south-western brush-tailed phascogale *(Phascogale tapoatafa wambenger)*	CD	-	Possible
Black-striped burrowing snake (*Neelaps calonotos*)	P3	-	Possible
Swan Coastal Plain shield-backed trapdoor spider (*Idiosoma sigillatum*)	P3	-	Possible
Douglas' Broad-headed Bee (*Hesperocolletes douglasi*)	CR	CR	Possible

Fauna habitats and fauna occurrence to be determined through surveys as part of infrastructure planning.

4.4.5 Potential impacts and mitigations

An environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts to terrestrial fauna quality along with proposed measures to mitigation potential impacts within the MDE and IDEA are summarised below in Table 27.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phase. Mitigations will be presented in the ERD.

Table 27. Terrestrial Fauna – Potential environmental impacts and proposed mitigations

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Avoid**
Clearing of up to 940 ha of remnant native vegetation which provides habitat for native fauna including conservation significant species.	« The MDE is contained to Chalice-owned farmland. « Pre-clearance surveys will be undertaken to ascertain no active nesting Black Cockatoo's are present.
Mortality, injury and/or displacement of individuals as a result of construction and operational vehicle movements.	**Minimise**
Disturbance due to construction and operational noise and/or operational blasting and night lighting	« Prioritise use of previously disturbed areas to the extent possible.
Impact to condition of fauna habitats due to introduction and spread of invasive weed species and/or Phytophthora dieback.	« Minimise clearing which provides fauna habitat, within the MDE and IDE to the extent required for safe and adequate construction and operation.
Impact to condition of fauna habitats due to accidental discharges of hydrocarbons, chemicals and wastes.	« Clearing will be undertaken progressively to allow fauna to migrate away from clearing activities or machinery movement.
Impact to aquatic fauna habitats and populations from changes to stream flow and/or water quality (See Inland Waters, Section 4.5)	« Implementation of light, noise and vibration measures to minimise indirect impacts to fauna.

IDE	
Disturbance of remnant native vegetation, which provides habitat for native fauna including conservation significant species.	« Limit the spread of existing weeds by implementing a Weed Management Strategy specific to the MDE and IDE. « Maintain existing surface water flow regimes as much as possible with the installation and maintenance of surface water/drainage infrastructure across the MDE and IDE. **Rehabilitate** « Chalice will prepare and implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020), for the Proposal « Inclusion of offsets to mitigate any significant residual impact from the Proposal via restoration and connection of fragmented habitat in the vicinity of the MDE.
Mortality, injury and/or displacement of individuals as a result of construction and operational vehicle movement.	
Impact to condition of fauna habitats due to introduction and spread of invasive weed species and/or Phytophthora dieback.	
Impact to condition of fauna habitats due to acid sulfate soil disturbance.	
Impact to condition of fauna habitats due to accidental discharges of hydrocarbons, chemicals and wastes.	

4.4.6 Proposed studies

Investigations associated with the MDE have been ongoing since 2020 and will continue in 2024 to inform the preparation of the ERD.

Studies for the IDE are planned for H2 2024.

4.4.7 Assessment and significance of residual impacts and environmental outcomes

An assessment of potential residual impacts and environmental outcomes resulting from the Proposals implementation, and their significance, will be undertaken during the assessment process and will be presented in the ERD.

Julimar Rd

Plunkett Rd

Rd No. 14748

Keating Rd

Beach Rd

Rd No. 10825

Results pending

Unknown Rd

Legend

- Mine Development Envelope

Fauna Habitat

- Cleared
- Dam/ Waterbody
- Minor Drainage Line
- Jarrah and Marri Woodland
- Banksia Woodland
- Mixed Wandoo Woodland
- Pasture
- Sedgeland
- Road

Waterbodies

- Dam
- Marsh

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometers

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

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GHD

Chalice Gonneville Project

Fauna Habitat Types-
Mine Development Envelope

Project No. 12619855
Revision No. 0
Date 21/03/2024

FIGURE 6

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Print date: 21 Mar 2024 - 14:51

Data source: World Imagery: Maxar. Created by: aridgard

4.5 Inland waters

4.5.1 EPA Objective

The EPA objective for inland waters is '*To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected*' (EPA 2023a).

4.5.2 EPA policy and guidance

- Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2023a)
- Environmental Factor Guideline – Inland Waters (EPA, 2018)

4.5.3 Receiving environment – Mine Development Envelope

4.5.3.1 Surface Water

The MDE is located within the catchment of the Avon River. The western portion (38 %) of the MDE is drained by two un-named tributaries of the Brockman River and the eastern portion (62 %) of the MDE drains into Julimar Brook (see Figure 7). The Brockman River and Julimar Brook flow to the south through rural properties and discharge into the Avon River.

Julimar Brook has a catchment area of approximately 22,464 ha, including cleared and forested rural land and a portion of Julimar State Forest. Brockman River has a catchment area of approximately 1500 km^2, the majority of which is cleared, and includes a portion of Julimar State Forest.

Surface water flows within the MDE are seasonal, with no natural perennial water bodies present. Farm dams comprise artificial perennial and semi-perennial water bodies within the MDE.

Stream flow monitoring has commenced and will be expanded to characterise surface water flows and water quality both within and external to the MDE.

4.5.3.2 Groundwater

The main aquifer systems found in the Darling Plateau which are relevant to the Project are:

- Quaternary-age deposits along modern drainage lines – groundwater associated with those sediments is low yielding, shallow and unconfined.
- Weathered bedrock producing a vuggy texture and development of secondary calcrete/silcrete minerals dependent on the degree of weathering.
- Fractured bedrock relating to a local network of interconnected structures and structural integrity.

Fresh, unfractured bedrock at the MDE would be expected to have essentially zero potential to act as an aquifer. However, fractured rock aquifers may be important water sources depending on the extent, intensity and connectivity of fractures.

Aquifer recharge is via rainfall infiltration. Most of the rainfall is lost by evaporation or runoff and only a very minor portion of rainfall infiltrates through the soil and recharges the groundwater. The groundwater table of the entire aquifer follows the regional topographic gradient and tends to come closer to the surface in valleys.

Baseline groundwater monitoring has commenced to characterise groundwater levels, groundwater flow direction and groundwater quality within the MDE.

Legend
River
Contour (50m)
Mine Development Envelope
Townsite
Rail
Road

Great Northern Hwy
Old Great Northern Hwy (Muchea)
Great Northern Hwy
Julimar Rd
Julimar Brook
Julimar Rd
Brockman River
Chittering Rd
Chittering Valley Rd
Muchea East Rd
Avon River
Chittering Rd

Paper Size ISO A3
0 1 2 3 4
Kilometers
Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

N

GHD

Chalice Gonneville Project

Inland Waters - Mine Development Envelope

Project No. 12619855
Revision No. 0
Date 21/03/2024

FIGURE 7

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Print date: 21 Mar 2024 - 14:44

Data source: World Imagery: Earthstar Geographics. Created by: aridgard

4.5.5 Receiving environment –Infrastructure Development Envelope

Within the NJF, the IDE is located within the catchment of the Avon River. The western portion (95% %) of the IDE is drained by un-named tributaries of the Brockman River and the eastern portion (5 %) of the IDE drains into Julimar Brook. The Brockman River and Julimar Brook flow to the south through rural properties and discharge into the Avon River.

Julimar Brook has a catchment area of approximately 22,464 ha, including cleared and forested rural land and a portion of Julimar State Forest. Brockman River has a catchment area of approximately 1500 km^2, the majority of which is cleared, and includes a portion of Julimar State Forest.

Within the SCP, the IDE intersects the Gnangara Underground Water Pollution Control Area, a P1 Groundwater Protection Area (protected under *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*). And the Perth Coastal and Gwelup Underground Water Pollution Control Area, a P3 Protection Area.

The IDE intersects with a number of mapped geomorphic wetlands of the SCP, including Conservation Category Wetlands. Wetlands on the SCP are generally an expression of groundwater and are responsive to changes in the catchment which can affect soil transmissivity i.e., the rate of water movement through the soil (Water and Rivers Commission 2001)

4.5.6 Potential impacts and mitigations

An environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts to inland waters quality along with proposed measures to mitigate potential impacts within the MDE and IDE are summarised below in Table 28.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Mitigations will be presented in the ERD.

Table 28. Inland Waters – Potential environmental impacts and proposed mitigations

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Avoid:**
Changed surface water catchments during operations and with mined landforms post-closure.	« Hydrocarbon storage facilities and all associated connections will be located within appropriately contained areas.
Sediment discharges to steams during construction and operations.	**Minimise:**
Acidic, saline and/or metalliferous drainage from waste rock landforms and tailings storage.	« Maintain existing surface water flow regimes as much as possible with the installation and maintenance of surface water/drainage infrastructure across the MDE and IDE.
Groundwater drawdown from mine pit during operations and post-closure.	

Pit lake formation and potential water quality impacts post-closure.	« Appropriate drainage design to manage run-off and surface water flow to prevent sediment discharges and erosion. « Geochemical assessment will be undertaken to determine if any materials are expected to result in acid and/or metalliferous drainage and develop management strategies for such material as required. « Undertake further hydrogeological investigations and modelling to improve understanding of the potential impacts to Inland Waters. **Rehabilitate:** « Chalice will prepare and implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020), for the Proposal
Water contamination due to accidental discharges of hydrocarbons, chemicals and wastes.	
IDE	
Sediment discharges from erosion due to vegetation clearing and earthworks.	
Disturbance of acid sulfate soils causing acidic and metalliferous drainage.	
Impacts to hydrological processes of wetlands due to foundations and pipeline crossings.	
Contamination due to accidental discharges of hydrocarbons, chemicals and wastes.	
Disturbance of existing site contamination.	

4.5.7 Proposed studies

Investigations associated with the MDE have been ongoing since 2020 and will continue in 2024 to inform the preparation of the ERD.

Studies for the IDE are planned for H2 2024.

4.5.8 Assessment and significance of residual impacts and environmental outcomes

An assessment of potential residual impacts and environmental outcomes resulting from the Proposals implementation, and their significance, will be undertaken during the assessment process and will be presented in the ERD.

4.6 Air quality

4.6.1 EPA Objective

The EPA objective for air quality is '*To maintain air quality and minimise emissions so that environmental values are protected*' (EPA 2023a)

4.6.2 EPA policy and guidance

- Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2023a)
- Environmental Factor Guideline – Air Quality (EPA, 2020d)

4.6.3 Receiving environment

The MDE is surrounded by forested and rural properties, with dust and other air emissions occurring from:

- Rural activities, including wind eroded dust from cleared areas
- Motor vehicle emissions from nearby public roads
- Motor vehicle movements causing dust from unsealed roads
- Domestic fuel burning (gas, liquid, solid) from rural properties
- Regional events such as dust storms, dust events during harvest, prescribed burning and wildfires.

According to the National Pollutant Inventory, the closest industrial air emissions source to the MDE is Austral Bricks Toodyay Schist Clay Pit, located in Morangup, approximately 9 km south east. This industry emits fluoride compounds.

The IDE dissects various land uses including forested and vegetated areas, rural properties, and urban centres with dust and other air emissions occurring from:

- Rural activities, including wind eroded dust from cleared areas
- Motor vehicle emissions from nearby public roads
- Motor vehicle movements causing dust from unsealed roads
- Domestic fuel burning (gas, liquid, solid) from rural properties
- Regional events such as dust storms, dust events during harvest, prescribed burning and wildfires.

4.6.4 Potential impacts and mitigations

An environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts to air quality along with proposed measures to mitigate potential impacts within the MDE and IDE are summarised below in Table 29.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Mitigations will be presented in the ERD.

