

# 11. Air Quality

## 11.1 EPA objective

*To maintain air quality and minimise emissions so that environmental values are protected.*

For the purposes of EIA, the EPA defines the factor Air Quality as the chemical, physical, biological and aesthetic characteristics of air.

## 11.2 Policy and guidance

### EPA Policy and Guidance

- *Statement of Environmental Principles, Factors and Objectives* (EPA 2018b)
- *Instructions on how to prepare an Environmental Review Document* (EPA 2018a)
- *Environmental Factor Guideline: Air Quality* (EPA 2016m)

### Other policy and guidance

- *National Greenhouse and Energy Reporting Act 2007* (NGER Act)

## 11.3 Required work

The required work for the air quality factor as stipulated in the approved ESD and its location within this ERD is documented in Table 11-1.

Table 11-1 Required work for the air quality factor

Task No	Required work	Section
85	An air quality assessment will be undertaken to determine the likely impacts from dust generated at the site as a result of the Proposal, specifically on flora and vegetation, nearby homesteads and the operational accommodation camp. This will include noting whether these impacts are unknown, unpredictable or irreversible, or combination or contrary to that thereof	Section 11.4.1
86	A Dust Management Framework will be developed to establish targets to protect flora and vegetation, surrounding land uses and on-site users	Section 11.4.1
87	Estimate of expected pollutants (i.e. criteria air pollutants) from the Proposal.	Section 11.6.2
88	Greenhouse gas emissions key sources from the Proposal will be characterised and the expected greenhouse gas emissions estimated during construction activities, general mine operation and for the power station	Section 11.4.7
89	The residual health and aesthetic impacts on air quality will be predicted for direct, indirect and cumulative impacts, after considering avoidance and minimisation measures	Section 11.6
90	The ERD will demonstrate and document how the EPA's objective for this factor can be met	Section 11.8

## 11.4 Receiving Environment

This section has been prepared in alignment with the requirements of *Environmental Factor Guideline: Air Quality* (EPA 2016m).

### 11.4.1 Supporting air quality technical studies

A summary of the air quality technical study that was completed with regard to the MDE is provided in Table 11-2.

Table 11-2 Supporting air quality technical studies

Report Title Author (Month Year)	Focus	Location	Date	Summary	Survey area relevance to Proposal
<i>Air Quality Assessment</i> GHD 2019g (Appendix B)	Dust and GHG emissions	L 59/ 156 M 59/ 740-1 P 59/ 2133 M 59/ 637-1 G 59/ 53 (MDE) & entire PDE	May 2019	This assessment included a review of ambient air quality and meteorological conditions. Sources of dust and other pollutants relating to implementation of the Proposal were identified. Approved dispersion modelling methodologies were applied to the sources. Greenhouse gas emissions were quantified. A Dust Management Framework was included.	The survey area of this technical study is congruent with the MDE.

#### 11.4.2 Climate

The climate of the region is Mediterranean, with warm semi-arid to arid conditions. The region experiences a hot and dry summer (December to February) and a mild wet winter (June to August) (Payne et al. 1998; Markey and Dillon 2006). The mean annual rainfall recorded in Mt Magnet is 217.1 mm, with an average of 56 days of rain per year (BoM 2019). The mean maximum temperature ranges from 18.8 °C in July to 37.9 °C in January. The mean minimum temperature ranges from 7.0 °C in July to 23.5 °C in February.

Additional information regarding the climate within the region is provided in Section 2.4.1.

#### 11.4.3 Background air quality

There has been no meteorological or air quality monitoring conducted at the site. It is likely that due to the closest other development being at least 20 km away, there are no anthropogenic sources of air pollution contributing to the Yogi local airshed. Background dust concentrations are most likely to be influenced by natural sources such as bushfires or wind erosion from the semi-arid/arid conditions in the Yalgoo region. Background levels of other pollutants are unlikely to be of any significance.

#### 11.4.4 Wind distribution

The predicted annual average wind speed for within the MDE is 2.4 m/s, with summer being the windiest (2.9 m/s or 10.4 km/hr) season and autumn (2.4 m/s or 8.64 km/hr) the calmest. On the Beaufort scale, this indicates that winds are generally no more than a light breeze throughout the year.

The predicted annual and seasonal wind roses for the Project site are shown in Figure 11-1. Wind roses provide a graphical representation of the frequency distribution of winds of varying strength, from varying compass points. Figure 11-1 shows a strong seasonal cycle in wind direction, namely:

- Easterly winds present throughout all seasons.
- West, south-west, east and south-east winds during spring, with the westerly winds subsiding and easterly winds predominating during summer.
- Variable winds during autumn with increasing easterly winds.
- Increased frequency and strength of winds in the north-west quadrant during winter.

#### 11.4.5 Sensitive receptors

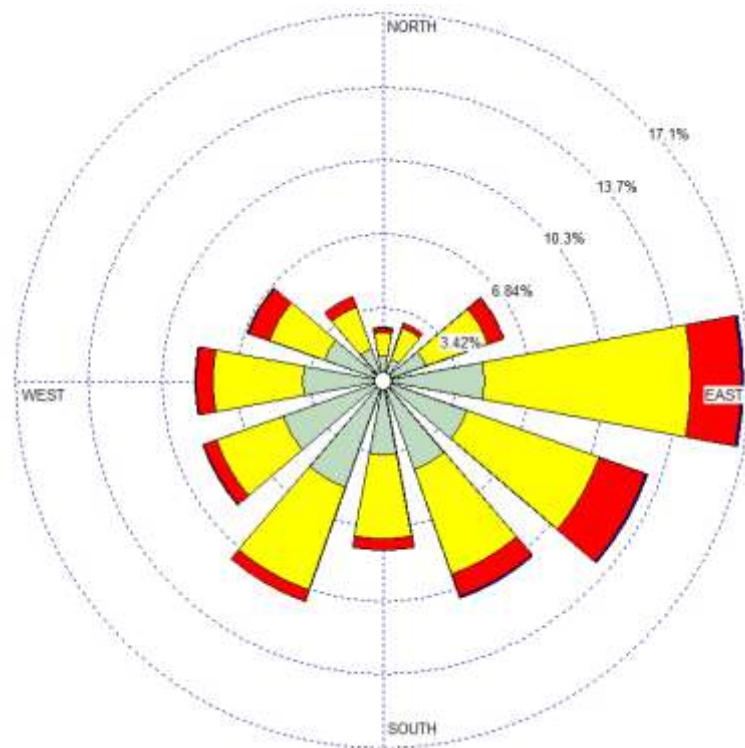
The closest sensitive receptors to the proposed Yogi Mine Project reside in Yalgoo Township. Three locations at the north-east edge of the Yalgoo Township (closest to the project site) were selected as sensitive receptors for the purpose of the *Air Quality Assessment* (GHD 2019g). These are listed in Table 11-3.

Additional sensitive receptors also includes any areas of the Yogi mine where staff will work or stay in for extended periods of time.

Table 11-3 Sensitive receptors

ID	Easting	Northing	m AGL	Distance from project boundary (km)
SR1	468836	6865284	320	15.3
SR2	469057	6865145	321	15.3
SR3	469173	6865023	320	15.3

## Annual



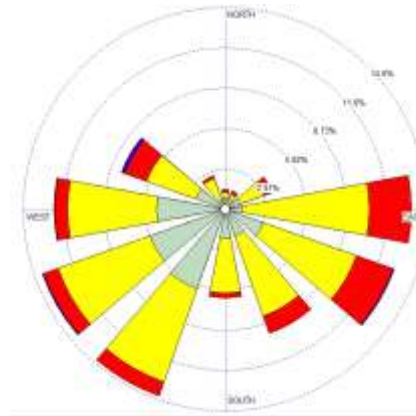
WIND SPEED  
(m/s)

- $\geq 8.00$
- 6.00 - 8.00
- 4.00 - 6.00
- 2.00 - 4.00
- 0.50 - 2.00

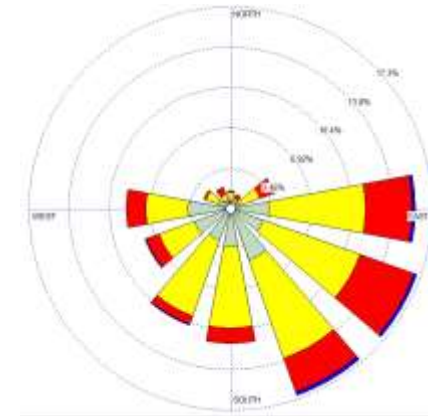
### Average wind speeds

Annual:	2.4 m/s	Calms 0.89%
Spring:	2.6 m/s	
Summer:	2.9 m/s	
Autumn:	2.4 m/s	
Winter:	2.5 m/s	

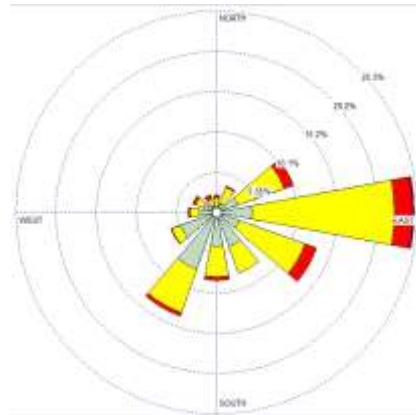
## Spring



## Summer



## Autumn



## Winter

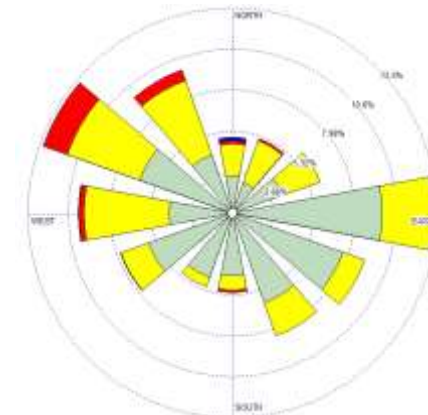


Figure 11-1 Annual and seasonal wind roses for TAPM synthesised meteorological data at the Project site (GHD 2019g)

#### 11.4.6 Activities that impact air quality

The project is located in an environment that experiences extended periods of low rainfall. Dust emissions generated in the surrounding area are generally the result of wind erosion from local sources and traffic, and the semi-arid to arid conditions of the surrounding landscape will add to the overall dust emissions in the region.

In addition to existing dust sources (local traffic and the semi-arid environment), activities of the Proposal which have the potential to impact air quality include:

- Clearing of native vegetation for mine and pipeline corridor
- Loading and unloading of ore and waste rock into dump trucks and stockpiles
- Processing of material by crushing and screening processes
- Wind erosion of uncovered stockpiles and pit and waste rock dump open areas
- Wheel generated dust from movement of vehicles along unpaved areas of unconsolidated soil
- Power generation

#### 11.4.7 Greenhouse gas emissions

Greenhouse gas emissions contribute to a changing climate on a global scale. The effects of the changing climate are predicted to be significant for Western Australia.

Total GHG emissions have been calculated for Year 14, which is considered to be the year that has the maximum amount of GHG emissions.

The total GHG emissions for normal operations during Year 14 and shown in Table 11-4.

Table 11-4 Summary of total emissions – Normal operations

Source	Total Emissions (t CO <sub>2</sub> -e)	Percentage of total
Total diesel fleet	68,435	30%
Total electricity	161,625	70%
All emissions	230,061	100%

### 11.5 Potential impacts

Potential direct and indirect impacts to air quality include the following:

- Direct:
  - Dust generation (11.6.1)
  - Pollutant emissions from mining and power generation activities (11.6.2)
- Indirect:
  - Ore processing (11.6.3)
  - Post –closure rehabilitation (11.6.4)
  - Greenhouse gas emissions (11.6.5)

### 11.6 Assessment of impacts

#### 11.6.1 Dust Generation

In the assessment of environmental impacts, dust is more conventionally referred to as 'particulates' or 'airborne particulates'. Dust is made up of a number of different sized particles.

Airborne particulate matter less than 50 micrometres ( $\mu\text{m}$ ) in diameter are referred to as Total Suspended particulates (TSP). Finer particles less than 10  $\mu\text{m}$  and 2.5  $\mu\text{m}$  in diameter are referred to as  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  respectively (GHD 2019g). Most airborne particulates likely to originate from the proposed operations are greater than  $\text{PM}_{10}$  and are more associated with nuisance rather than public health impacts. The larger particles tend to settle back to the ground within a short range (less than 300 m) from the source (GHD 2019g).

Dust generation can reduce air quality leading to:

- Safety impacts such as reduced visibility when driving;
- Health impacts from inhalation of dust particles;
- Nuisance build-up of dust on clothing, vehicles and outdoor areas.
- Dust may also interfere with physiological processes of flora and vegetation such as:
- Photosynthesis; and transpiration and respiration.
- It may increase leaf temperature and interfere with the diffusion of gases through plants.

In extreme cases dust deposition can smother and kill vegetation and lead to increased incidence of plant pests and diseases.

Vegetation damage from dust deposition can result in degradation of fauna habitat leading to loss or fragmentation of foraging areas and may expose fauna to increased risk of predation. This reduction in vegetation cover can restrict the movement of animals within their established foraging and breeding habitat.

#### 11.6.2 Pollutant emissions from mining and power generation activities

The primary pollutants from gas turbines are oxides of nitrogen ( $\text{NO}_x$ ) formed by high temperatures generated in the combustor and CO and VOCs which are formed predominantly by the incomplete combustion of fuel.  $\text{PM}_{10}$  and  $\text{SO}_2$  are emitted in trace amounts as the gas turbines will be fired using natural gas.

Due to the preliminary phase of the Yogi Mine Project at the time of writing this report, the parameters of the power station were not yet defined and therefore for the purpose of this assessment have been assumed based on a similar project.

The following information was assumed for the Yogi Mine Project power station:

- The power station will deliver 470 MW of electrical power at an ambient temperature of 45 C.
- The power station will consist of five combined cycle blocks each made up of two gas turbines using heat recovery steam generation.
- Each gas turbine will be coupled to an electricity generator and Heat Recovery Steam Generator (HRSG), which uses heat from the gas turbine exhaust gases to produce steam. A single steam turbine generator will be driven by steam from both operating HRSGs via a common steam header.

VOCs modelled in the assessment include hexane, toluene, xylene, phenol, formaldehyde, acetaldehyde and acetone.  $\text{O}_3$  was not included as it is considered a secondary pollutant.

Diesel emissions are a complex mixture of particulate matter and gaseous components.

The particulate component comprises solid carbon cores, produced during the combustion process, with a range of organic carbon compounds condensed onto the solid nucleus, as well as some metallic compounds. More than 90 per cent of the carbon particulates are respirable,

having diameters of 1 µm or less, which are capable of entering the deepest regions of the lungs.

The gaseous components include water vapour, oxides of carbon (CO, CO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>), volatile organic compounds, and unreacted gases from air such as nitrogen.

Emissions from heavy vehicles and diesel powered equipment would consist of products of combustion, including oxides of nitrogen (NO<sub>x</sub>), SO<sub>2</sub>, PM<sub>10</sub> and volatile organic compounds (VOCs). Emissions from heavy equipment will be minimised by ensuring all vehicles on-site are well maintained and operated in an efficient manner (Department of Mines and Petroleum 2013)

Emission from vehicles on-site are not considered to represent a significant source of emissions.

#### 11.6.3 Ore processing

Ore extracted during mining requires some processing to ensure that the final product meets customer demands with regards to iron content and impurities. Dust deposition can occur through this process.

A range of effective dust control measures will be put in place to reduce the effects of dust deposition on the surrounding environment. Table 11-5

Table 11-5 Dust control measures for Ore processing activities

Activity	Dust control	Effectiveness
Drilling	Water sprays	70%
Wheel generated dust (ore haul roads)	Level 1 watering	50%
Wheel generated dust (waste haul roads)	Level 1 watering	50%
Unloading (ore)	Water sprays	50%
Unloading (waste rock)	Water sprays	30%
Primary crushing	Use of fabric filters	99%
Secondary crushing	Use of fabric filters	99%
Tertiary crushing	Use of fabric filters	99%
Ore handling and transfer	Enclosure	70%
Screening	Enclosure and use of fabric filters	83%

#### 11.6.4 Post-closure rehabilitation

Prior to closure the MCP (GHD 2019c, Appendix D) will be reviewed and updated with specific control measures for closure and rehabilitation and implement post closure. The waste rock dump and DPWF will be designed with appropriate containment (cover / capping and liners) and the landform surfaces will be stabilised by re-vegetation.

#### 11.6.5 Greenhouse gas Emissions

Emissions of greenhouse gases contribute to the changing climate. The effects of the changing climate are predicted to be significant in Western Australia, with a drying climate in the south-west, more frequent and severe storms in the north-west, and a rising sea level along our entire coastline.

Greenhouse gas emissions resulting from the Proposal will be generated through the combustion of hydrocarbons, clearing of native vegetation, the use of explosives during blasting operations and the use of electricity.

Total GHG emissions for the worst-case operational year are estimated to be 230,061 t CO<sub>2</sub>-e (normal operations) and 262,386 t CO<sub>2</sub>-e (upset conditions). Management measures including

improving fuel efficiency in vehicles and implementing of cogeneration of renewable energy with natural gas at the power plant were recommended.

#### 11.6.6 Cumulative impacts

The existing mines in the area may contribute to regional levels of particulate matter. However, their 65 km separation distances from the proposed minesite is considered to be a sufficient buffer to ensure the local air shed is not significantly influenced by existing mining activity.

Due to the distance to the nearest significant other development, there are no anticipated cumulative impacts relating to dust generation and ore processing from the Yogi mine in the region.

### 11.7 Mitigation

The mitigation hierarchy (avoid, minimise, rehabilitate) has been applied to this proposal in relation to air quality.

The inherent impacts that must be managed include:

- Ore processing activities
- Increase in dust depositions
- Increase in pollutant emissions

Management and monitoring measures for the above impacts are well practiced and understood in the industry, and are considered to be effective.

Mitigation strategies to address the above potential impacts are presented in Table 11-6.

Table 11-6 Mitigation for impacts to air quality

Impact	Mitigation measures
Dust Generation	<p><b>Avoid</b></p> <ul style="list-style-type: none"> <li>• Wet down areas ahead of blasting.</li> <li>• Vehicle speeds would be limited to 25 km/h on areas on unconsolidated or unsealed soil associated with the project.</li> <li>• Sprinklers on the fine ore stockpiles.</li> <li>• Review of daily weather updates from BoM, or a private meteorology service provider, to give warning of likely strong winds to assist with daily management of windblown dust from unconsolidated soil surfaces and material stockpiles.</li> <li>• All haulage vehicles are to have their loads covered while transporting material to or from the work area through off-site routes that may have sensitive receptors.</li> <li>• Operate water carts during dry, windy conditions and spring (i.e. driest) months</li> </ul> <p><b>Mitigate</b></p> <ul style="list-style-type: none"> <li>• Defined haul routes to be used wherever it is necessary for vehicles to traverse unsealed surfaces or unformed roads.</li> <li>• Prompt mitigation of excessive visible dust emissions, which may involve application of water</li> <li>• Awareness of operational areas more frequently exposed to higher winds and the predominant wind directions in these areas at various times of the year. Temporary wind barriers may be employed where necessary.</li> </ul>

Impact	Mitigation measures
	<ul style="list-style-type: none"> <li>An air quality monitoring programme for TSP, PM<sub>10</sub> and dust deposition will be implemented to determine ambient dust concentrations. A monitoring station for TSP and PM<sub>10</sub> will be located at the Yalgoo township and dust deposition gauges will be located at the boundary of the Site. Monitoring equipment and sampling methods will conform to Australian standards and will be selected prior to commencement of the dust monitoring programme.</li> </ul>
Pollutant emissions from mining and power generation activities	<p><b>Avoid</b></p> <ul style="list-style-type: none"> <li>All construction and maintenance equipment/vehicles to be operated and maintained to manufacturers' specifications in order to minimise exhaust emissions.</li> <li>Servicing should be undertaken by competent personnel who can interpret diesel emission monitoring results to minimise emissions following maintenance and repairs.</li> </ul> <p><b>Mitigate</b></p> <ul style="list-style-type: none"> <li>Good maintenance practices will be implemented in an effort to reduce raw exhaust emission levels.</li> <li>Operators should report any equipment issues.</li> </ul>
Ore processing	<p><b>Avoid</b></p> <ul style="list-style-type: none"> <li>Use of hooding with baghouse (or fabric filter) with a dust extraction system. Regular maintenance inspections and repairs on dust extraction ducting and baghouses</li> <li>Enclosure on conveyors</li> </ul>
Post-closure rehabilitation	<p><b>Avoid</b></p> <ul style="list-style-type: none"> <li>Post-closure landforms are not to be left as bare earth and should be appropriately re-vegetated to reduce dust emissions.</li> <li>The MCP will be updated prior to closure to ensure that appropriate land formation characteristics are included and revised according to the new landforms.</li> </ul>
Greenhouse gas emissions	<p><b>Avoid</b></p> <ul style="list-style-type: none"> <li>Operating the power plant at a suitable efficiency to meet demand and not produce excess electricity.</li> <li>Install energy efficient fittings, fixtures and equipment where appropriate.</li> </ul>

## 11.8 Predicted outcome

### 11.8.1 Residual impacts

A summary of residual impacts after the implementation of the proposal and the application of the mitigation measures outlined in Table 11-6 above is provided in Table 11-7.

Table 11-7 Mitigation measures and predicted outcome for impacts to air quality

Impact	Residual impact
Dust Generation	Any changes in dust deposition is expected to be limited to the immediate vicinity of the mine and roads. The MDE is currently an active pastoral station, with dust generated as a result of cattle and vehicle movement. The

Impact	Residual impact
and ore processing	<p>mining operation are not expected to result in a measurable change to vegetation health in the wider region.</p> <p>Dust management measures implemented will reduce the amount received in nearby areas of vegetation and fauna habitat such that it is assessed to have no significant impact.</p>
Pollutant emissions from mining and power generation activities	<p>It is unlikely that the Yogi Mine Project will have an adverse impact on local ambient air quality.</p> <p>Nearest sensitive receptor is located in the town of Yalgoo which is approximately 16 km east of the MDE.</p> <p>The majority of airborne particulates likely to originate from the proposed operations are greater than PM<sub>10</sub> and are more associated with nuisance rather than public health impacts. The larger particles tend to settle back to the ground within a short range (less than 300 m) from the source.</p>
Ore processing	Ore processing is assessed to have no significant impact on air quality given consideration of the control measures
Post-closure rehabilitation	Post-closure rehabilitation will be adequately planned to ensure that there are no significant impacts to air quality.
Greenhouse gas emissions	<p>Greenhouse gas emissions from the Proposal are anticipated to contribute to the overall global warming of the earth, with GHG emissions presently mainly attributed to power generation (70%).</p> <p>It is recommended that opportunities for reducing greenhouse gas emissions during the life of the Proposal should be investigated.</p>

#### 11.8.2 Assessment against the EPA objective

Following completion of the assessment and the residual impact outlined in Table 11-6, it is considered that the implementation of the proposal will not have significant residual impacts. As such, it meets the objective for this factor such that the emissions are minimised and air quality is maintained.