Table 29. Air Quality – Potential environmental impacts and proposed mitigations

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Minimise**: « Undertake air quality investigations and modelling to improve understanding of the potential impacts to air quality. « Implement dust suppression techniques, where required. « Implement an air quality management plan to minimise indirect impacts to air quality. **Rehabilitate:** « Chalice will prepare and implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020), for the Proposal.
Dust emission from unsealed roads and cleared areas.	
Dust emissions from mining and processing operations (including but not limited to blasting, loading, hauling, crushing and stockpiling materials and transport).	
Gaseous emissions from processing operations.	
Gaseous emissions from diesel power supply if required during construction.	
Gaseous emissions from construction (including clearing) and operational vehicles and equipment.	
IDE	
Dust emissions from construction vehicles	
Dust emission from unsealed roads and cleared areas.	

4.6.5 Proposed studies

Investigations associated with the MDE have been ongoing since 2020 and will continue in 2024 to inform the preparation of the ERD.

Studies for the IDE are planned for H2 2024.

4.6.6 Assessment of significance of residual impacts and environmental outcomes

An assessment of potential residual impacts and environmental outcomes resulting from the Proposals implementation, and their significance, will be undertaken during the assessment process and will be presented in the ERD.

4.7 Greenhouse gas emissions

4.7.1 EPA Objective

The EPA objective for greenhouse gas emissions is '*To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change*' (EPA 2023a).

4.7.2 EPA Policy and guidance

« Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2023a)

« Environmental Factor Guideline – Greenhouse Gas Emissions (EPA, 2023b)

4.7.3 Receiving environment

Not applicable to this factor.

4.7.4 Potential impacts and mitigation

An environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts relating to GHG emissions within the MDE and IDE are summarised below in Table 30.

The extent of GHG for the Proposal remains to be determined. However, the combined Scope 1 and 2 emissions from the Proposal have the potential to exceed 100,000 tonnes of carbon dioxide equivalent ($CO_{2\text{-}e}$) per annum during operations.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Mitigations will be presented in the ERD.

Table 30. Greenhouse gas emissions – Potential environmental impacts and proposed mitigations

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Minimise:** « GHG assessment will be undertaken during the course of the assessment to understand Scope 1 and Scope 2 emissions. « A GHG Management Plan will be implemented based on the outcome of the assessment to identify opportunities to further reduce energy consumption and minimise GHG emissions.
Electricity supplied from the SWIS to power operations of the Gonneville Project.	
On-site diesel power generation if required, during construction.	
On-site diesel vehicle and equipment during construction and operations.	
Clearing of vegetation (land use change),	
IDE	
On-site diesel vehicle and equipment during construction.	
Clearing of vegetation (land use change).	

4.7.5 Proposed studies

Investigations associated with the MDE have been ongoing since 2020 and will continue in 2024 to inform the preparation of the ERD.

Studies for the IDE are planned for H2 2024.

4.7.6 Assessment and significance of residual impacts and environmental outcomes

An assessment of potential residual impacts and environmental outcomes resulting from the Proposals implementation, and their significance, will be undertaken during the assessment process and will be presented in the ERD.

4.8 Social surroundings

4.8.1 EPA Objective

The EPA objective for social surroundings is '*To protect social surroundings from significant harm*' (EPA 2023a).

4.8.2 EPA Policy and guidance

- Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2023a)
- Environmental Factor Guideline – Social Surroundings (EPA, 2023b)
- Interim Technical Guidance – Environmental impact assessment of Social Surroundings – Aboriginal cultural heritage (EPA, 2023d)

4.8.3 Receiving environment – Mine Development Envelope

The MDE for the Gonneville Project is located approximately 70 km northeast of Perth, 25 km west of Toodyay townsite and 10 km east of Chittering (Figure 1). The MDE is located in the Wheatbelt Region, within the Shire of Toodyay which has a population of approximately 4,600 (2021 census).

The MDE is located on freehold land owned by Chalice. The MDE is adjacent to Julimar State Forest to the north, Moondyne Nature Reserve to the south, and rural properties to the west and east (see Figure 8).

Native Title and Aboriginal heritage

The MDE lies within the Whadjuk People Indigenous Land Use Agreement Area (Whadjuk People ILUA, WI2017/015).

There are no recorded Aboriginal heritage sites within the MDE on the DPLH Aboriginal Cultural Heritage Inquiry System (ACHIS). The closest registered Aboriginal heritage site is Site ID: 15979 - Avon River, which includes a portion of Julimar Brook located 800m to the east of the MDE (see Figure 8).

Whadjuk representatives, independently of Chalice and in accordance with the NSHA, have undertaken cultural heritage surveys over the MDE. Chalice is awaiting receipt of the heritage survey results and report.

European Heritage

Desktop research indicates that there are no State Heritage Register or Local Heritage Survey sites within 5 km of the MDE (see Figure 8). The closest State Heritage Register site is 'Enderslea' (Place number 3569) located approximately 9 km to the northwest of the MDE.

Social and economic receptors

The MDE lies in the Wheatbelt Region, which has an economy based mainly on agriculture. Likewise, land surrounding the MDE is mainly rural and utilised for agriculture. The MDE lies within undulating landforms with a predominantly rural and forested visual character.

The closest residential receptors to the MDE are rural properties to the east and west, within 1km of the MDE boundary. The MDE also lies adjacent to Julimar State Forest to the north and Moondyne Nature Reserve to the south. Recreational uses of Julimar State Forest include bushwalking, cycling and four-wheel driving, as well as other outdoor activities.

4.8.4 Receiving environment – Infrastructure Development Envelope

As detailed in Table 31, the IDE corridor options intersect a total of 12 different registered Aboriginal heritage sites. Many of these 12 sites occur in multiple or all corridor options. Specifically, there are 11 registered sites within Power Route Option 1, 12 within Power Route Option 2, 11 within Water Route Option 1 and three are within Water Route Option 2. None of the four Corridors intersect with any Aboriginal Lands Trust (ALT) areas. There are no registered Aboriginal Heritage Sites within the Site Access Roads

As detailed in Table 32, the IDE collectively intersects with three local government areas (LGAs), the City of Wanneroo, the Shire of Chittering and the Shire of Toodyay. Each corridor has its largest portion fall within the Shire of Chittering, Water Route Option 1 and Water Route Option 2 have their next largest portions in the City of Wanneroo, and Shire of Toodyay holds the remaining LGA proportion for all four corridors.

Land uses within the IDE are shown in Table 33. For all options, agriculture is the dominant land use. For Water Route Option 1 and Water Route Option 2, water supply is the second most prominent land use. For the power corridors, Power Route Option 1 and Power Route Option 2, rural land is the second more prominent land use.

Table 31. Registered Aboriginal Heritage Sites within the IDE

Corridor	Site ID	Site Name	Site Description	Extent within IDE (ha; %)
Power Route Option 1	15979	Avon River	Mythological, Camp, Natural Feature, Water Source, Other: Food Resource	1 (<1%)
	21616	Boonanarring Brook	Mythological	1 (<1%)
	21619	Breera Brook	Mythological	1 (<1%)
	21620	Chandala Brook #Duplicate of ID 3525	Mythological	1 (<1%)
	20008	Gingin Brook Waggyl Site	Historical, Mythological, Camp, Hunting Place, Plant Resource, Water Source	23 (9%)
	20650	Lennard Brook	Mythological, Natural Feature, Water Source, Other: Creek	1 (<1%)
	20749	Moore River Waugul	Mythological	1 (<1%)
	21618	Nullilla Brook	Mythological	1 (<1%)
	19183	Red Gully Creek	Mythological, Plant Resource	1 (<1%)
	21617	Wallering Brook	Mythological	1 (<1%)
	19138	Wetlands & Watercourses Moore River to Bullsbrook	Mythological	1 (<1%)
Power Route Option 2	15979	Avon River	Mythological, Camp, Natural Feature, Water Source, Other: Food Resource	2 (<1%)
	21616	Boonanarring Brook	Mythological	1 (<1%)
	21619	Breera Brook	Mythological	1 (<1%)
	21620	Chandala Brook #Duplicate of ID 3525	Mythological	1 (<1%)
	3525	Ellen Brook: Upper Swan	Mythological	75 (28%)
	20008	Gingin Brook Waggyl Site	Historical, Mythological, Camp, Hunting Place, Plant Resource, Water Source	46 (17%)
	20650	Lennard Brook	Mythological, Natural Feature, Water Source, Other: Creek	1 (<1%)
	20749	Moore River Waugul	Mythological	1 (<1%)

Corridor	Site ID	Site Name	Site Description	Extent within IDE (ha; %)
	21618	Nullilla Brook	Mythological	1 (<1%)
	19183	Red Gully Creek	Mythological, Plant Resource	1 (<1%)
	21617	Wallering Brook	Mythological	1 (<1%)
	19138	Wetlands & Watercourses Moore River to Bullsbrook	Mythological	1 (<1%)
Water Route Option 1	15979	Avon River	Mythological, Camp, Natural Feature, Water Source, Other: Food Resource	1 (<1%)
	21616	Boonanarring Brook	Mythological	1 (<1%)
	21619	Breera Brook	Mythological	1 (<1%)
	21620	Chandala Brook	Mythological	1 (<1%)
	20008	Gingin Brook Waggyl Site	Historical, Mythological, Camp, Hunting Place, Plant Resource, Water Source	38 (7%)
	20650	Lennard Brook	Mythological, Natural Feature, Water Source, Other: Creek	1 (<1%)
	20749	Moore River Waugul	Mythological	1 (<1%)
	21618	Nullilla Brook	Mythological	1 (<1%)
	19183	Red Gully Creek	Mythological, Plant Resource	1 (<1%)
	21617	Wallering Brook	Mythological	1 (<1%)
	19138	Wetlands & Watercourses Moore River to Bullsbrook	Mythological	1 (<1%)
Water Route Option 2	15979	Avon River	Mythological, Camp, Natural Feature, Water Source, Other: Food Resource	2 (<1%)
	3525	Ellen Brook: Upper Swan	Mythological	84 (16%)
	20008	Gingin Brook Waggyl Site	Historical, Mythological, Camp, Hunting Place, Plant Resource, Water Source	8 (2%)
Mid-Route Option	nil	nil		
	3525	Ellen Brook: Upper Swan	Mythological	28 (80%)

Corridor	Site ID	Site Name	Site Description	Extent within IDE (ha; %)
Muchea Contingency	20008	Gingin Brook Waggyl Site	Historical, Mythological, Camp, Hunting Place, Plant Resource, Water Source	20 (57%)
Northen Contingency	15979	Avon River	Mythological, Camp, Natural Feature, Water Source, Other: Food Resource	1 (<1%)
Site Access Roads	nil	nil		