#### 11.8.3 Offsets

This Proposal meets the EPA's objective for the air quality factor, with residual impacts not considered significant, and thus no offsets are proposed for this environmental factor.

## 12. Social Surroundings

### 12.1 EPA objective

*To protect social surroundings from significant harm.*

For the purposes of EIA, the EPA defines the factor as, the social surrounding of man are his aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by his physical or biological surroundings.

### 12.2 Policy and guidance

- *Statement of Environmental Principles, Factors and Objectives* (EPA 2018b)
- *Instructions on how to prepare an Environmental Review Document*, (EPA 2016b)
- *Environmental Factor Guideline: Social Surroundings* (EPA 2016n)
- *Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41* (EPA 2004a).

#### Other policy and guidance

- *Aboriginal Heritage – Due Diligence Guidelines* (Version 3.0) (Department of Aboriginal Affairs and Department of the Premier and Cabinet 2013).

### 12.3 Required work

The required work for the social surroundings factor as stipulated in the approved ESD and its location within this ERD is documented in Table 12-1.

Table 12-1 Required work for the social surroundings factor

Task No	Required work	Section
<b>Mine Development Envelope</b>		
91	The heritage and cultural values of the Development Envelope will be characterised.	Section 12.4
92	Aboriginal heritage surveys will be conducted to identify Aboriginal archaeological and ethnographic sites of significance and concerns associated with the Proposal. The surveys will be limited to area not previously surveyed.	Section 12.4.1
93	Appropriate consultation will be conducted to identify the potential impacts on the social surroundings of people affected by the Proposal (related to the physical area involved in the Proposal)	Section 12.4.1
94	The potential impacts to economic surroundings of people referred to in scope 93 above will be identified and discussed. The discussion will include consideration of the mitigation hierarchy. This will include noting whether these impacts are unknown, unpredictable or irreversible, or combination or contrary to that thereof.	Section 12.6
95	The current and any other reasonably foreseeable land and recreational uses, and amenity values (including for visual, noise, odour and dusts) of the Development Envelope will be characterised.	Section 12.6.4
96	The outcome of the consultation and heritage surveys will be provided.	Section 12.4.4

Task No	Required work	Section
97	A detailed description and figure (s) of the proposed disturbance and impacts to heritage sites, value and/or cultural associations relating to the Proposal will be provided.	Figure 12-2 (Section 12.4.4)
98	An environmental management plan will be provided that describes the proposed management, and monitoring methods to be implemented to mitigate potential impacts to social surrounds.	GHD 2020d, Appendix C
99	The residual impacts on social surrounds will be predicted for direct, indirect and cumulative impacts, after considering avoidance and minimisation measures.	Section 12.8.1
100	A mine closure plan will be prepared, consistent with the DMIRS and EPA Guidelines.	GHD 2019c, Appendix D
101	The ERD will demonstrate and document how the EPA's objective for this factor can be met.	Section 12.8.2
<b>Pipeline Development Envelope</b>		
102	A desktop review of available reports, government databases and spatial data will be undertaken to identify and characterise the heritage and cultural values of the Pipeline Development Envelope.	Section 12.4.1 and 12.4
103	Impacts on any heritage sites, values/ and or cultural associations, associated with implementation of the Proposal will be assessed, including those resulting from changes to the environment which may impact on cultural and heritage significance values. This will include noting whether these impacts are unknown, unpredictable or irreversible, or combination or contrary to that thereof.	Figure 12-3 (Section 12.4.4)
104	An environmental management plan will be provided that describes the proposed management, and monitoring methods to be implemented to mitigate potential impacts to social surrounds.	GHD 2020e, Appendix C
105	The residual impacts on social surrounds will be predicted for direct, indirect and cumulative impacts, after considering avoidance and minimisation measures.	Section 12.8.1
106	The ERD will demonstrate and document how the EPA's objective for this factor can be met.	Section 12.8.2

## 12.4 Receiving Environment

This section has been prepared in alignment with the requirements of *Environmental Factor Guideline: Social Surroundings* (EPA 2016n).

### 12.4.1 Supporting social surroundings technical studies

A summary of the social surroundings technical study that was completed within and in close proximity to the Proposal area are provided in Table 12-1.

A total of 42 Aboriginal Heritage Surveys including ethnographical and archaeological have been completed through the Proposal Area; these are summarised in Table 5 of *Due Diligence risk assessment advice for a Mine Proposal at Yalgoo and an Infrastructure Corridor between Yalgoo and Geraldton Western Australia* (Brad Goode & Associates 2019a, Appendix B).

Table 12-2 Supporting social surroundings technical studies

Report Title Author (Month Year)	Targeted group	Location	Date	Summary	Survey area relevance to Proposal
<i>Due diligence risk assessment advice for a mine proposal at Yalgoo and an infrastructure corridor between Yalgoo and Geraldton Western Australia</i> Brad Goode & Associates 2019a (Appendix B)	Registered Aboriginal Heritage sites	L 59/ 156 M 59/ 740-1 P 59/ 2133 M 59/ 637-1 G 59/ 53 (MDE) & entire PDE	April 2019	A search of the DPLH Aboriginal Sites and Places register within the Study Area defined for the Pipeline revealed eight Registered Aboriginal heritage sites. There are also 24 Other Heritage Places on the Sites and Places register within this Study Area. Within the Study Area defined for the development of the Mine there are no registered sites but there are two places recorded on the DPLH public database that may be sites but have not yet been assessed by the ACMC, one of which is also within the Pipeline Study Area.	The survey area of this technical study is congruent with the MDE and PDE.
<i>Report of an Aboriginal Heritage Survey for the Yogi Magnetite Project in the Shire of Yalgoo, Western Australia</i> Brad Goode & Associates 2019b (Appendix B)	Registered Aboriginal Heritage sites	MDE	May 2019	Provides an overview of any previously recorded Aboriginal Heritage sites, consultations with the Widi Mob Native Title Claim.	The survey area of this technical study is congruent with the MDE.

#### 12.4.2 Population centres

The MDE is located in the Yalgoo region, within the Shire of Yalgoo (Local Government Area) (Figure 1-1). The town of Yalgoo has a population of 279 (Australian Bureau of Statistics 2016).

The PDE includes several Local Government Areas: Shire of Yalgoo, City of Greater Geraldton, Shire of Murchison, and Shire of Chapman Valley. The Pipeline is proposed to link the Mine with port facilities at Geraldton. The proposed infrastructure corridor is aligned for the most part along the Geraldton to Mount Magnet Road. The proposed Pipeline is 247.7 kilometres long and the Study Area for the infrastructure corridor varies from five kilometres to one kilometre wide.

#### 12.4.3 Native Title

Native title recognises the traditional rights and interests to land and waters of Aboriginal and Torres Strait Islander people. An Aboriginal Heritage assessment was completed by Brad Goode & Associates (2019) as part of the planning for Yogi Mine. This assessment included a desktop assessment where Native Title claimants through the Proposal area were identified and the area to which they lay claim (Brad Goode & Associates 2019a).

The MDE and PDE lie within the Widi Mod Native Title Claim (NNTT No. 2661). The PDE also covers the Mullewa Wadjari Community, the Wajarri Yamatji and the Southern Yamatji. Land use over these claims are summarised in Table 12-3 and Table 12-4. The location of Native Title Claims in relation to the proposal area is shown in Figure 12-1.

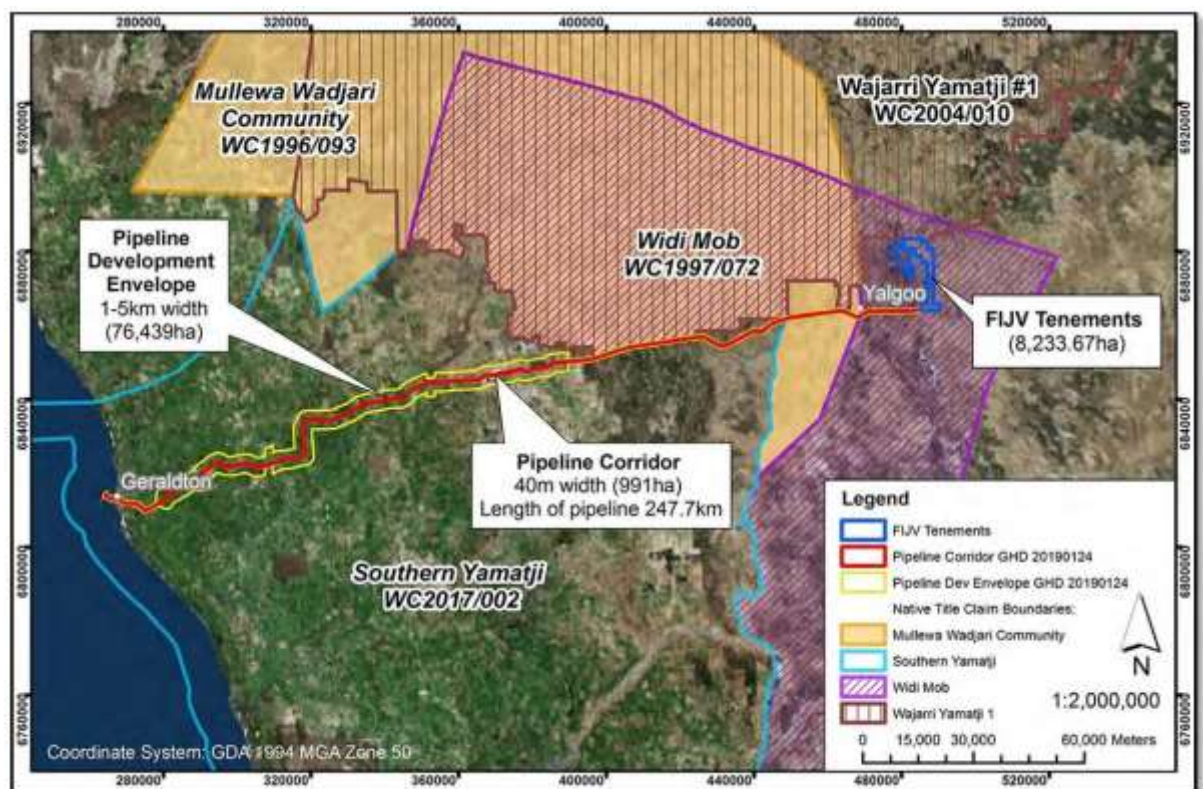


Figure 12-1 Map of Native Title Claims in relation to the Proposal area (Brad Goode & Associates 2019a)

Table 12-3 Native title claims and proposed land use within the MDE (Brad Goode & Associates 2019a)

ID	Project	Dimensions	Area (ha)	Mining Tenement	Native Title Claim
1	Crusher	417 m NS x 225 m EW	9.40	M 59/740-I	Widi Mob
2	Ore Stockpile	485 m NS x 327 m EW	13.50	M 59/740-I	Widi Mob
3	Administration	520 m NS x 404 m EW	21.05	L 59/156	Widi Mob
4	Workshop	358 m NS x 326 m EW	11.66	L 59/156	Widi Mob
5	Processing Plant	500 m NS x 966 m EW	48.35	L 59/156	Widi Mob
6	Overburden Facility	920 m NS x 790 m EW	53.45	M 59/740-I	Widi Mob
7	Mine Pit	2,509 m x 560 m	147.91	M 59/740-I	Widi Mob
8	Waste Rock Facility	1,916 m NS x 1,306 m EW	214.08	M 59/740-I	Widi Mob
9	Dry Processing Waste Facility	1,352 m NS x 1,186 m EW	160.44	L 59/156	Widi Mob
10	Fresh Water Pond	259 m NS x 273 m EW	7.10	L 59/156	Widi Mob
11	Drainage Water Pond	259 m NS x 259 m EW	6.74	M 59/740-I	Widi Mob
12	Parking	230 m NS x 246 m EW	5.67	M 59/740-I	Widi Mob
	Total		699.34		

Table 12-4 Native title claims and proposed land use within the PDE (Brad Goode & Associates 2019a)

ID	Sections of the Pipeline Development Envelope Project Area	Dimensions	Approx. Area (ha)	Mining Tenement (intersect portions of tenement)	Native Title Claim
1	Pipeline corridor commencing from the FIJV Tenements in Yalgoo, west to Barnong-Wurarga Road in Yalgoo	58.2 km length x 1 km corridor	5,864	E 59/1151, E 59/2077, E 59/2243, E 59/2244, E 59/2252, E 59/2284, E 59/2285, E 59/2288, E 59/2295, L 59/156, L 59/70	Mullewa Wadjari Widi Mob Wajarri Yamatji #1 Southern Yamatji
2	Barnong-Wurarga Road in Yalgoo, west to Fegan Road in Pindar	48.1 km length x 1 km-5 km corridor	7,366	None	Mullewa Wadjari Widi Mob Wajarri Yamatji #1 Southern Yamatji

ID	Sections of the Pipeline Development Envelope Project Area	Dimensions	Approx. Area (ha)	Mining Tenement (intersect portions of tenement)	Native Title Claim
3	Fegan Road in Pindar, west to Tenindewa North Road in Tenindewa	44.8 km length x 5 km corridor	22,365	E 70/4995, E 70/4996, G 70/201, G 70/202, G 70/203, G 70/204, G 70/205, L 70/73, L 70/74	Southern Yamatji
4	Tenindewa North Road, west to Kojarena South Road in Kojarena	61.7 km length x 5 km corridor	30,785	E 70/5199	Southern Yamatji
5	Kojarena South Road, west to Marine Terrace in Geraldton	34.2 km length x 1 km-5 km corridor	10,059	None	Southern Yamatji

#### 12.4.4 Aboriginal heritage

Two Aboriginal Heritage assessments were completed by Brad Goode & Associates (2019a; 2019b) as part of the planning for Yogi Mine. The assessment included a desktop assessment of the Department of Planning, Lands and Heritage (DPLH) *Aboriginal Heritage Inquiry System* and a risk assessment and development of recommendations to minimise contravention to the *Aboriginal Heritage Act 1972* (Brad Goode & Associates 2019a), and a review of traditional Yamatji culture, which refers to Aboriginal people of 'mixed tribal origin who may or may not be of Western Desert Background' (Brad Goode & Associates 2019b).

A search of the DPLH Aboriginal Sites and Places register shows there are no Registered Aboriginal Sites within the MDE (Brad Goode & Associates 2019b). However there are two Aboriginal 'Other Heritage Places', one of which is also partially within the PDE. The two 'Other Heritage Places' are not within the current footprint for mining or its associated infrastructure. These locations are shown in Figure 12-2 and are outlined in Table 12-5.

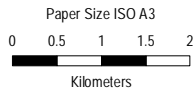
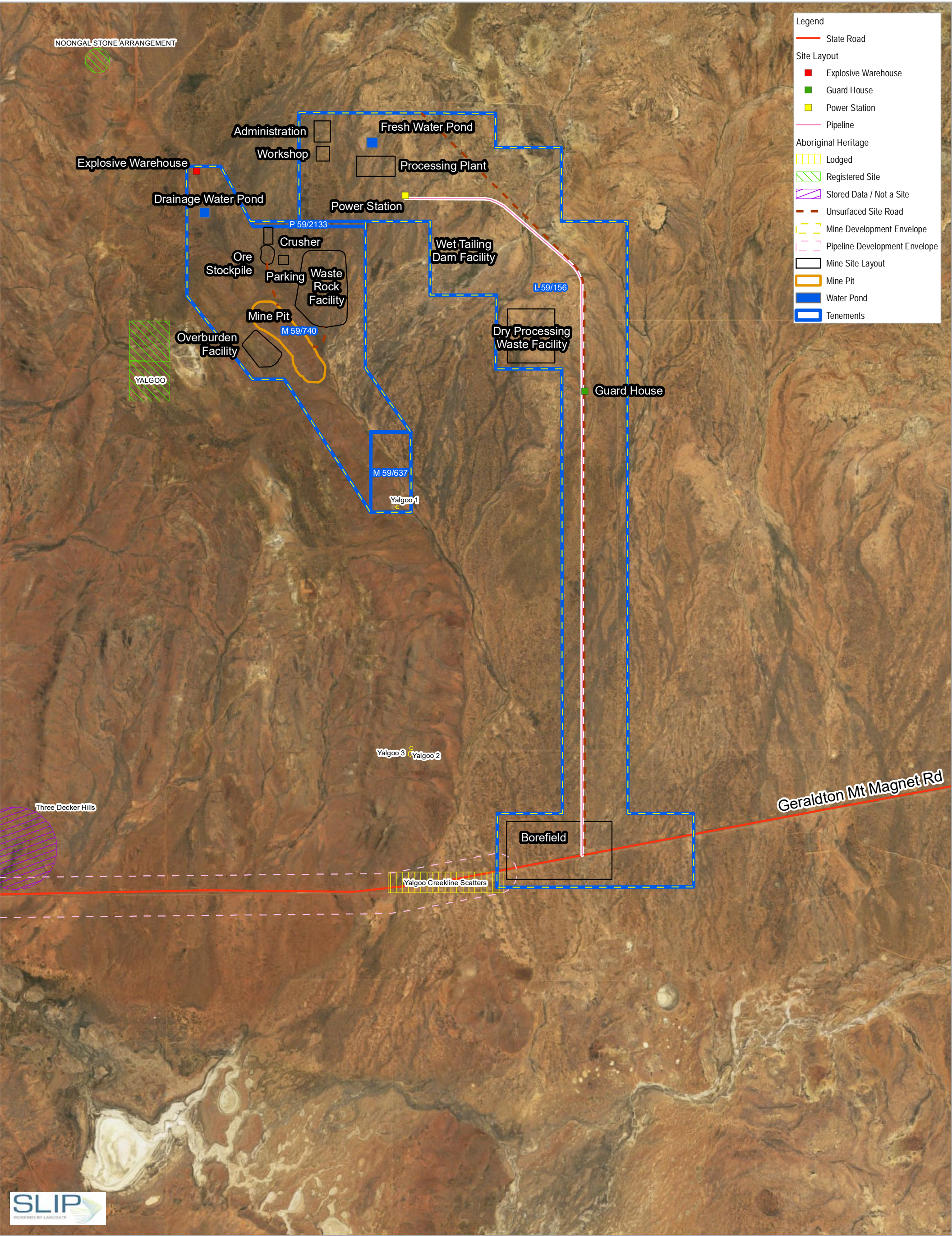
There are eight Registered Aboriginal heritage sites within the PDE (Brad Goode & Associates 2019a). There are 24 'Other heritage Places' on the Aboriginal Sites and Places register within the PDE (Brad Goode & Associates 2019a). Sites on the Aboriginal Sites and Places register within the PDE are presented in Figure 12-3 and are outlined in Table 12-5.

Table 12-5 Aboriginal Heritage Places within the Mine Development Envelope (Brad Goode & Associates 2019a)

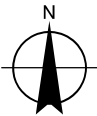
ID	Name	Type
<b>Other Heritage Places</b>		
20469	Yalgoo Creekline Scatters	Artefacts / Scatter
24169	Yalgoo 1	Artefacts / Scatter

In relation to this proposal Schedule 1 of the *Aboriginal Heritage Act 1972*, Aboriginal Heritage Due Diligence Guidelines has determined that the establishment of the Proposal constitutes a 'Major Disturbance,' as it involves clearing, blasting, construction and mining in a relatively unaltered environment (Brad Goode & Associates 2019a).

In relation to the Pipeline corridor, Schedule 1 of the AHA Aboriginal Heritage Due Diligence Guidelines has determined that the construction of a New Pipeline constitutes a 'Significant Disturbance' (Brad Goode & Associates 2019a). However, the proposed Pipeline alignment is 247.7 km long and traverses a range of different environmental landscapes. Schedule 2, the risk assessment matrix, suggests that the works pose a 'Low Risk' where the land is a 'Built Environment'. However, where the works proceed outside the existing road formation, or previous pipeline trenches, then the risk increases to 'moderate to high,' as the potential does exist for subsurface archaeological material to be present or the prospect of impacting the registered ceremonial or spiritual sites.