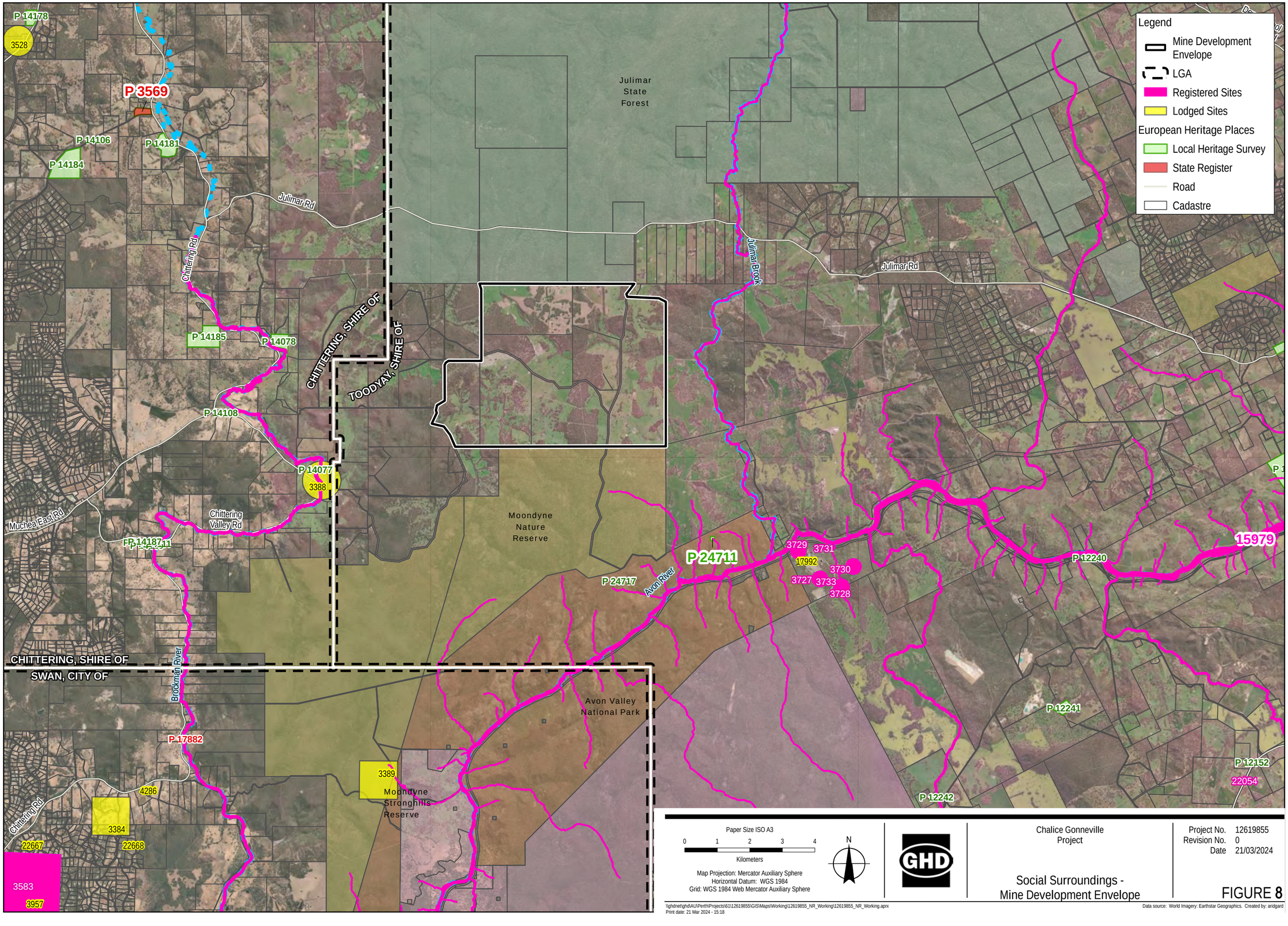
Table 32. Local government areas within the IDE

Local Government Area	Extent within IDE (ha; %)							
	Power Option 1	**Power Option 2**	**Water Option 1**	**Water Option 2**	**Site Access Road**	**Mid-Route Option**	**Muchea Contingency**	**Northern Contingency**
Shire of Chittering	226 (85%)	225 (85%)	311 (58%)	297 (55%)	0 (0%)	0 (0%)	35 (100%)	113 (84%)
Shire of Toodyay	39 (15%)	39 (15%)	39 (7%)	39 (7%)	52 (100%)	0 (0%)	0 (0%)	21 (16%)
City of Wanneroo	0 (0%)	0 (0%)	183 (34%)	201 (38%)	0 (0%)	86 (100%)	0 (0%)	0 (0%)
TOTAL	**259 (100%)**	**258 (100%)**	**545 (100%)**	**531 (100%)**	**52 (100%)**	**86 (100%)**	**35 (100%)**	**134 (100%)**

Table 33. Land uses within the IDE

Land Use	Extent within IDE (ha; %)							
	Power Option 1	Power Option 1	Power Option 1	Power Option 1	Site Access Road	Mid-Route Option	Muchea Contingency	Northern Contingency
Agricultural resource	193 (73%)	162 (61%)	189 (35%)	138 (26%)	0 (0%)	0 (0%)	23 (66%)	113 (84%)
Centre	0 (0%)	0 (0%)	3 (1%)	18 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Highway	1 (0%)	3 (1%)	8 (1%)	1 (0%)	0 (0%)	0 (0%)	1 (2%)	0 (0%)
Industrial development	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	11 (31%)	0 (0%)
Landscape enhancement	0 (0%)	0 (0%)	5 (1%)	4 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Light industry	0 (0%)	2 (1%)	0 (0%)	4 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Local road	0 (0%)	0 (0%)	6 (1%)	8 (2%)	0 (0%)	0 (0%)	0 (1%)	0 (0%)
Local roads	6 (2%)	6 (2%)	6 (1%)	6 (1%)	28 (54%)	0 (0%)	0 (0%)	0 (0%)
Major road	1 (0%)	27 (10%)	1 (0%)	27 (5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Parks and recreation	0 (0%)	4 (2%)	4 (1%)	4 (1%)	24 (46%)	86 (100%)	0 (0%)	0 (0%)
Public purposes	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Railway	1 (0%)	1 (0%)	1 (0%)	1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Residential	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Rural	33 (13%)	33 (13%)	38 (7%)	35 (6%)	0 (0%)	0 (0%)	0 (0%)	21 (15%)
Rural residential	27 (10%)	19 (7%)	29 (5%)	18 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Rural resource	0 (0%)	0 (0%)	8 (1%)	39 (7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Special use	0 (0%)	2 (1%)	0 (0%)	2 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Townsite	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Urban development	0 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Land Use	Extent within IDE (ha; %)							
	Power Option 1	Power Option 1	Power Option 1	Power Option 1	Site Access Road	Mid-Route Option	Muchea Contingency	Northern Contingency
Water supply	0 (0%)	0 (0%)	79 (15%)	97 (18%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
TOTAL	**259 (100%)**	**258 (100%)**	**545 (100%)**	**531 (100%)**	**52 (100%)**	**86 (100%)**	**35 (100%)**	**134 (100%)**



Paper Size ISO A3

0 1 2 3 4

Kilometers

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

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GHD

Chalice Gonneville Project

Social Surroundings - Mine Development Envelope

Project No.	12619855
Revision No.	0
Date	21/03/2024

FIGURE 8

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Print date: 21 Mar 2024 - 15:18

Data source: World Imagery: Earthstar Geographics. Created by: aridgard

4.8.5 Potential impacts and mitigations

An environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts relating to Social Surroundings along with proposed measures to mitigate potential impacts within the MDE and IDE are summarised below in Table 34.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Mitigations will be presented in the ERD.

Table 34. Social surroundings – Potential environmental impacts and proposed mitigations

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Avoid**: « Registered Aboriginal heritage sites will be avoided as far as practicable. **Minimise:** « Approval will be sought under Section 18 of the AH Act for any registered Aboriginal Heritage site that cannot be avoided. « Continued consultation with the Whadjuk Traditional Owners regarding the minimisation of impacts to traditional uses of the area. « A Cultural Heritage Management Plan will be developed for the MDE and IDE. « The Gonneville Project will be designed to minimise impacts from dust, noise, light and visual amenity. « Ongoing stakeholder engagement and feedback. « Potential property acquisition with access and amenity agreements with landowners. **Rehabilitate:** « Chalice will prepare and implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020), for the Proposal.
Disturbance of Aboriginal heritage sites.	
Visual impact from mining landforms during operations and post-closure.	
Noise impact from construction and operations.	
Nuisance dust from construction and operations.	
Heavy and light vehicle traffic on public roads during construction and operations.	
IDE	
Disturbance to Aboriginal heritage sites.	
Visual impact from transmission lines.	
Noise and nuisance dust from construction.	
Heavy and light vehicle traffic on public roads during construction.	

4.8.6 Proposed studies

Investigations associated with the MDE have been ongoing since 2020 and will continue to inform the preparation of the ERD.

Field studies for the IDE are planned for H2 2024.

4.8.7 Assessment and significance of residual impacts and environmental outcomes

An assessment of potential residual impacts and environmental outcomes resulting from the Proposals implementation, and their significance, will be undertaken during the assessment process and will be presented in the ERD.

4.9 Other environmental factors

Chalice considers that the Proposal is unlikely to impact the following Key Environmental Factors:

- Landforms
- Subterranean Fauna

4.9.1 Landforms

The MDE does not contain any significant landforms. The landforms factor is therefore not relevant to the Proposal.

The IDE will traverse numerous landforms across both the SCP and NJF bioregions. On the SCP, the proposal intersects all three dune landforms, namely (from west to east) the Quindalup South System, the Spearwood Dune System, and the Bassendean Dune System. Of significance is the Quindalup South System, which has three unique individual dune types including parabolic dunes, nested parabolic dunes, and blow-outs. The Quindalup Parabolic Dune System comprises all four phases of dune formation (Q1, Q2, Q3 and Q4) that occur on the SCP and is considered a significant landform. It also supports threatened vegetation communities, provides habitat for significant fauna species as well as a regional ecological linkage between coastal foreshore reserve and regional conservation areas to the east (RPS 2016). While the IDE will traverse this significant landform, the construction of the water pipeline infrastructure will not interfere with its function as an ecological linkage, nor will it interfere with the integrity of the physical landform itself, as no permanent removal or modification will occur. Given this, it is expected that the EPA's objective for landforms "To maintain the variety and integrity of significant physical landforms so that the environmental values are protected" can be met.

The landforms factor is therefore not relevant to the Proposal.

4.9.2 Subterranean fauna

A subterranean fauna desktop study was completed for the Gonneville Project (Bennelongia, 2023; Appendix A), with the aim of determining the likelihood of subterranean fauna occurring within the MDE.

Bennelongia (2023) reported that a relatively small number of stygofauna records from six species were recovered from the desktop search area (100km x 100km). No troglofauna records were recovered (Bennelongia 2023). There are no TECs or PECs for subterranean fauna in the vicinity of the MDE (Bennelongia 2023). The records returned suggest that any stygofauna community in the MDE will be depauperate and contain relatively widespread species typical of streambeds and shallow groundwater, such as occurs within the jarrah forest south of Perth (Bennelongia 2021). The records also suggest the occurrence of troglofauna is unlikely.

The conclusions drawn from the small number of fauna records is supported by geological and hydrogeological information. Much of the surface geology in the vicinity of the MDE is residual and unlikely to support suitable habitat for stygofauna or troglofaunal (Bennelongia 2023). There are areas of alluvium and colluvium within the MDE that may support stygofauna, with similar geologies that may support stygofauna located in areas around the MDE. However, based on habitat and the occurrence of nearby stygofauna records, it is considered likely only a depauperate community of stygofauna species that use shallow creek bed and spring groundwater habitats will be present. As there are no topographic anomalies that would cause range restriction within the MDE, any stygofauna species present are unlikely to have localised distributions. Based on the desktop analysis, Bennelongia (2023) concluded that it is unlikely that the Gonneville Project will adversely affect subterranean fauna conservation values in the MDE.

Soils across the IDE range from sand dunes and sand plains of the SCP changing to gentle to steep hills with gentle valleys on metamorphic gneiss and schist, and dolerite along the darling escarpment through to the MDE. Potential subterranean fauna habitats such as karstic ground formations are known to occur in the limestone rock band running north-south along the eastern side of Wanneroo Road. However, these are unlikely to be disturbed due to the shallow construction depth of the water pipeline infrastructure. Further, the linear nature of the construction would not significantly intersect habitat were it to be present at shallow levels (<3m below ground level). For the remainder of the IDE, while there are areas of alluvium and colluvium that may support stygofauna, as there are no topographic anomalies that would cause range restriction within the MDE, any stygofauna species present are unlikely to have localised distributions.

The subterranean fauna factor is therefore not relevant to the Proposal.

4.10 Matters of National Environmental Significance

Under the EPBC Act, an action will require approval from the Commonwealth if the action is likely to have a significant impact on the following MNES:

- World heritage properties
- National heritage places
- Ramsar Wetlands of international importance
- Listed threatened species and ecological communities
- Listed migratory species
- Nuclear action
- Commonwealth marine environment
- The Great Barrier Reef Marine Park
- Water resources, in relation to large coal mining development or coal seam gas

Table 35 presents a summary of the MNES that are relevant to the Project. As presented, the Project may impact listed threatened species and ecological communities and has the potential to impact migratory species.