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

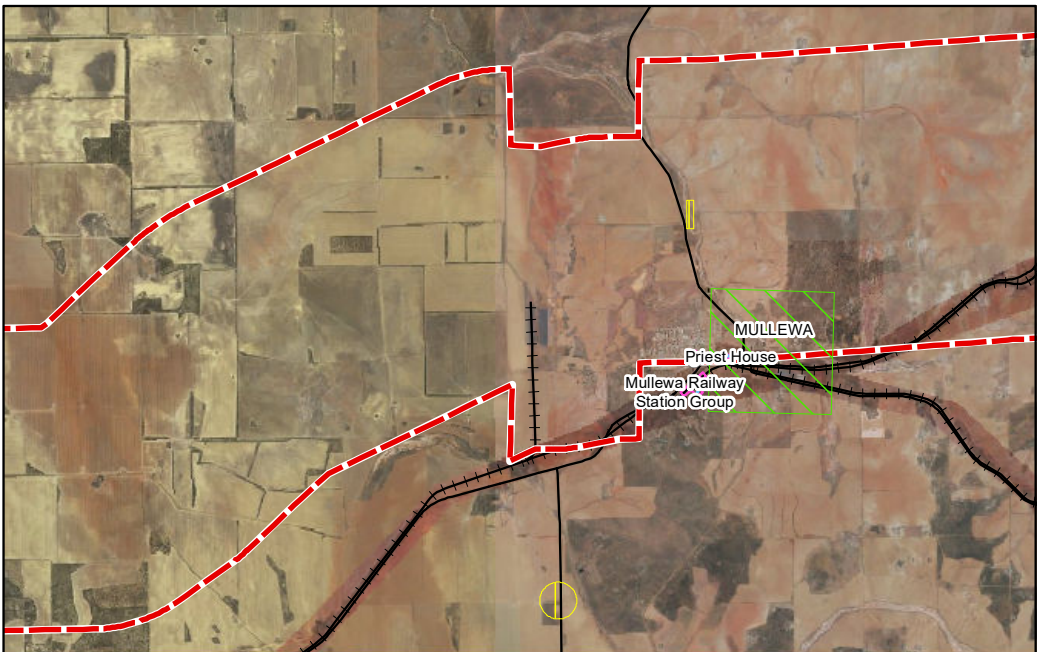
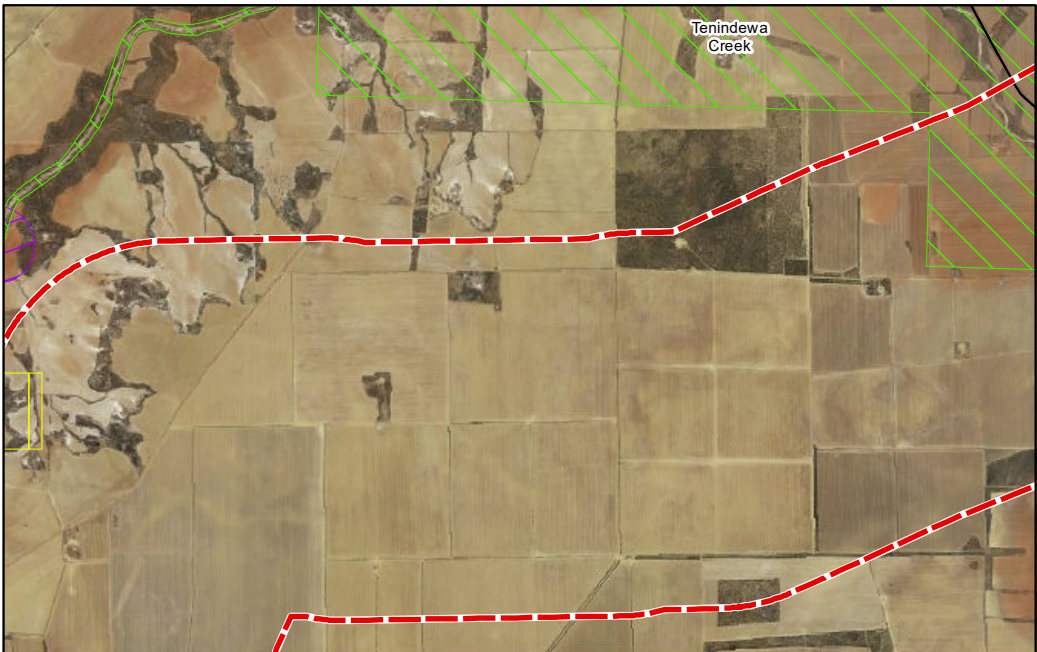
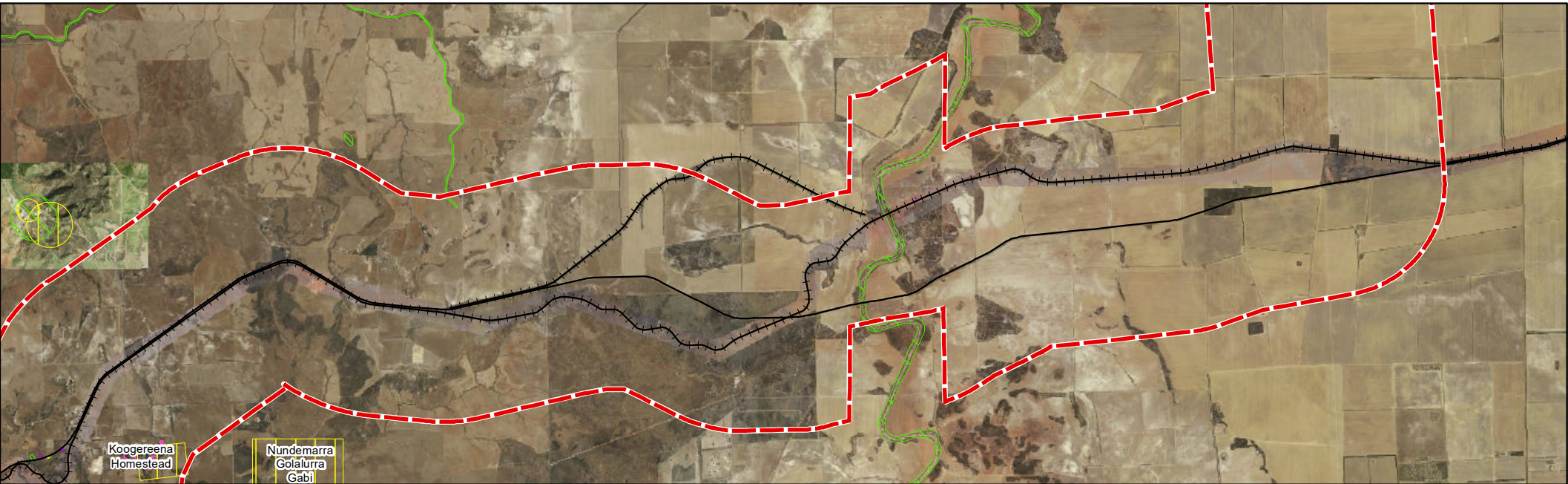
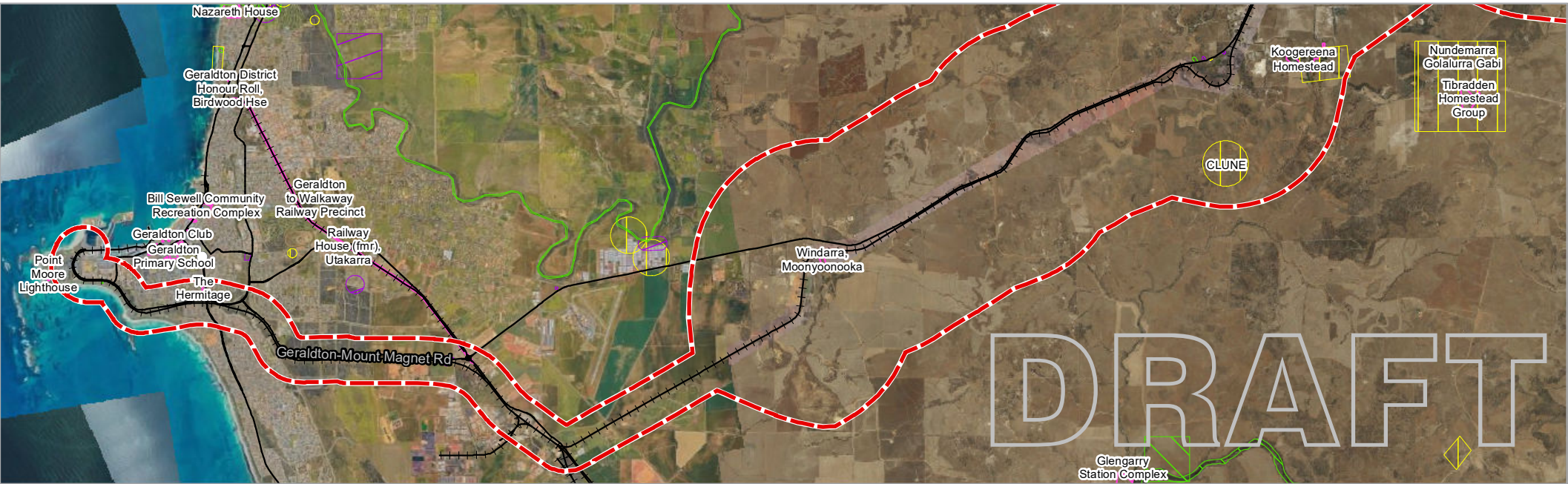