Table 35. Assessment of relevant MNES

MNES	Relevance to the Action (MDE)	Relevance to the Action (IDE)
World heritage properties	**Not relevant** No World Heritage properties in vicinity of the MDE.	**Not relevant** No World Heritage properties in the vicinity of the IDE.
National heritage places	**Not relevant** No National heritage places in vicinity of the MDE.	**Not relevant** No National heritage places in the vicinity of the IDE.
Ramsar Wetlands of international importance	**Not relevant** No Ramsar Wetlands of international importance in vicinity or downstream of the MDE.	**Not relevant** No Ramsar Wetlands of international importance in vicinity or downstream of the IDE.
Listed threatened species and ecological communities	**Relevant** One TEC is confirmed as occurring within the MDE (will be avoided). No threatened flora species are likely or have potential to occur within the MDE. Five threatened terrestrial fauna are known or have potential to occur within the MDE and one threatened aquatic fauna species has the potential to occur downstream of the MDE.	**Relevant** Three TECs are likely to occur or may be present within the IDE. Numerous threatened flora species have potential to occur within the IDE. Five threatened terrestrial fauna and one threatened aquatic fauna species have potential to occur within the IDE.
Listed migratory species	**Potentially relevant** No migratory species are likely to occur within the MDE.	**Potentially relevant** Numerous migratory bird species have potential to occur within the IDE.
Nuclear action	**Not relevant** The project is not a nuclear action	**Not relevant** The project is not a nuclear action
Commonwealth marine environment	**Not relevant** The project does not include an offshore marine component.	**Not relevant** The project does not include an offshore marine component.
The Great Barrier Reef Marine Park	**Not relevant** The project is located on the west coast of Australia.	**Not relevant** The project is located on the west coast of Australia.
Water resources, in relation to large coal mining development or coal seam gas	**Not relevant** The project does not involve coal seam gas or coal mine development	**Not relevant** The project does not involve coal seam gas or coal mine development.

4.10.1 Nationally threatened species and ecological communities

4.10.1.1 Threatened ecological communities (TEC)

There is one TEC mapped within the MDE (see Table 36). Occurrence of other conservation significant ecological communities and their potential to occur within/ adjacent areas to the MDE are also provided. Section 4.2.3.5. which provides further detail about EPBC listed TECs and their nearest occurrence to the MDE.

Table 36. Listed EPBC Act TEC within MDE

Threatened Ecological Community (TEC)	EPBC Act Status	Occurrence within the MDE	Description
Banksia Woodlands of the Swan Coastal Plain IBRA region	EN	Yes - identified in baseline survey	Canopy is most commonly dominated or co-dominated by *Banksia attenuata* and/or *B. menziesii*. Other *Banksia* species that can dominate are *B. prionotes* or *B. ilicifolia*. Typically occurs on sandplain landforms, particularly Bassendean and Spearwood sands and occasionally Quindalup sands; also common on sandy colluvium and aeolian sands of Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau and, in other less common scenarios.

No field surveys have been conducted across the IDE. Occurrence of conservation significant ecological communities and their potential to occur based on desktop assessment within the IDE are summarised in Table 37. Three TECs are identified as potentially occurring within the IDE as outlined in Table 37. These communities will be the subject of targeted flora surveys across the IDE to confirm presence or absence.

Table 37. Listed EPBC Act TECs with potential to occur within the IDE

TEC	EPBC Act Status	Occurrence within the MDE	Description
Banksia Woodlands of the Swan Coastal Plain IBRA region	Endangered	Likely	Canopy is most commonly dominated or co-dominated by *Banksia attenuata* and/or *B. menziesii*. Other *Banksia* species that can dominate are *B. prionotes* or *B. ilicifolia*. Typically occurs on sandplain landforms, particularly Bassendean and Spearwood sands and occasionally Quindalup sands; also common on sandy colluvium and aeolian sands of Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau and, in other less common scenarios.
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Likely	Woodlands or forests or other structural forms where the primary defining feature is the *Eucalyptus gomphocephala* (Tuart) in the uppermost canopy layer. Occur on the SCP strongly associated with calcareous soils of the western part of the plain, including those very close to the coast. Mainly occurs where soils are sandy and well drained.

Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion	Critically Endangered	May be present	Assemblage of plants and animals and other organisms associated with warm temperate shrubland or heath, dominated by *Melaleuca huegelii* (chenille honeymyrtle), *M. systena* (coastal honeymyrtle), and/ or *Banksia sessilis* (parrot bush).

4.10.1.1.1 Potential impacts and mitigations

An environmental impact assessment is currently in preparation for the Proposal. The Proposal will not cause direct impacts to the area of EPBC Act listed Banksia Woodlands of the SCP TEC within the MDE as the area will be avoided through provision of an Protected Area avoidance zone and a vegetated buffer surrounding the defined patch boundary (Figure 4).

Predicted potential indirect impacts to the patch of EPBC Act listed Banksia Woodlands of the SCP TEC within the MDE along with proposed measures to mitigate potential impacts are summarised in Table 38.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Further mitigations will be presented in the ERD.

Table 38. TEC – potential environmental impacts and proposed mitigation

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Avoid:** « The MDE is contained to Chalice-owned farmland. « The conceptual disturbance footprint within the MDE has been designed to avoid a patch of EPBC Act listed TEC (WA listed PEC) (Banksia Woodlands of the Swan Coastal Plain). « A buffer around the TEC within the MDE has been incorporated into the Protected Area avoidance zone. « The disturbance footprint within the IDE will be refined pending the outcome of baseline flora add vegetation surveys, with avoidance of threatened ecological communities as far as practicable. **Minimise:** « Minimise clearing within the MDE and IDE to the extent required for safe and adequate construction and operation. « Prioritise use of previously disturbed areas to the extent possible. « Manage the potential degradation of vegetation by dust deposition through development of dust suppression and management techniques.
Direct impact to the patch of EPBC Act listed Banksia Woodlands of the SCP TEC	
Introduction and/or spread of invasive species	
Smothering of vegetation by dust	
Fire and alteration of fire regimes	
Spread of Phytophthora dieback	
Changes to hydrological regimes	
IDE	
Direct impact to EPBC Act listed ecological communities.	
Introduction and/or spread of invasive species.	
Smothering of vegetation by dust	
Fire and alteration of fire regimes	
Spread of Phytophthora dieback	
Changes to hydrological regimes	

	« Limit the spread of existing weeds by implementing a Weed Management Strategy specific to the MDE and IDE. « Limit the spread of Phytophthora dieback by implementing dieback management controls specific to the MDE and IDE. « Manage the potential degradation of vegetation as a result of increased fire risk by implementing fire prevention and management measures. « Maintain existing surface water flow regimes to extent practicable with the installation and maintenance of surface water/drainage infrastructure across the MDE and IDE. **Rehabilitate:** « Chalice will prepare and implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020), for the Proposal.

4.10.1.2 Threatened species – flora

There has been no threatened flora identified within the MDE in the baseline surveys.

Table 39 presents EPBC Act listed Threatened flora species identified in a Protected Matters Search Tool (PMST) search of the IDE. A likelihood of occurrence assessment was undertaken based on habitat preferences, fauna records, and baseline studies within and adjacent to the IDE. A likelihood of occurrence assessment was undertaken based on habitat preferences, and regional vegetation mapping data. Based on this assessment, 12 threatened flora, possibly occur within the IDE and 16 threatened flora are considered unlikely. These species will be the subject of targeted flora surveys across the IDE to confirm presence or absence.

Table 39. Flora MNES results from PMST search - IDE

Taxon	Common Name	EPBC Act status	Likelihood of occurrence	Rationale
Acacia anomala	Grass Wattle, Chittering Grass Wattle	VU	Possible	Within known range and suitable habitat present
Andersonia gracilis	Slender Andersonia	EN	Unlikely	Outside of known range and suitable habitat
Anigozanthos viridis subsp. *terraspectans*	Dwarf Green Kangaroo Paw	VU	Unlikely	Outside of known range
Banksia mimica	Summer Honeypot	EN	Unlikely	Outside of known range and suitable habitat
Caladenia huegelii	King Spider-orchid, Grand	EN	Unlikely	Outside of known range and suitable habitat

Taxon	Common Name	EPBC Act status	Likelihood of occurrence	Rationale
	Spider-orchid, Rusty Spider-orchid			
Caleana dixonii	Sandplain Duck Orchid	EN	Unlikely	Outside of known range and suitable habitat
Chamelaucium lullfitzii	Gingin Wax	EN	Possible	Within known range
Conospermum densiflorum subsp. *unicephalatum*	One-headed Smokebush	EN	Unlikely	Outside of known range and suitable habitat
Darwinia carnea	Mogumber Bell, Narrogin Bell	EN	Unlikely	Outside of known range and suitable habitat
Darwinia foetida	Muchea Bell	CR	Possible	Within known range
Diplolaena andrewsii	null	EN	Unlikely	Outside of known range
Diuris micrantha	Dwarf Bee-orchid	VU	Unlikely	Outside of known range
Diuris purdiei	Purdie's Donkey-orchid	EN	Unlikely	Outside of known range
Drakaea elastica	Glossy-leafed Hammer Orchid,	EN	Unlikely	Outside of known range and suitable habitat
Eleocharis keigheryi	Keighery's Eleocharis	VU	Possible	Within known range
Eucalyptus argutifolia	Yanchep Mallee, Wabling Hill Mallee	VU	Possible	Within known range
Eucalyptus leprophloia	Scaly Butt Mallee, Scaly-butt Mallee	EN	Unlikely	Outside of known range and suitable habitat
Grevillea corrugata	a shrub	EN	Possible	Within known range and suitable habitat present
Grevillea curviloba subsp. *curviloba*	Curved-leaf Grevillea	EN	Possible	Within known range and suitable habitat present
Grevillea curviloba subsp. *incurva*	Narrow curved-leaf Grevillea	EN	Possible	Within known range and suitable habitat present
Grevillea flexuosa	Zig Zag Grevillea	VU	Possible	Within known range and suitable habitat present

Taxon	Common Name	EPBC Act status	Likelihood of occurrence	Rationale
Hypocalymma sylvestre	chittering Myrtle	EN	Possible	Within known range and suitable habitat present
Macarthuria keigheryi	Keighery's Macarthuria	EN	Unlikely	Outside of known range
Melaleuca sciotostyla	Wongan Melaleuca	EN	Unlikely	Outside of known range and suitable habitat
Melaleuca sp. Wanneroo (G.J. Keighery 16705)	null	EN	Possible	Within known range and suitable habitat present
Synaphea sp. Fairbridge Farm (D.Papenfus 696)	Selena's Synaphea	CR	Unlikely	Outside of known range
Thelymitra dedmaniarum	Cinnamon Sun Orchid	EN	Unlikely	Outside of known range and suitable habitat
Thelymitra stellata	Star Sun-orchid	EN	Possible	Within known range and suitable habitat present

4.10.1.2.1 Potential impacts and mitigations

An environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts to Threatened species – flora, along with proposed measures to mitigate potential impacts are summarised below in Table 40. No threatened flora is identified in the MDE.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Mitigations will be presented in the ERD.

Table 40. Threatened species - flora – potential environmental impacts and proposed mitigation

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
IDE	**Avoid:** « The disturbance footprint within the IDE will be refined pending the outcome of baseline flora and vegetation surveys, with avoidance of threatened flora populations as far as practicable. **Minimise:** « Minimise clearing within the IDE to the extent required for safe and adequate construction and operation. « Prioritise use of previously disturbed areas to the extent possible.
Direct impact to EPBC Act listed flora and supporting habitat	
Introduction and/or spread of invasive species	
Smothering of vegetation by dust	
Fire and alteration of fire regimes	
Spread of Phytophthora dieback	
Changes to hydrological regimes	

	« Manage the potential degradation of vegetation through dust deposition by implement dust suppression techniques. « Limit the spread of existing weeds by implementing a Weed Management Strategy specific to the IDE. « Limit the spread of Phytophthora dieback by implementing dieback management controls specific to the IDE. « Maintain existing surface water flow regimes as much as possible with the installation and maintenance of surface water/drainage infrastructure across the IDE.