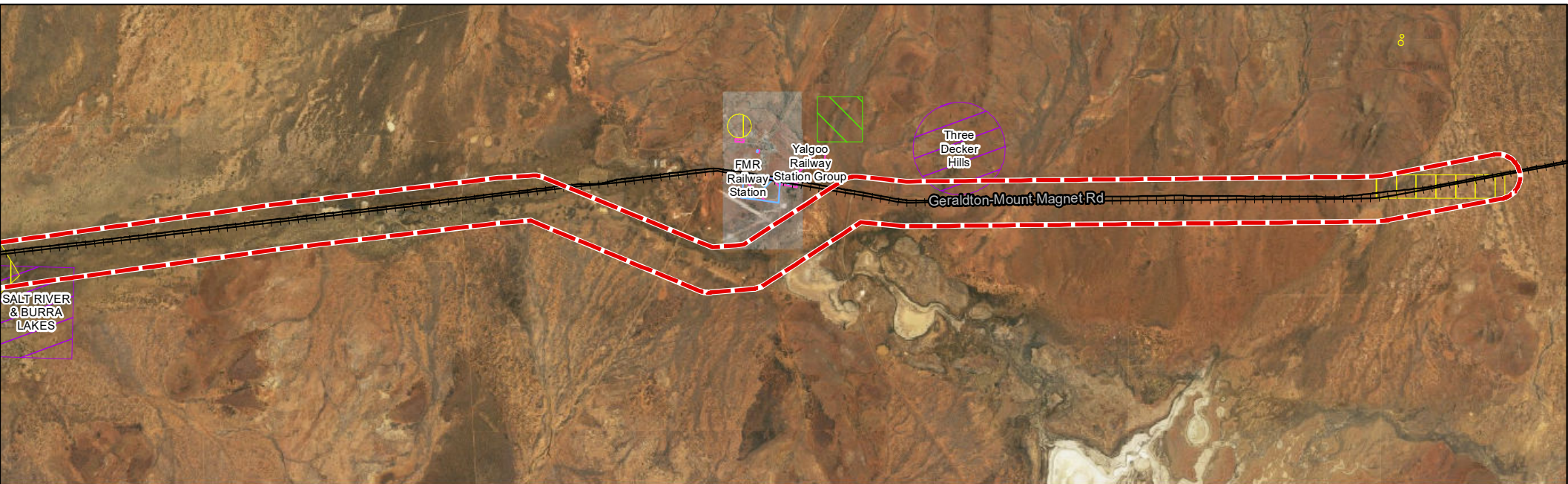
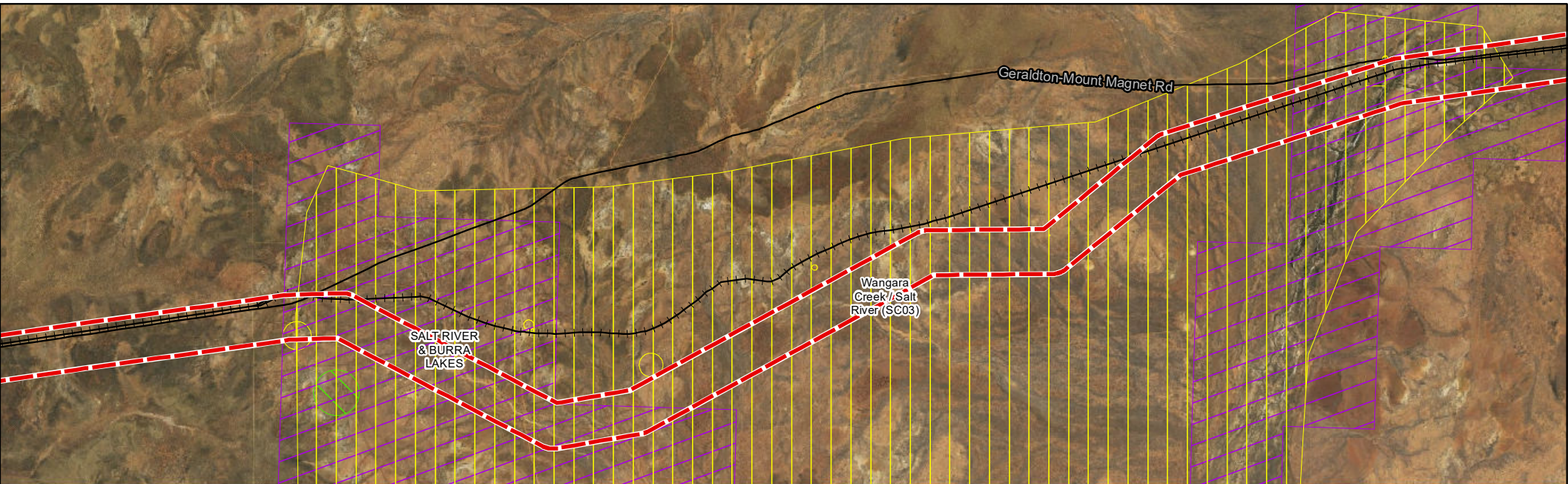
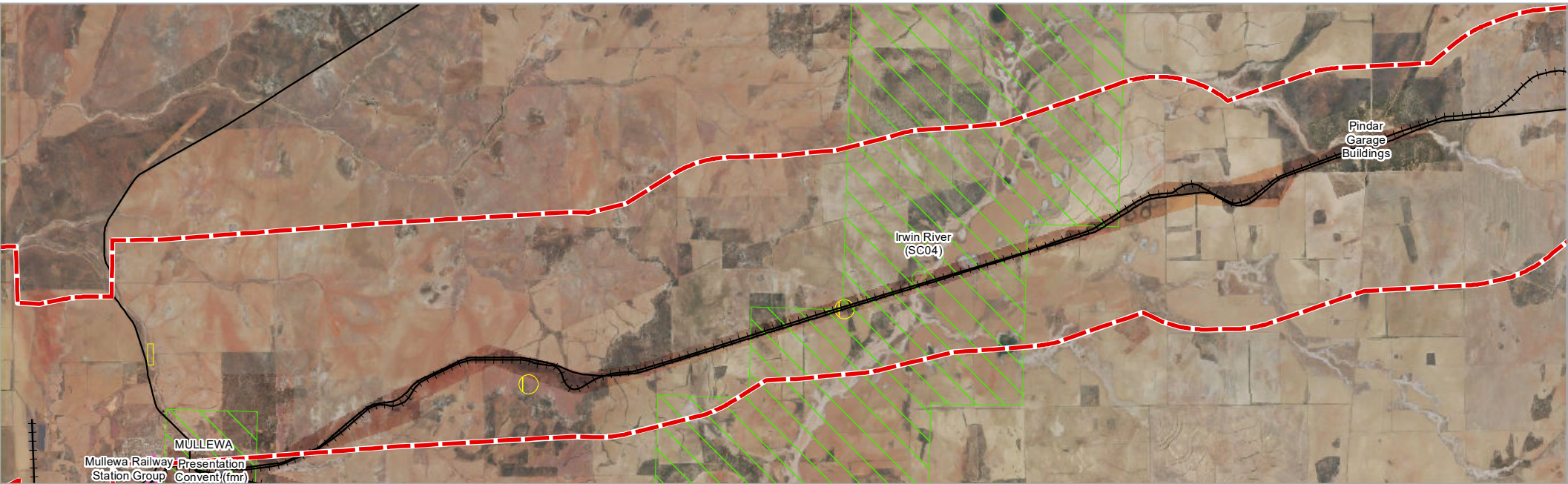
FI Joint Venture Pty Ltd  
Environmental Review Document

Heritage Areas in the  
Mine Development Envelope

Project No. 61-37117  
Revision No. 0  
Date 26 Feb 2020

FIGURE 12-2





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Table 12-6 Registered Aboriginal Sites and Aboriginal Places within the pipeline development envelope (Brad Goode & Associates 2019a)

ID	Name	Type
<b>Registered Sites</b>		
4810	Bringo Road Deviation 3	Artefacts/ Scatter
5673	Mullewa	Ceremonial
16157	Nungulya Well	Artefacts/ Scatter
18905	Tenindewa Creek	Artefacts, Myth Arch Deposit
18907	Irwin River (SC04)	Historical/ Myth
20853	Geraldton Southern Transport Corridor Field Site 04	Natural Feature
24761	Greenough River	Mythological
30063	Chapman River (Geraldton)	Historical, Mythological, Birth Place, Water Source
<b>Other Heritage Places</b>		
4497	Salt River & Burra Lakes	Mythological
4551	Clune	Artefacts/ Scatter
4808	Bringo Road Deviation 1	Artefacts/ Scatter
4809	Bringo Road Deviation 2	Artefacts/ Scatter
5477	Gas Pipeline 75	Artefacts
18906	Wangara Creek/ Salt River (SC03)	Mythological, Rockshelter, Named Place, Water Source
19478	Kockatea Creek Artefact Scatter	Artefacts/ Scatter, Grinding Patches/ Grooves
19479	Woderarrung Creek Artefact Scatter	Artefacts/ Scatter
19480	Noorgung Hill – Site 3	Artefacts/ Scatter
19482	Wurarga Deviation Site 2	Artefacts/ Scatter, Quarry
19483	Wurarga Rockhole 2	Water Source
19484	Wurarga Rockhole	Artefacts/ Scatter, Man- Made Structure, Water Source
19526	WMSC25 – Breakaway Line	Camp
19527	WMSC26 – Breakaway Line	Artefacts/ Scatter, Mythological
20468	Wurarga Rockshelters	Artefacts/ Scatter, Mythological, Rockshelter, Natural Feature
20469	Yalgoo Creekline Scatters	Artefacts/ Scatter, Natural Feature
20852	GSTC-ISO-01 to 04	Isolated Artefacts
20854	Geraldton Southern Transport Corridor Field Site 03	Modified Tree
20855	Geraldton Southern Transport Corridor Field Site 02	Artefacts/ Scatter

ID	Name	Type
21137	Three Decker Hills	Mythological, Natural Feature
25557	Nundemarra - Kojarena Gabi	Mythological, water sources
26739	GSTCS2 – Artefact Scatter AS001/2009	Artefacts/ Scatter
29199	AARNET AS- 01	Artefacts/ Scatter, Natural Feature
29217	Geraldton- Mount Magnet Road Artefact Scatter	Artefacts/ Scatter

#### 12.4.5 Non-Indigenous Heritage

In Western Australia, the *Heritage of Western Australia Act 1990* provides for the conservation of places identified to have significance to the cultural heritage of the State. Under the Act, places identified as meeting the criteria outlined in Section 47 are placed onto the State Register of Heritage Places. Places of Commonwealth heritage significance are protected under Part 15 of the EPBC Act and include World Heritage properties, National Heritage places and Commonwealth Heritage places.

Searches of the following databases were undertaken to identify cultural heritage values relevant to the Proposal:

- *inHerit*: searchable, online database of the Western Australian Register of Heritage Places
- Heritage registers maintained by the Shire of Yalgoo, City of Greater Geraldton, Shire of Murchison, and Shire of Chapman Valley.
- Australian Heritage Database: searchable, online database of places on the following lists:
- World Heritage List
- National Heritage List
- Commonwealth Heritage List.

Three National Heritage or Commonwealth Heritage listed sites are found within the township of Yalgoo, all approximately 1 km north of the PDE and 17 km west of the MDE:

- Yalgoo Railway Station Group (No. 2778)
- Yalgoo Justice Precinct (No. 2770)
- Dominican Convent Chapel of St Hyacinth (No. 2776).

A Fourth National Heritage or Commonwealth Heritage listed site is located approximately 5 km north of the MDE:

- Noongal Station Group (No. 2787).

Eight sites are found within the township Mullewa approximately 2.5 km south of the pipeline corridor (shown in Figure 12-3), with a further four sites identified along the PDE between Mullewa and Geraldton.

## 12.5 Potential impacts

Potential impacts that may occur to the social surrounds as a consequence of developing the proposal are:

- Direct

- Loss/disturbance to Aboriginal or European heritage sites (Section 12.6.1)
- Activities may occur in areas of Native Title (Section 12.6.2)
- Negative impacts to pastoral lease operations and any tourism activities in the Development Envelope (Section 12.6.3).
- Indirect
  - Impacts to amenity values (including visual landscape, visual aesthetics values and recreational tourism) associated with the Pipeline corridor (Section 12.6.4).

## 12.6 Assessment of impacts

### 12.6.1 Loss or disturbance to Aboriginal or European heritage sites

Archaeological and ethnographic heritage surveys completed to date have identified 50 archaeological and five ethnographical heritage places across the PDE and MDE.

Impacts related to heritage may result largely due to clearing and earthworks associated with construction and operation of the Proposal and include:

- Impacts to Aboriginal heritage places
- Prevention or disruption to access to an Aboriginal heritage place
- Changes to the attributes of the environment which may impact an Aboriginal heritage place
- Disturbance to vegetation and fauna habitat which may change the ability of traditional owners to use the land for tools, bush tucker or medicine.

Given the distance of the mining activities to significant places outside the MDE, indirect impacts as a result of noise, vibration and dust emissions are not anticipated to impact these places, or impact the amenity of traditional owners accessing these places. Based on the impacts to surface water and groundwater discussed in Section 10.6, impacts to significant places outside the MDE are not anticipated.

The risk of impact to European heritage places is considered to be low, as none of the identified State Heritage sites will be directly disturbed by the proposal.

### 12.6.2 Activities may occur in areas of Native Title

The proposed pipeline route within the PDE is the least constrained regarding Native Title, however it is expected that Native Title negotiations will be required for works within the PDE and the MDE. The recommended next step to resolving the Native Title obligations of the alignment for the FIJV is to conduct a workshop with Department of Jobs, Tourism, Science and Innovation and a Native Title / heritage advisor. The workshop should consider if any changes could be made to reduce constraints and develop a strategy to negotiate native title.

Potential impacts to Native Title could include;

- limited access to areas for traditional purposes (camping and ceremonies)
- disassociation with local customs and culture
- changes in amenity
- potential lack of provision of appropriate compensation.

### 12.6.3 Impacts to pastoral lease operations and any tourism activities in the Development Envelope

Five pastoral stations will be intersected by the MDE and PDE. The Proposal will result in reduction of the available area on the following stations:

- Talling
- Gabyon
- Carlamundan
- Bunnawarra
- Wagga Wagga.

The pipeline corridor broadly follows the Dampier Bunbury Natural Gas Pipeline, extending from the Yogi Mine, east of Yalgoo to Geraldton Port. Initially three routes were proposed, however the selected route was chosen to minimise impacts to additional land owners by proposing to follow existing linear infrastructure. The premise for this is that the proportional impact of the new pipeline corridor to a site with an existing pipeline will be less than if the pipeline was proposed to traverse through an entirely new area. The route was also selected based on suitable landownership, and land tenure, and was selected to minimise disturbance to remnant vegetation and through Native Title areas.