4.10.1.3 Threatened species - fauna

Table 41 presents EPBC Act listed Threatened and Migratory species identified in a PMST search within 10km of the MDE. A likelihood of occurrence assessment was undertaken based on habitat preferences, fauna records, and baseline studies within and adjacent to the MDE. Based on this assessment, five threatened terrestrial fauna, and one migratory fauna species are known or have potential to occur within the MDE, and one species of threatened aquatic fauna has potential occur downstream of the MDE.

All remaining migratory species identified from the PMST search are considered unlikely to occur within the MDE or surrounding areas. The habitat of these species is likely to be associated with wetlands within the Swan Coastal Plan region, to the west of the MDE, and outside of the Jarrah Forest bioregion. As the MDE will not interact with the marine environment, Marine listed species have been excluded from this analysis.

Table 42 presents EPBC Act listed Threatened and Migratory species identified in a PMST search of the IDE. A likelihood of occurrence assessment was undertaken based on habitat preferences, and regional vegetation mapping data. Based on this assessment, five threatened terrestrial fauna, have potential to occur within the IDE.

All remaining migratory species identified from the PMST search are considered unlikely to occur within the IDE. As the MDE will not interact with the marine environment, Marine listed species have been excluded from this analysis.

Table 41. Terrestrial fauna MNES results from PMST search - MDE

Taxa	Common Name	Class	Status	Nearest record	Likelihood of occurrence	Occurrence
Actitis hypoleucos	Common sandpiper	Bird	MI, marine	21 km NE, 20 km W	Unlikely	n/a
Aphelocephala leucopsis	Southern whiteface	Bird	VU	84 km NE	Unlikely	n/a
Apus pacificus	Fork-tailed swift	Bird	MI, marine	25 km SW	Possible	Infrequent visitor (foraging/ dispersal)
Calidris acuminata	Sharp-tailed sandpiper	Bird	MI, VU, marine	50 km SSW	Highly unlikely	n/a
Calidris ferruginea	Curlew sandpiper	Bird	MI, CR, marine	55 km SW	Highly unlikely	n/a
Calidris melanotos	Pectoral sandpiper	Bird	MI, marine	50 km SW	Highly unlikely	n/a
Calyptorhynchus banksii naso	**Forest red-tailed black cockatoo**	**Bird**	**VU**	**1.3 km S**	**Confirmed**	**Regular visitor (foraging/ dispersal and potentially breeding)**
Falco hypoleucos	Grey falcon	Bird	VU	20 km E	Unlikely	n/a
Leipoa ocellata	Malleefowl	Bird	VU	20 km E	Highly unlikely	n/a
Motacilla cinerea	Grey wagtail	Bird	MI, marine	203 km N	Highly unlikely	n/a
Pandion haliaetus	Osprey	Bird	MI, marine	45 km SE	Highly unlikely	n/a
Rostratula australis	Australian painted snipe	Bird	EN, marine	55 km SSW	Highly unlikely	n/a
Zanda latirostris	**Carnaby's black cockatoo, short-billed black cockatoo**	**Bird**	**EN**	**2.5 km E**	**Confirmed**	**Regular visitor (foraging/ dispersal and potentially breeding)**

Bettongia penicillata ogilbyi	Woylie	Mammal	EN	1.4 km N	Possible	Population is likely below detection level (Wayne et al., 2017).
Dasyurus geoffroii	**Chuditch, western quoll**	**Mammal**	**VU**	**1.5 km N**	**Confirmed**	**Confirmed – Resident or regular visitor**
Petrogale lateralis lateralis	Black-flanked rock wallaby, moororong, black-footed rock wallaby	Mammal	EN	4.6 km S	Unlikely	Potential transient visitor (though unconfirmed) for foraging/dispersal as no suitable rocky habitat.
Phascogale calura	Red-tailed phascogale, red-tailed wambenger	Mammal	VU	50 km SE	Unlikely	n/a
Idiosoma nigrum	Shield-backed trapdoor spider, black rugose trapdoor spider	Invertebrate	VU	39 km NNE	Unlikely	n/a
Westralunio carteri	Carter's freshwater mussel, freshwater mussel	Invertebrate	VU	8 km W	Unlikely	Possible presence downstream of MDE in perennial freshwater bodies

Table 42. Terrestrial fauna MNES results from PMST search - IDE

Taxa	Common Name	Class	Status	Likelihood of occurrence
Aphelocephala leucopsis	Southern Whiteface	Bird	VU	Unlikely
Botaurus poiciloptilus	Australasian Bittern	Bird	EN	Unlikely
Calidris acuminata	Sharp-tailed Sandpiper	Bird	VU, MI	Unlikely
Calidris canutus	Red Knot, Knot	Bird	VU, MI	Highly unlikely
Calidris ferruginea	Curlew Sandpiper	Bird	CR, MI	Unlikely
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo, Karrak	Bird	VU	Likely
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	Bird	VU, MI	Highly unlikely

Taxa	Common Name	Class	Status	Likelihood of occurrence
Dasyurus geoffroii	Chuditch, Western Quoll	Mammal	VU	Likely
Hesperocolletes douglasi	Douglas' Broad-headed Bee, Rottnest Bee	Insect	CR	Possible
Leipoa ocellata	Malleefowl	Bird	VU	Highly unlikely
Macroderma gigas	Ghost Bat	Mammal	VU	Highly unlikely
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Bird	CR, MI	Highly unlikely
Rostratula australis	Australian Painted Snipe	Bird	EN	Possible
Sternula nereis nereis	Australian Fairy Tern	Bird	VU	Highly unlikely
Tringa nebularia	Common Greenshank, Greenshank	Bird	EN, MI	Unlikely
Zanda latirostris	Carnaby's Black Cockatoo, Short-billed Black-cockatoo	Bird	EN	Likely
Westralunio carteri	Carter's freshwater mussel, freshwater mussel	Invertebrate	VU	Possible

4.10.1.3.1 Potential impacts and mitigations

An environmental impact assessment is currently in preparation for the Proposal. Predicted potential impacts to Threatened species – fauna, along with proposed measures to mitigate potential impacts are summarised below in Table 43.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Mitigations will be presented in the ERD.

Table 43. Threatened species – fauna – potential environmental impacts and proposed mitigations.

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
MDE	**Avoid:** « The MDE is contained to Chalice-owned farmland. « Pre-clearance surveys will be undertaken to ascertain no active nesting Black Cockatoo's are present. **Minimise:** « Prioritise use of previously disturbed areas to the extent possible. « Minimise clearing which provides fauna habitat, within the MDE and IDE to the extent required for safe and adequate construction and operation. « Clearing will be undertaken progressively to allow fauna to migrate away from clearing activities or machinery movement. « Implementation of light, noise and vibration measures to minimise indirect impacts to fauna. « Limit the spread of existing weeds by implementing a Weed Management strategy specific to the MDE and IDE. « Limit the spread of Phytophthora dieback by implementing dieback management controls specific to the MDE and IDE. « Further studies into Chuditch habitat utilisation and population in Julimar area to inform required management strategies. **Rehabilitate:** « Chalice will prepare and implement a Mine Closure Plan (MCP) in accordance with the Statutory Guidelines for Mine Closure Plans (DMIRS 2020), for the Proposal. « Inclusion of offsets to mitigate any significant residual impact from the Proposal via restoration and connection of fragmented habitat in the vicinity of the MDE.
Clearing of up to 940 ha of remnant native vegetation which provides habitat for Threatened species.	
Mortality, injury and/or displacement of individuals as a result of construction and operational vehicle movements.	
Disturbance due to construction and operational noise and/or operational blasting and night lighting.	
Impact to condition of fauna habitats due to introduction and spread of invasive weed species and/or Phytophthora dieback.	
IDE	
Clearing of native vegetation and/or displacement of individuals as a result of construction vehicle movements.	
Mortality, injury and/or displacement of individuals as a result of construction vehicle movements.	
Impact to condition of fauna habitats due to introduction and spread of invasive weed species and/or Phytophthora dieback.	

4.10.1.4 Potential Impacts to downstream receptors and mitigations

The Gonneville Project may impact aquatic fauna habitats and populations from changes in stream flow and/or water quality, downstream of the MDE. This has the potential to impact habitat of Carters freshwater mussel, which may occur downstream of the MDE. Potential impacts to downstream receptors, along with proposed measures to mitigate potential impacts are summarised below in Table 44.

Further mitigation measures will be developed during the environmental impact assessment process, which is running in parallel with the PFS. This allows for proactive integration of environmental considerations and stakeholder feedback in the early engineering phases. Mitigations will be presented in the ERD.

Table 44. Potential impacts to downstream receptors and mitigations

Predicted potential environmental impact	Proposed measures to mitigate potential impacts
Increased sediment from erosion of post-mining landforms Contamination from spills and/or leaks from mine waste storage and handling of hazardous materials and waste Changes to hydrological regimes	**Minimise:** « Surveys of downstream perennial waterbodies to determine whether Carter's freshwater mussel is present. « Appropriate drainage design to manage run-off and surface water flow to prevent sediment discharges and erosion. « Geochemical assessment will be undertaken to determine if any materials are expected to result in acid and/or metalliferous drainage and develop management strategies for such material as required.

4.11 Holistic impact assessment

The EPA emphasizes a comprehensive approach to impact assessment, ensuring that all environmental factors are considered holistically. Implementing the EPA guidance ensures that development proposals do not consider these elements in isolation but rather assess their interdependencies and cumulative effects.

While the proposal's outcomes in relation to the environmental principles and the EPA's environmental objectives for each environmental factor will be considered independently, additional combined environmental effects may become significant and require additional mitigation. The level of connectivity between the environmental factors identified for the Project, will be described during the assessment phase.

4.12 Cumulative environmental impact assessment

Cumulative effects to the environment result from multiple activities whose direct or indirect impacts may be relatively minor, but in combination with other activities can result in significant environmental and social effects.

The MDE is located within the NJF subregion which has 58% pre-European native vegetation extent remaining. This project represents the only mining development within 20km, with most impacts within this area restricted to farming related activities.

The IDE is located within both the SCP bioregion and NJF subregion. The SCP has been subject to a significant level of development with disturbance associated with urban development and infrastructure, with 34% pre-European native vegetation extent remaining at the sub-regional scale. Further to this, numerous projects are either approved or currently under assessment by the EPA.

As part of the environmental impact assessment process, a detailed assessment of the cumulative effects of clearing within the local area will be undertaken. The nature of this assessment will be outlined in a framework to be defined in the proposal's Environmental Scoping Document. The assessment will provide a robust analysis of the successive, incremental and combined impacts on the environment, arising from past, present and reasonably foreseeable future actions, in the context of this proposal.

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Appendix A Gonneville Project Subterranean Fauna Desktop Review

Bennelongia Environmental Consultants

Gonneville Project

Subterranean Fauna

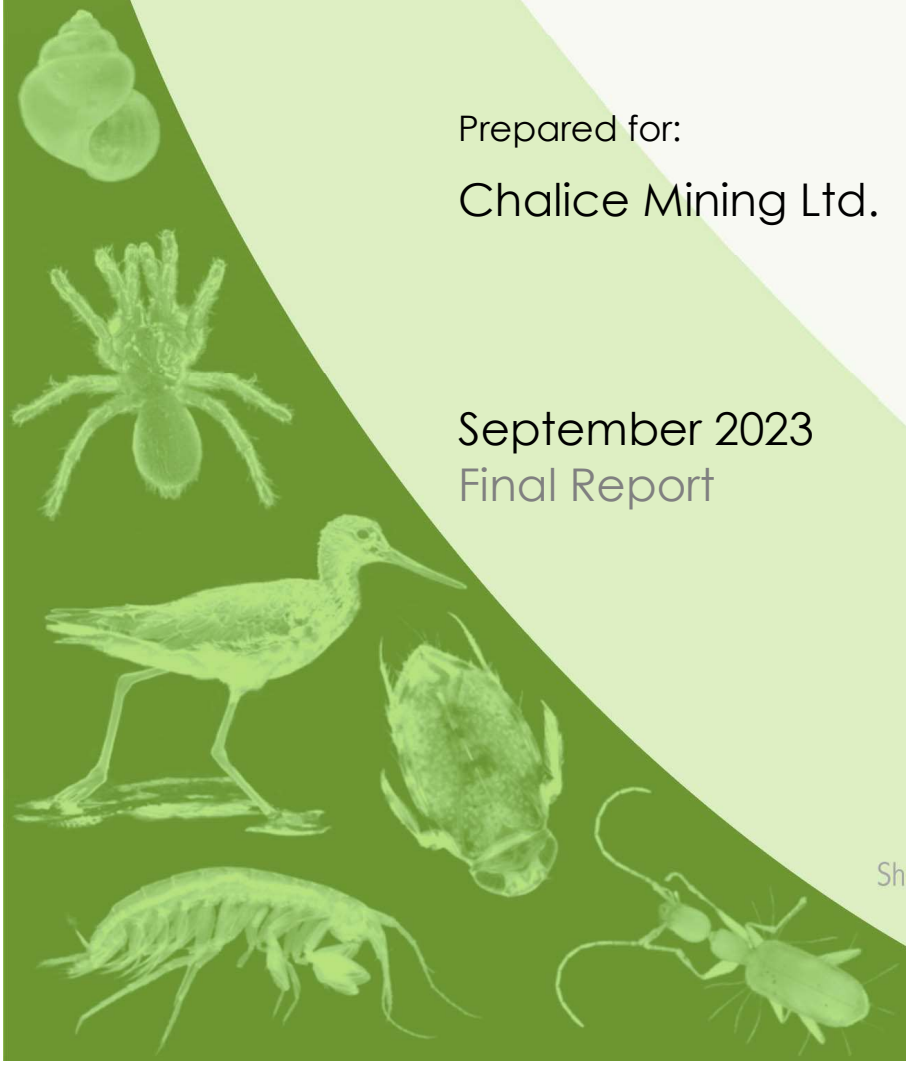
Desktop Review

Prepared for:

Chalice Mining Ltd.

September 2023

Final Report



Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Gonneville Project
Subterranean Desktop Review

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EXECUTIVE SUMMARY

Chalice Mining Limited is seeking to mine nickel-copper-platinum group elements at the Gonneville Project, located approximately 70 km northeast of Perth in the Shire of Toodyay, Western Australia. This desktop report provides information about the likelihood of subterranean fauna occurring at the Project.

A square of 100 km x 100 km around the Project was defined as the search area for records of subterranean fauna that could be used to infer the likelihood of subterranean fauna occurrence in the Project area. The Western Australian Museum and Bennelongia databases were examined for records of stygofauna, as well as published research papers, available environmental reports, and online resources such as the Atlas of Living Australia.

Geological and hydrogeological reports were reviewed to assess the occurrence of prospective habitat for subterranean fauna. The local geology of the Project is not necessarily conducive to high numbers of subterranean fauna; however, it is similar to the geology where stygofauna records were located in the desktop survey.

No records were found of troglofauna within the project area or the wider desktop search area. A few records of stygofauna were found but none of these was within the Project area, and all were at least 15 km away from the Project. Three of these species are only known from their type location, while other species are more widespread. Some species are also associated with springs which is a major outflow from groundwaters at the Project site.

In conclusion, based on geology and the lack of nearby records, it is considered unlikely that a significant troglofauna community occurs in the Project area. Based on habitat and the occurrence of nearby stygofauna records, it is considered likely a depauperate community of stygofauna species that use shallow creek bed and spring groundwater habitats will be present. Such species are unlikely to have Project-scale distributions unless there are topographic anomalies that would cause range restriction. This is not the case at the Project. Accordingly, it is considered unlikely that Project development will adversely affect subterranean fauna conservation values.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Chalice Mining Limited (Chalice) plans to mine nickel-copper-platinum group elements (Ni-Cu-PGE) at the Gonneville Project (hereafter 'The Project'), located approximately 70km northeast of Perth in the Shire of Toodyay, Western Australia. The Project is based on exploration tenements E70/5118 and E70/5119. These tenements overlay Julimar State Forest and private farmland and cover a 30 km length of unexplored Julimar Intrusive Complex. Drilling has occurred south of the Project at the Gonneville Deposit, which covers approximately 7% of the Julimar Intrusive Complex.

The purpose of this desktop subterranean fauna assessment is to support future approvals for the Project under the *Environmental Protection Act 1986* (EP Act) and the *Environment Protection and Biodiversity Act 1999* (EPBC Act). Available information on potential subterranean habitats at the Project and previous subterranean fauna records in the vicinity are examined to appraise the likelihood of subterranean fauna occurring at the Project.

2. SUBTERRANEAN FAUNA FRAMEWORK

2.1. Subterranean Fauna

The term subterranean fauna refers to animals living underground. Subterranean taxa are divided into two main groups: stygofauna comprises aquatic animals that live below ground in water, while troglofauna is made up of terrestrial animals that live underground and breathe air but require very high humidity (Gibson et al., 2019). Stygofauna inhabits various, mostly small spaces in the matrix of groundwater aquifers, especially those in alluvium and calcretes. Troglofauna inhabits similar spaces above the water table including vugs, fissures, and relatively large interstitial spaces.

Subterranean species share several adaptations to the dark underground life where resources are limited. These include worm-shaped bodies, elongated chemosensory apparatus, and the loss of skin colouration and eyes. Western Australia supports a particularly rich subterranean fauna outside caves, with estimates of over 4,000 species, 90% of which remain to be described (Halse, 2018). Almost all subterranean animals in Western Australia are invertebrates, but fish (Whitely, 1945) and one snake (Aplin, 1998) have also been recorded.

The distribution of subterranean animals is largely determined by prevailing lithology. In Western Australia, subterranean animals appear mostly to occupy spaces only a few millimetres in width (Halse et al., 2018; Halse, 2018) but the key characteristics of their habitat(s) is that it is rich in such spaces and that the spaces are well connected laterally and vertically. Lateral connectivity facilitates dispersal of animals, while vertical connectivity ultimately to the surface is crucial for delivering carbon and other nutrients to subterranean ecosystems (Korbel & Hose, 2011). Connectivity may be disrupted by a range of factors, including dykes, major landscape features, and chemical barriers.

Subterranean animals tend to have limited distributions. Most stygofauna species exhibit short range endemism (SRE), having substantially smaller ranges than Harvey's (2002) criterion for SRE species of 10,000 km^2 (Cooper et al., 2007; Cooper et al., 2002; Eberhard et al., 2009). The ranges of troglofauna have yet to be investigated in detail but are generally more restricted than those of stygofauna, with many species having linear ranges less than 10 km (Halse & Pearson, 2014; Lamoreux, 2004).

2.1.1. Stygofauna

Most stygofauna species in Western Australia are crustaceans, particularly ostracods and copepods, although other groups such as worms and beetles are sometimes abundant (DEC, 2009; DPAW, 2021; Matthews et al., 2019). Stygofauna typically inhabits aquifers in alluvium and colluvium and karstic limestones (Halse, 2018b; Hyde et al., 2018) and the group is rarely abundant where depth to the water

table is more than 30 m below ground level (Halse, 2018). Aquifers with higher transmissivity are more likely to host stygofauna than aquifers with lower transmissivity (Maurice & Bloomfield, 2012). Stygofauna mostly occurs in fresh to hyposaline water (Halse et al., 2014; Humphreys et al., 2009), but can occur in salinities greater than seawater.

2.1.2. Troglofauna

Western Australia appears to be almost unique for its diverse and widespread troglofauna inhabiting small spaces in the vadose zone (Halse & Pearson, 2014). Troglofauna in Western Australian comprises mostly arthropods, including a variety of isopods, insects, spiders, pseudoscorpions, millipedes and centipedes. Troglofauna is particularly likely to occur in weathered or mineralised iron formations, alluvium or colluvium in valley-fill areas (including areas of karstic calcrete), and fractured sandstone (Halse, 2018).

2.2. Listed Species and Communities

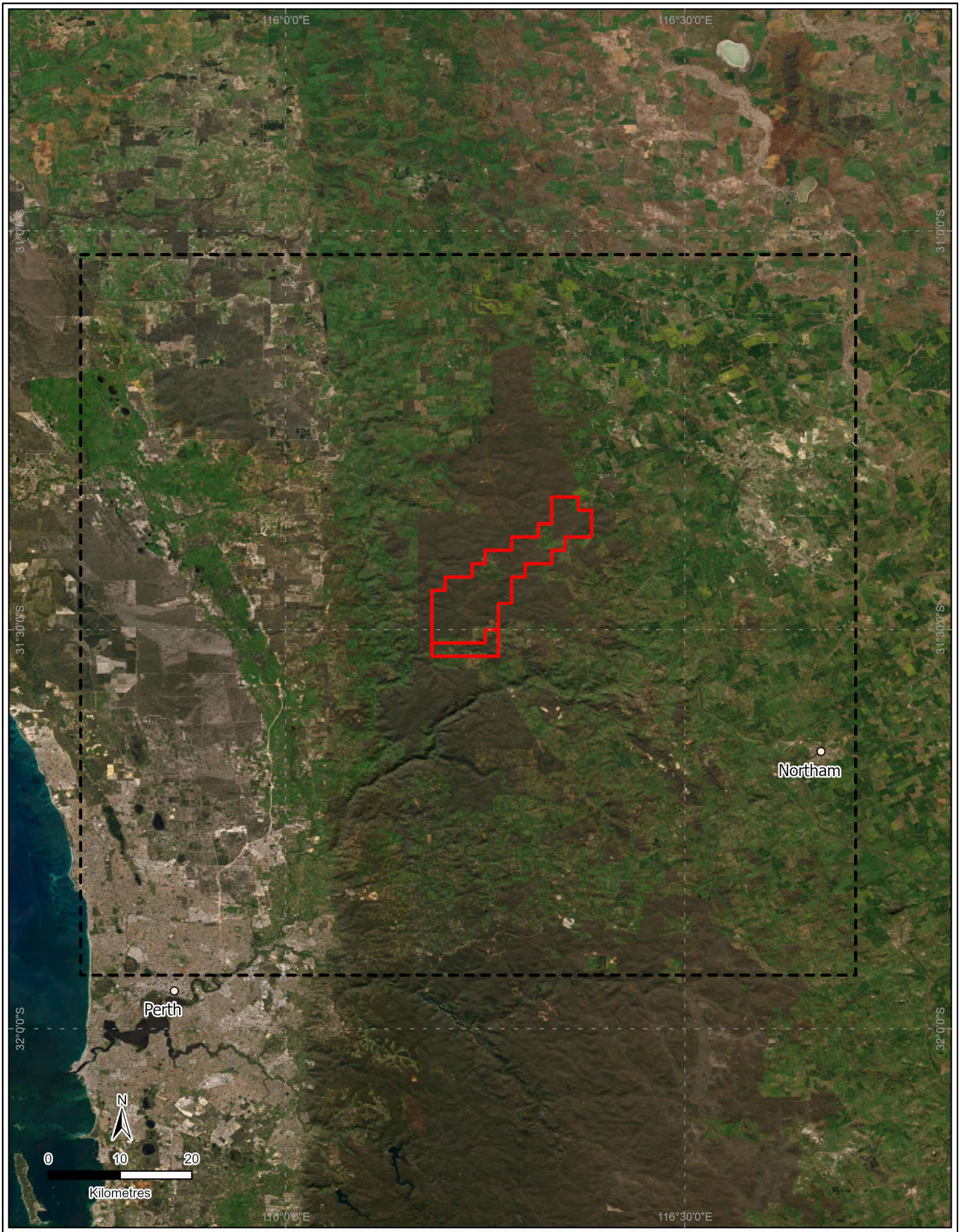
Native flora and fauna in Western Australia are protected at both State and Commonwealth levels. At the state level, the *Biodiversity Conservation Act 2016* (BC Act) provides a legal framework for protection of species, particularly for species listed by the Minister for the Environment as threatened. In addition to the formal list of threatened species under the BC Act, the Department of Biodiversity, Conservation and Attractions (DBCA) maintains a list of priority fauna species that are of conservation importance but, for various reasons, do not meet the criteria for listing as threatened. At the national level, the EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna and ecological communities.