### 12.6.4 Impacts to amenity values (including visual landscape, visual aesthetics values and recreational tourism) associated with the Pipeline corridor

The MDE, including the associated access road, is located at least 16 km from the closest town; no impacts to human health or amenity at residential receptors is anticipated as a result of the dust, noise or visual impacts from the Proposal.

The pipeline corridor broadly follows the Mt Magnet Road extending from the Yogi Mine Project west to the Geraldton Port, therefore much of the proposed disturbance is pre-existing and does not pose unprecedented disruption to land owners and local residents.

No direct impacts to national parks or other recreational or tourism features will occur as a result of the Proposal. The closest is Coalseam Conservation Park is located approximately 33 km south east of the PDE.

### 12.6.5 Cumulative impacts

A summary of the impacts of other developments in close proximity to the Proposal area is provided in Table 12-7.

A comparison of impacts to social surroundings from the implementation of the Proposal to impacts from other developments indicates the following:

- Implementation of the Proposal will have negligible impact to Aboriginal Sites and Places at a regional level as none will be affected as a result of the Proposal. Two of the other developments (Mummaloo Project and Shire Iron Ore Project) do not have Aboriginal Sites or Places within their development envelope, for Karara Mine and Mount Gibson, the registered sites within the development envelope of these projects are adequately protected via management processes.
- The Proposal and the other developments are sufficiently far enough apart to make any cumulative impacts to amenity negligible.

- As the Proposal and the other development do not intersect or impact the same parcels of land, they are assessed to have no cumulative impact to pastoral leases.
- Two of the other developments fall within the same Native Title claimant area as the Proposal, however impacts are assessed as negligible.

Table 12-7 Cumulative impacts to social surroundings of the Proposal and regional projects

Project	Karara Iron Ore Mine	Mount Gibson Iron Ore Mine	Shine Iron Ore Project	Mummaloo Project
Variable Company	Karara Mining Ltd	Mount Gibson Mining Limited	Mount Gibson Mining Limited	Top Iron Pty Ltd.
Location	Shire of Perenjori 215 east south east of Geraldton	Shire of Yalgoo 270 km east south east of Geraldton	Shire of Yalgoo 68 km south of Yalgoo 308 km east-southeast of Geraldton	Shire of Yalgoo 300 km south east of Geraldton.
Aboriginal Sites or Places within the Development Envelope	Eleven registered sites have been identified within 100 m of the linear infrastructure corridor. Removal in one Aboriginal Site (Kar/02, Mt Karara (Women's only site, Site ID 21374). Direct impacts to three Aboriginal Sites: Kar/01 (ochre source, rockshelter and creek), Kar/08 and Kar/10 sites.	Project does not intersect any 'Registered site' of Aboriginal heritage. Project coincides with Department of Aboriginal Affairs (DAA) record 25293 which is an 'other heritage places' data record held by the DAA.	Four potential heritage sites were identified within or intersecting the development envelope.	There are no Aboriginal reserves in the vicinity of the Mummaloo tenement.
Native Title Claimants	Widi Mob and Widi Binyardi are the two groups that have unregistered native title claims over the minesite area. Badimia is the only registered claimant group of a section at the Silverstone water pipeline	This project does not fall within a registered Native Title claim area.	Widi Mob have registered claim over the project area.	This project does not fall within a registered Native Title claim area.

Project	Karara Iron Ore Mine	Mount Gibson Iron Ore Mine	Shine Iron Ore Project	Mummaloo Project
Pastoral leases intersected	Karara Pastoral Lease – portions are proposed to be converted to a conservation reserve by the State of Western Australia	Not within a pastoral lease. Adjacent to three pastoral leases including White Wells, Ningham Indigenous Owned, and Mount Gibson (conservation purposes).	Project is located on Badja Station.	Occurs within the Mount Gibson Pastoral Lease (conservation purposes).

## 12.7 Mitigation

The mitigation hierarchy (avoid, minimise, rehabilitate) has been applied to this proposal in relation to social surrounds.

The inherent impacts that must be managed include:

- Activities may occur in areas of Native Title
- Disturbance to pastoral lease operations and any tourism activities in the Development Envelope
- Impacts to amenity values (including visual landscape, visual aesthetics values and recreational tourism) associated with the Pipeline corridor.

Management and monitoring measures for the above impacts are well practiced and understood in the industry, and are considered to be effective.

Proposed mitigation measures to address the above potential impacts to social surroundings are outlined in Table 12-8.

Table 12-8 Mitigation measures for impacts to social surroundings

Impact	Mitigation measures
Loss/disturbance to Aboriginal or European heritage sites	<b>Avoid</b> <ul style="list-style-type: none"><li>• Mine design has considered the Aboriginal heritage and Native Title within the Development Envelope and has been through a substantial number of versions balancing economic and cultural concerns.</li></ul> <b>Minimise</b> <ul style="list-style-type: none"><li>• The Disturbance Footprint has been minimised by generating engineering solutions which have permitted the Proposal to remain feasible while reducing impacts on environmental and cultural values.</li><li>• 'Other heritage places' will be flagged on site and avoided where possible.</li><li>• Inductions will include information on sites and aboriginal culture and the requirement not to disturb these sites.</li><li>• Any potential aboriginal materials found on site will be subject to an immediate shutdown of activities and an exclusion zone of 20m. The Environmental Superintendent will be notified, and the Department of Planning, Lands and Heritage (DPLH) will be notified. DPLH will advise further management. An incident report will be lodged.</li></ul>
Activities may occur on areas of Native Title	<b>Minimise</b> <ul style="list-style-type: none"><li>• The Disturbance Footprint has been minimised by generating engineering solutions which have permitted the Proposal to remain feasible while reducing impacts on environmental and cultural values.</li><li>• FIJV will continue to consult with the relevant native title groups and obtain approval under Section 18 of the <i>Aboriginal Heritage Act 1972</i> as required, prior to the disturbance of any heritage sites under the meaning of the <i>Aboriginal Heritage Act 1972</i>.</li></ul>

Impact	Mitigation measures
	<b>Rehabilitate</b> <ul style="list-style-type: none"> <li>• Proposal disturbance areas to be rehabilitated in accordance with the Yogi Proposal MCP (GHD 2019c, Appendix D).</li> </ul>
Impacts to pastoral lease operations	<b>Avoid</b> <ul style="list-style-type: none"> <li>• Clearing and ground disturbance will only be completed in designated areas, with no additional unnecessary clearing proposed</li> </ul> <b>Minimise</b> <ul style="list-style-type: none"> <li>• Erosion control measures will be incorporated into the design and management of the pipeline corridor to minimise erosion and sedimentation</li> <li>• Surface water collected within the pipeline corridor will not be allowed to disperse into the surrounding land</li> <li>• The pipeline will be constructed to minimise impacts to livestock and movement across the site (where reasonably practicable)</li> </ul> <b>Rehabilitate</b> <ul style="list-style-type: none"> <li>• Rehabilitation on pastoral leasehold land will be based on minimising adverse impacts on the viability of the pastoral operation; Any land that will not be rehabilitated to its former condition needs to be stabilized, and, where necessary, isolated from the surrounding</li> <li>• Land operators of mines on pastoral leases will fully compensate the leaseholder for any losses incurred as a result of the mining operations.</li> </ul>
Impacts to amenity values	<b>Avoid</b> <ul style="list-style-type: none"> <li>• Minimise impacts to the BIF ridgeline as low as reasonably practicable.</li> <li>• Implement dust management controls to reduce impacts outside the site boundary.</li> </ul> <b>Minimise</b> <ul style="list-style-type: none"> <li>• Construct the pipeline infrastructure to minimise impacts to existing land uses and visual amenity by aligning it with existing infrastructure as much as reasonably practicable and approved.</li> </ul> <b>Rehabilitate</b> <ul style="list-style-type: none"> <li>• Rehabilitate the waste rock dump and remnant ridgeline such that it merges with the surrounding landscape, and appears relatively natural from the Geraldton-Mount Magnet Road.</li> <li>• Maintain a Complaints Register. Complaints to be actioned within 24 hours.</li> </ul>

## 12.8 Predicted outcome

### 12.8.1 Residual impacts

A summary of residual impacts after the implementation of the proposal and the application of the mitigation measures outlined in Table 12-8 above is provided in Table 12-9.

Table 12-9 Residual impacts to social surroundings

Impact	Residual impact
Loss/disturbance to Aboriginal or European heritage sites	FIJV will facilitate access to country for traditional owners within safety and operational constraints. Traditional owners will continue to have access to land and the flora and fauna on that land for hunting or cultural purposes during following closure. Rehabilitation and closure of the Proposal will be undertaken to meet land use outcomes negotiated in consultation with Native Title Groups
Activities may occur in areas of Native Title	Impacts to Native Title areas are considered negligible, with the majority of the development envelope still able to maintain Native Title function.
Impacts to pastoral lease operations	Based on the percentage of the pastoral stations to be intercepted by the Proposal, no significant impact to these stations are anticipated. FIJV will continue to consult with the pastoral station holders to ensure impacts are managed, as far as is practicable.
Impacts to amenity values	Residual impacts to amenity are estimated to be minimal following rehabilitation, with any impacts being short term only.

#### 12.8.2 Assessment against the EPA objective

Following completion of the assessment and the residual impact outlined in Table 12-9, it is considered that the Proposal will not have significant residual impacts on Social Surroundings. As such, it meets the objective for this factor such that social surroundings are protected from significant harm.

#### 12.8.3 Offsets

Based on the expectation that there will be no significant impact to Social Surroundings, no offsets are proposed.

## 13. Matters of National Environmental Significance

As introduced in Section 1.3.2, the Yogi project was referred to the DAWE on 1 February 2018. Of the nine MNES that are managed under the EPBC Act, one was identified to be directly or indirectly affected by the proposal. The controlling provisions for the proposal are as follows:

- Listed threatened species or any threatened ecological community, or their habitat (Section 18 and 18A).

### 13.1 Matters of national environmental significance

Based on the flora and vegetation and fauna assessments completed which included a desktop assessment of the Protected Matters Search Tool (PMST), an assessment of relevance and applicability of the nine MNES was completed (Table 13-1). The output reports for these enquiries are included within flora and fauna technical studies (Appendix B).

Table 13-1 EPBC Matters of National Environmental Significance for the Yogi Project

Matter of MNES	Relevance to the MDE	Relevant to the PDE
Threatened Species and ecological communities	<ul style="list-style-type: none"> <li>• Impacts to one threatened fauna species: Western Spiny tailed Skink (Endangered)</li> <li>• All other fauna species identified in the desktop assessment of the PMST were determined to be unlikely to occur (GHD 2020b).</li> <li>• No threatened flora species or threatened ecological communities were identified within the MDE or considered likely to occur.</li> </ul>	<ul style="list-style-type: none"> <li>• Impacts to one threatened flora species like to occur within the PDE: <i>Eremophila viscida</i> (Endangered)</li> <li>• Impacts to two threatened fauna species: <ul style="list-style-type: none"> <li>• Western Spiny tailed Skink (Endangered)</li> <li>• Malleefowl (Vulnerable)</li> <li>• All other fauna species identified in the desktop assessment of the PMST were determined to be unlikely to occur (GHD 2020c).</li> </ul> </li> </ul>
Migratory Species	Not considered likely to occur. No marine habitat present within or nearby MDE for migratory marine species. Migratory terrestrial/wetland were considered in the desktop assessment and determined would not rely on habitat present (GHD 2020b).	Not considered likely to occur. No marine habitat present within or nearby PDE for migratory marine species. Migratory terrestrial/wetland were considered in the desktop assessment and determined would not rely on habitat present (GHD 2020c).
Marine Species	Not considered likely to occur as no marine habitat present within or nearby the MDE (GHD 2020b).	Not considered likely to occur as no marine habitat present within or nearby the PDE (GHD 2020c).
Commonwealth Marine Areas	Not applicable	Not applicable

Matter of MNES	Relevance to the MDE	Relevant to the PDE
World Heritage Properties	Not applicable	Not applicable
National Heritage Properties	Not applicable	Not applicable
Wetlands of International Importance	Not applicable	Not applicable

## 13.2 Threatened fauna species

### 13.2.1 Western Spiny tailed Skink

The Western Spiny Tailed Skink (*Egernia stokesii*) is listed as 'Endangered' under the EPBC Act. Western Spiny-tailed Skinks (subspecies *badia*) historically have a patchy distribution which inhabit arid and semi-arid areas of Western Australia.