For the purposes of environmental impact assessment in Western Australia, an ecological community is defined as a naturally occurring group of plants, animals, and other organisms interacting in unique habitat (with the unique habitat created by the combination of the species and their landscape setting; DEC, 2013). Communities occupying a small or threatened habitat are classified as threatened ecological communities (TECs) under the BC and EPBC Acts. Other potentially at-risk communities in Western Australia that do not meet the criteria for TEC listing may be informally listed by DBCA as priority ecological communities (PECs). There are a small number of subterranean fauna TECs and many subterranean fauna PECs.

2.3. Potential impacts

The impacts associated with developing mining infrastructure and subsequent mining operations can be broadly divided into two categories in terms of their effect on subterranean fauna conservation values:

1. *Primary impacts* – these are impacts that may lead to extinction of species (or threaten persistence of local populations). The most common primary impact is direct removal of habitat, usually through mine pit excavation or groundwater drawdown from dewatering or abstraction of water for processing ore.
2. *Secondary impacts* – these are impacts that mostly cause reduction in population densities as a result of reduced habitat quality rather than loss and include pollutants, blast vibration, increased turbidity, and shadowing effects of surface infrastructure that reduce recharge. In an extreme form, some secondary impacts such as salinisation (which occurs on a large scale) can threaten species persistence through physiological stress and can be considered a primary impact. The same applies to various forms of poisoning, oil spills etc, although the small scale of these usually means they are better classified as secondary impacts.



Bennelongia Environmental Consultants

GCS GDA 1994
Author: mlewis
Date: 5/09/2023

Legend

Desktop study area

Chalice Exploration Tenements

Figure 1. Location of Chalice Exploration Tenements

3. METHODS

3.1. Subterranean Fauna

A search of databases and literature was undertaken to find out what subterranean fauna records were available for the area surrounding the proposal, as well as whether any TECs or PECs featuring subterranean fauna occurred nearby. The search covered an area of approximately 100 x 100km area centred on the Project area (vertices at -31.9333970 and -31.0272824 and 115.7412011E and 116.7174162E). Analysis and mapping were undertaken using ArcGIS Pro v2.9.

The search used the following sources of information:

- The Western Australian Museum and Bennelongia databases were searched for information regarding subterranean species. For each identifiable species, the number of records (i.e., the number of times a species was found) and the total number of individuals collected from these sources was collated. Distribution patterns of identifiable species were cross referenced with the Atlas of Living Australia.
- Relevant consulting reports were also examined.
- Location and boundary information regarding the potential additional exploration of the Julimar Project were provided by Chalice.
- Boundaries of TECs and PECs were sourced from DBCA databases.

3.2. Geology and Hydrogeology

Regional and local geological and hydrogeological reports were reviewed to assess whether prospective habitat for subterranean fauna is likely to occur in and around the project.

The assessment of habitat prospectivity for stygofauna and troglofaunal considered:

- Regional and local geological and hydrogeological mapping;
- Geological and hydrogeological information in previous reports;
- Habitat information collected during any previous field survey; and
- Lithological logs.

The approach in this desktop review conforms with the relevant Environmental Protection Authority (EPA) guidelines for subterranean fauna assessment (EPA, 2016, 2021).

4. RESULTS

4.1. Climate and Bioregion

The climate in the Project area is classified as a hot-summer Mediterranean climate under the Köppen Climate Framework (Kottek et al., 2006). This includes hot, dry summers and cold, wet winters. Rainfall occurs dominantly during the winter with around 500-800mm on average (BOM, 2016). The Project is based within the Swan Coastal Plain bioregion and the Mediterranean forests, woodlands and shrubs ecoregion (DCCEEW, 2021).

4.2. Gonneville Project in a Hydrogeological Context

The Project lies over Julimar Intrusive Complex located within the Darling Ranges upland area to the east of Chittering Valley and approximately 25 km west of Toodyay. A range of platinum group elements (PGE) are hosted within the mafic to ultramafic layered intrusion including nickel, copper, cobalt and gold sulphite mineralisation. The location of the Project is shown in Figure 1.

Further detail is available in a recent groundwater and surface water baseline monitoring report that provides background on the local geology and hydrology (Kozikowska & Nicholls, 2021).

4.2.1. Geology

The Project is located on the western margin of the Yilgarn Craton on the Archean age mafic-ultramafic Julimar complex. Bedrock formations consist of Yilgarn Craton granites and Southwest Terrane greenstones (Figures 2 and 3).

The Gonneville deposit consists predominantly of serpentinised olivine peridotite / harzburgite, with some pyroxenite, gabbro and leucogabbro. It is crosscut by a granite body that broadly parallels the dip and strike orientation of the mafic-ultramafic rocks and also by a series of northeast to northwest striking dolerite dykes. Both the granite body and dolerite dykes are unmineralised with respect to Ni-Cu-PGE. Primary Ni-Cu-PGE sulphide mineralisation occurs mostly within the ultramafic domains and also the minor gabbroic domains.

Bedrock at the Gonneville deposit is generally fresh below depths of approximately 30-40 mbgl, with laterite (ferruginous duricrusts and unconsolidated iron-rich gravels and pisoliths) and deeply weathered bedrock (saprolite) extending to approximately 25 m below the surface and containing elevated PGE grades. The transition zone between the oxide and sulphide zones (saprock), that is mosty less than 15 m thick.

4.2.2. Hydrogeology

The Project is located within the Karri Groundwater Area of the Avon catchment. There is a single semi-confined aquifer system in the Project area, consisting of four units:

- An upper unit in alluvium/colluvium and underlying saprolite;
- A unit in weathered ultramafic and gabbro;
- A deeper unit in fractures of the unmineralized bedrock; and
- A unit associated with dolerite dykes, often with high permeability.

Overall, transmissivity is likely to be low but there may be an interaction between surface water features in valleys and the regional aquifer that creates favourable habitat for stygofauna.

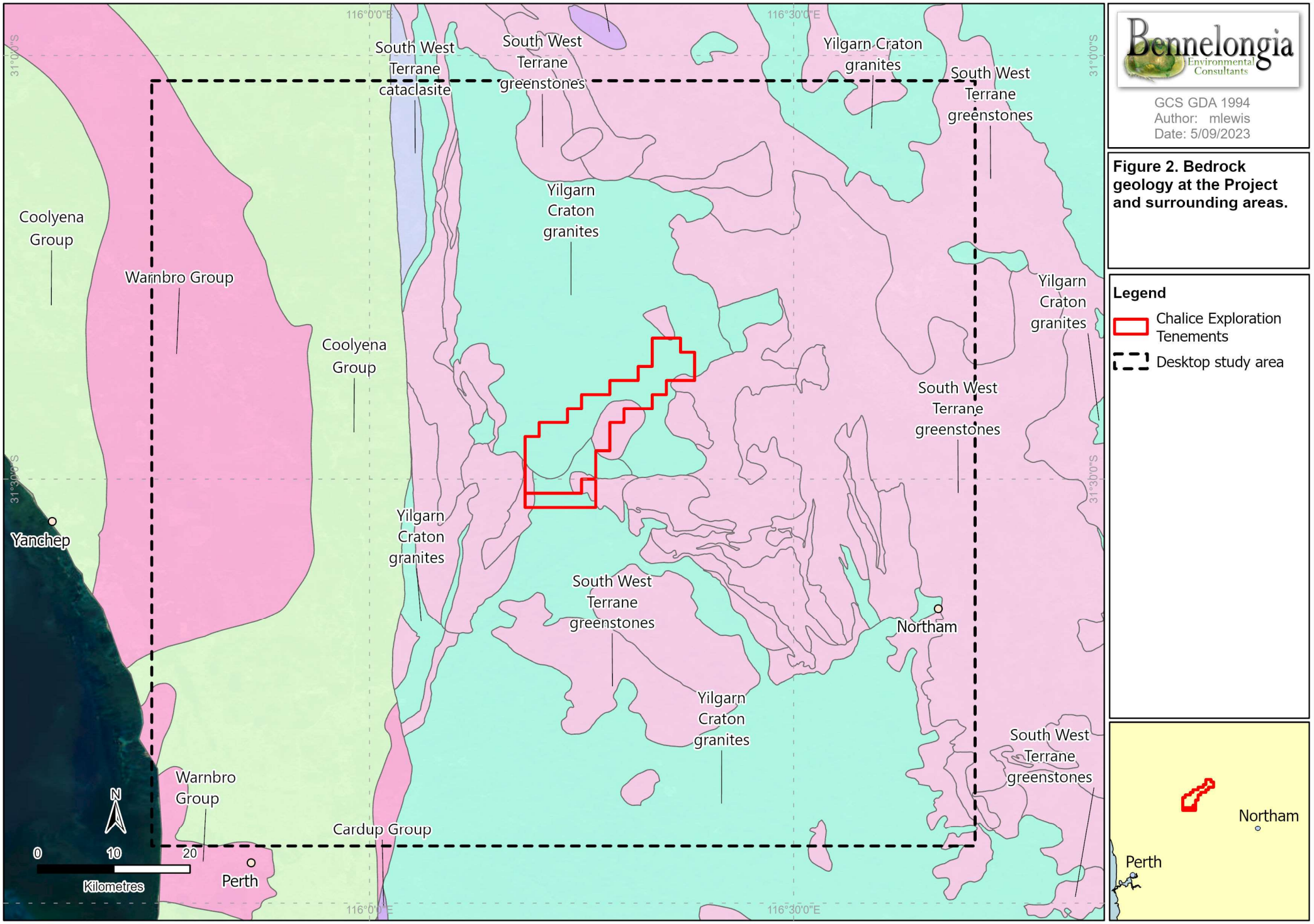
Depth to groundwater in the Gonneville deposit varies between 1.8 and 20.3 mbgl, with salinity between 1,400 and 6,100 mg/L total dissolved solids. The pH levels are circum-neutral and range between 6.2 and 7.4.

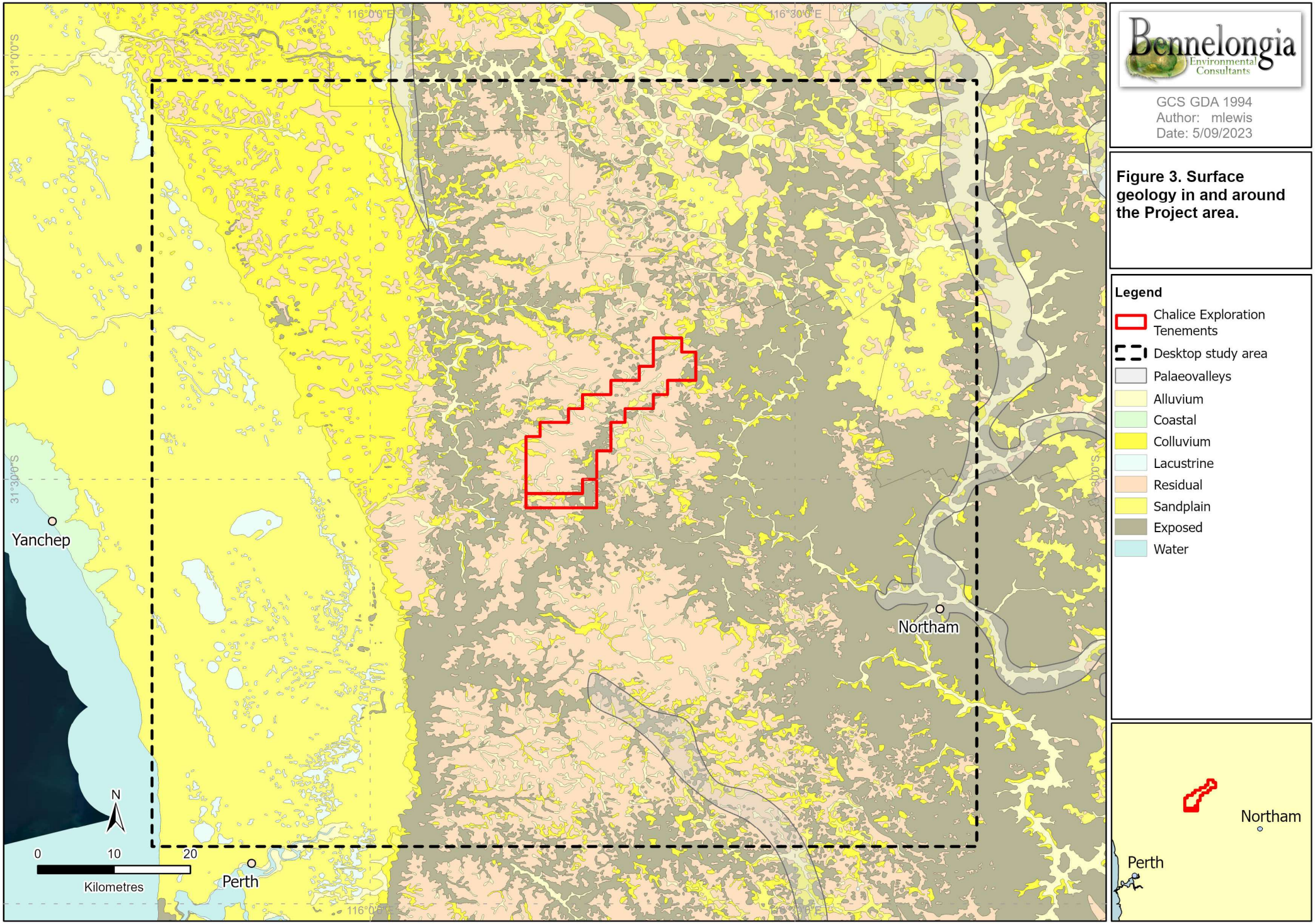
4.3. TECs and PECs

There are no TECs or PECS for subterranean fauna in the vicinity of the Project.

4.4. Subterranean Fauna Records

The database and literature search showed 198 individual stygofauna identifiable belonging to six species have been collected in the search area around the Project (Figure 4; Table 1). All species were crustaceans. Individuals in the Amphipoda order made up 93% of individuals and comprised four species. However, it is likely that the total number of *Uroctena affinis* is higher. Discrete numbers were not provided for two of the records associated with *U. affinis*; instead, a statement was made that there were "many" individuals. For the current calculations, we presumed that there would be at least 10 individuals within these records, though this is likely higher. No troglofauna was recovered by the desktop search.


116°0'0"E
116°30'0"E
31°0'0"S
31°30'0"S
South West Terrane cataclasite
South West Terrane greenstones
Yilgarn Craton granites
South West Terrane greenstones
Coolyena Group
Warnbro Group
Yilgarn Craton granites
Coolyena Group
South West Terrane greenstones
Yanchep
Yilgarn Craton granites
South West Terrane greenstones
Northam
Yilgarn Craton granites
South West Terrane greenstones
Warnbro Group
Cardup Group
Perth
N
0
10
20
Kilometres
Bennelongia Environmental Consultants
GCS GDA 1994
Author: mlewis
Date: 5/09/2023
Figure 2. Bedrock geology at the Project and surrounding areas.
Legend
Chalice Exploration Tenements
Desktop study area
Northam
Perth


116°0'0"E
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Kilometres
Bennelongia
Environmental Consultants
GCS GDA 1994
Author: mlewis
Date: 5/09/2023
Figure 3. Surface geology in and around the Project area.
Legend
Chalice Exploration Tenements
Desktop study area
Palaeovalleys
Alluvium
Coastal
Colluvium
Lacustrine
Residual
Sandplain
Exposed
Water
Northam
Perth

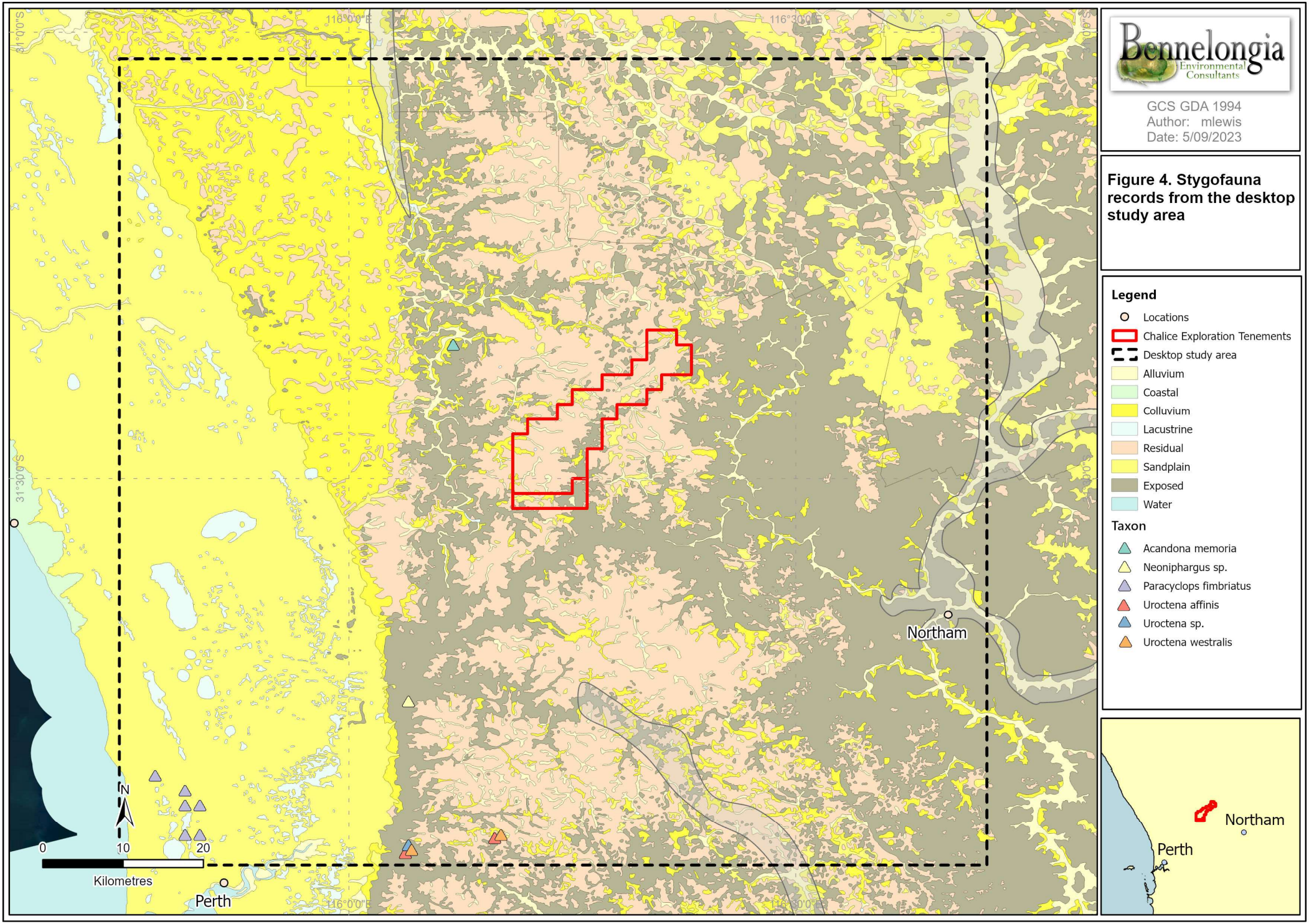
116°0'0"E
116°30'0"E
31°0'0"S
31°30'0"S
Northam
Perth
N
0
10
20
Kilometres
Bennelongia
Environmental Consultants
GCS GDA 1994
Author: mlewis
Date: 5/09/2023
Figure 4. Stygofauna records from the desktop study area
Legend
Locations
Chalice Exploration Tenements
Desktop study area
Alluvium
Coastal
Colluvium
Lacustrine
Residual
Sandplain
Exposed
Water
Taxon
Acandona memoria
Neoniphargus sp.
Paracyclops fimbriatus
Uroctena affinis
Uroctena sp.
Uroctena westralis
Northam
Perth

Table 1: Records of stygofauna from the desktop search area.
Higher taxonomic ranks are in bold. Unless unique to a higher order, records ending in 'sp.' Are not treated as discrete species.

Taxon	No. Individuals	Comments and references
Arthropoda	**198**	
Crustacea	**198**	
Malacostraca	**184**	
Amphipoda	**184**	
Gammarida	**184**	
Neoniphargidae	**1**	
Neoniphargus sp.	1	Stygofauna but possibly not in deep groundwater(Bradbury & Williams, 1997). Many species appear to have limited distribution and are known only from type locality.
Paramelitidae	**183**	
Uroctena affinis	161	Known only from type locality – South WA Stygofauna (see above). Associated with small springs, can be a boundary habitat for stygofauna (Manenti & Piazza, 2021). Two records did not specify a discrete number of individuals. There is likely more individuals of this species recorded in the area.
Uroctena sp.	13	May belong to one of the other *Uroctena* taxa
Uroctena westralis	9	Stygofauna (see above). Distribution across south WA (Williams & Barnard, 1988)
Maxillopoda	**10**	
Cyclopoida	**10**	
Cyclopidae	**10**	
Eucyclopinae	**10**	
Paracyclops fimbriatus	10	Stygofauna. Found in both surface waters and groundwaters. **Widespread.** (De Laurentiis et al., 1999)
Ostracoda	**4**	

Taxon	No. Individuals	Comments and references
Podocopida	**4**	
Candonidae	**4**	
Candoninae	**4**	
Acandona memoria	4	Stygofauna. Known only from type locality.
Grand Total	**24**	

5. DISCUSSION

A relatively small number of stygofauna records and only six species were recovered from the desktop search area, and no troglofauna records were recovered. Most species records from the search were located at least 29km southwest of the Project area. Another record of an unspecified *Uroctena* species was located around 15km northwest of the Project area. At least three species were only known from their type localities, suggesting either a lack of sampling or a narrow species distribution. The records suggest that any stygofauna community in the Project will be depauperate and contain relatively widespread species typical of streambeds and shallow groundwater, such as occurs in the jarrah forest south of Perth (Bennelongia 2021). The records also suggest the occurrence of troglofauna is unlikely. These conclusions, however, need to be seen in the context that there has been very limited sampling of subterranean fauna in the search area.

The conclusions drawn from the small number of fauna records is supported by geological and hydrogeological information. Much of the surface geology within the area is residual and unlikely to support suitable habitat for stygofauna or troglofauna. There are, however, some areas of alluvium and colluvium. Stygofauna has been collected from similar geologies in the search area around the Project. The water quality of Project area groundwater is suitable for stygofauna. Additionally, some of the stygofauna species from the search area are known to inhabit springs which are a boundary habitat of underground aquifers (Manenti & Piazza, 2021). Kozikowska and Nicholls, M. (2021) suggested that a major route of groundwater discharge within the Project area is through springs.

In conclusion, based on geology and the lack of nearby records, it is considered unlikely that a significant troglofauna community occurs in the Project area. Based on habitat and the occurrence of nearby stygofauna records, it is considered likely a depauperate community of stygofauna species that use shallow creek bed and spring groundwater habitats will be present. Such species are unlikely to have Project-scale distributions unless there are topographic anomalies that would cause range restriction. This is not the case at the Project. Accordingly, it is considered unlikely that Project development will adversely affect subterranean fauna conservation values.

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