#### 13.2.1.1 Relevant policy and guidelines

- *Western Spiny-tailed Skink (Egernia stokesii) National Recovery Plan* (DEC 2012)
- *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* (Department of the Environment 2013).

#### 13.2.1.2 Survey effort

A targeted survey effort for the Western Spiny Tailed Skink completed (January 2020) as part of this project. A terrestrial fauna survey was completed within the MDE in August (site reconnaissance) and October 2018 and January 2020 (detailed survey), and in the PDE in November 2018 (site reconnaissance only). The survey effort within the MDE is summarised in Table 9-3.

Individuals and groups were identified during the fauna survey of the MDE, and areas of suitable habitat (BIF Rdigeline and Granitic Formations) were identified within the MDE. No individuals were identified within the PDE, however the likelihood of occurrence assessment completed indicates that it is likely to occur within the PDE and that there is suitable habitat within the area.

An additional targeted Western Spiny-tailed Skink survey, including linear transects of the granitic formations, was undertaken in January 2020 to assess current use, and presences of the species within the MDE area. This additional survey also identify potential suitable sites for relocation of individuals that may be affected (refer to Table 9-6). Based on the results of this survey, where possible, the mine layout will be modified to minimise impacts to these fauna habitats and appropriate mitigation measures will be employed prior to clearing to reduce direct impacts to conservation significant fauna species, as outlined in the EMP (GHD 2020d, Appendix C).

#### 13.2.1.3 Habitat

The sub species varies in habitat use within their range with a rock dwelling population persisting from about Yalgoo to the Cue area including Woolgorong Rock and Twin Peaks Stations (Storr *et al* 1999, Pearson 2012, as cited in GHD 2020b). Typical habitat of the rock dwelling population is shown in Plate 1. The remainder of the population utilises aged

woodlands and shrublands with good ground cover and sufficient hide structures, sheltering in logs and hollow branches (Cogger *et al* 1993, Pearson 2012, as cited in GHD 2020b).

Within the MDE, the BIF Ridgeline and Granitic Formation were identified as being suitable habitat for the skink. BIF Ridgeline is characterised by open shrublands of *Acacia* sp., *Thryptomene* sp. *Eremophila forrestii*, *E. galeata* and *Ptilotus* sp. on low banded ironstone formation ridgelines and the Granitic Formations by scattered low shrublands of *Acacia*, *Eremophila*, *Grevillia*, *Hakea* and *Borya* amongst granite outcropping.

The Western Spiny Tailed Skink inhabits localised features of habitat, even though that particular habitat spans a large area. The removal of BIF Ridgeline and Granitic formations has the potential to significantly impact the skink particularly if such features are removed. Appropriate mitigation will be necessary to protect this conservation significant species during project development and construction.



Plate 1 Typical habitat for rock dwelling Western Spiny-tailed Skink

#### **13.2.1.4 Local population**

During the field survey four broad locations recorded the Western Spiny-tailed Skink. Three locations were present in granitic areas with one latrine site identified within the BIF formation. Records included actual individual observations or signs of the species via the presence of latrine sites.

Observations of animals was between one and five animals at each location, with two locations recording juveniles as well as adults. Camera traps recorded activity at the most northern site (along the northern boundary of the MDE) which consisted of basking (adults and juveniles) and mating or territorial male behaviour.

In the northern portion of their range they are found on Dirk Hartog Island and adjacent mainland to the northern Wheatbelt in the areas of Mullewa south to Kellerberrin, Perenjori and Mukinbudin in the south.

Surveys conducted by Department of the Environment and Conservation in the Wheatbelt and associated regional reserves recorded one population of skinks in a protected reserve and numerous populations in abandoned farm dwellings in the northern Wheat belt (Pearson 2012).

#### 13.2.1.5 Threats

Threats to the Western Spiny Tailed Skink, as outlined in the Recovery Plan (DEC 2012) with relevance to this proposal are discussed in Table 13-3. These threats are considered in the assessment of the impact of the proposal to the skink Section 13.2.1.6.

Table 13-2 Threats to the Western Spiny-tailed Skink

Threat	Relevance to the Western Spiny-tailed Skink
Habitat loss due to clearing for mining or agriculture	Large scale clearing throughout the Wheatbelt region for agricultural purposes and mining activities in the Mid-west have resulted in a significant loss of habitat for this species. Mining and associated infrastructure has affected individual populations due to the removal of habitat and translocation of populations has previously occurred within the Yalgoo bioregion.
Degradation of existing habitat	Grazing removes understorey and is presumed to restrict a range of plant and invertebrate species for the skink.
Discontinuation or modification to natural processes that generate suitable refuge habitat	Removal of trees and changes to fire regimes have resulted in the lack of recruitment of trees and long term creation of logs. The skink subspecies <i>badia</i> has been translocated in multiple regions due to mining activities, suggesting that suitable habitat for this subspecies is becoming increasingly fragmented and less available.

#### 13.2.1.6 Potential impacts

Potential impacts on the Western Spiny-tailed Skink are detailed in Table 13-3.

Table 13-3 Impacts to the Western Spiny Tailed Skink

Impact	Relevance to the Western Spiny-tailed Skink
Habitat loss	Development of the mine and mining of the resource will result in the removal of approximately 30% of BIF Ridgeline and 20% of Granitic Formations, which are identified as critical fauna habitat for this species.  Micro-habitat availability for the Western Spiny Tailed Skink is known to be sporadic within wider suitable fauna habitat types such as the BIF Ridgeline and Granitic Formations, with the species requiring specific features to facilitate its use of the area. This includes having sufficient hide structures such as smaller enclosed areas formed by rock piles and crevices. The sporadic nature of these micro-habitats demonstrates that they are highly valuable to the species persistence, with the

Impact	Relevance to the Western Spiny-tailed Skink
	removal of suitable habitat potentially having a significant impact.
Habitat fragmentation	Skink habitat fragmentation may result in individuals no longer being able to access nesting or denning habitat or alternatively may lose access to areas where they may forage.
Fauna death	Fauna death of the skink may occur directly relating to mining activities, as they are known to occur on, and inhabit the BIF Ridgeline.
Secondary impacts to dust, noise and light emissions	Secondary impacts relating to emissions are likely to be less of a consideration than direct impacts, particularly dust. However, noise and light has the potential to impact the skink through disrupting their traditional foraging habits.
Altered fire regimes	The implementation of a fire management program will minimise impacts to the existing skink population, and is not assessed to be significant.
Introduction to feral animals and weeds	The implementation of a pest animal and weed management program is likely to bring about improved outcomes to the existing skink population, and is not assessed to have a significant impact on the skink.

#### 13.2.1.7 Proposed management

Impacts to Western Spiny-tailed Skink will be managed under the EMP (GHD 2020d, Appendix C). The management actions outlined in the Plan address the significant main threats listed in Table 13-2 and are listed in Table 13-4 below.

Table 13-4 Proposed management for the Western Spiny-tailed Skink

Threat	Proposed management measures
Habitat loss	<ul style="list-style-type: none"> <li>• Section of haul road traversing granitic formations and BIF Ridgeline will be deviated and narrowed to avoid and reduce impact to these habitats.</li> <li>• Prior to clearing, areas of the granitic formation and BIF Ridgeline (all suitable habitat) will be targeted searched for Western Spiny-tailed Skink colonies. These areas will be demarcated and logged on the project's GIS database. The proposed site layout will be revised to avoid these areas. Where colonies of Western Spiny-tailed Skinks are present, and avoidance is not appropriate, these animals will be relocated to new sites. This will be discussed further in greater detail in the EMP (GHD 2020d, Appendix C).</li> </ul>
Habitat fragmentation	<ul style="list-style-type: none"> <li>• Minimise clearing and vegetation disturbance within skink habitat is minimally affected.</li> <li>• Conduct clearing in accordance with the permit and clearing procedure (to be developed).</li> <li>• Conduct progressive rehabilitation of disturbed areas, particularly those areas with known conservation significance</li> </ul>

Threat	Proposed management measures
	fauna and associated habitat, in accordance with the Yogi MCP.
Fauna death	<ul style="list-style-type: none"> <li>• Ensure that excavation and trenches are only open as long as necessary to facilitate the construction purpose.</li> <li>• Restrict the movement of vehicles to designated roads and access tracks and prohibit off-road driving.</li> </ul>
Secondary impacts to dust noise, and light emissions	<ul style="list-style-type: none"> <li>• Lighting designed to illuminate designated operations areas rather than the surrounding landscape.</li> <li>• Dust suppression, including use of water carts on access roads, to be implemented during all Proposal phases.</li> </ul>
Introduction to feral animals and weeds	<ul style="list-style-type: none"> <li>• Develop and implement a Feral Animal Program to effectively manage and control feral animals within FIJV controlled sites to minimise impacts on conservation significant fauna.</li> <li>• Implement biannual weed monitoring and targeted spraying program at the Proposal following completion of land clearing activities and during operations and closure activities.</li> <li>• Continued biannual weed monitoring and targeted spraying program along the pipeline route to minimise existing weed populations and reduce potential spread into adjacent land.</li> </ul>

### 13.2.1.8 Significance test

A summary of the assessment of the proposal against the Significant Impact Guidelines 1.1 (DotEE 2013) is provided in Table 13-5. The assessment takes into account the mitigation measures outlined above in Table 13-4.

Table 13-5 Significance test for the Western Spiny Tailed Skink

Criteria for endangered species	Assessment of significant impact
Lead to a long-term decrease in the size of the population	<p>The proposal will result in the removal of 558 ha of habitat comprising 357.48 ha of BIF Ridgeline and 201.45 ha of granitic formations from the MDE. Following the clearing and destruction of these two habitats, 71.39% and 80.39% respectively will remain.</p> <p>This indicates that a significant portion of suitable habitat remains within the MDE, and PDE. However, given the sporadic nature of suitable micro-habitats within these fauna habitats, the actual impacts to this species are indeterminable and may be significant.</p>
Reduce the area of occupancy of the species	<p>The number of western Spiny-tailed Skink that may inhabit the MDE and PDE is not definitively known as no targeted surveys have been completed, making determining an area of occupancy for the species in the local area somewhat difficult.</p> <p>The species lives in family colonies which comprises of 2-17 individuals in secure environment such as hollow logs or</p>

Criteria for endangered species	Assessment of significant impact
	<p>exfoliating rock (Duffield 2002, as cited in GHD 2019c). Dispersal rates of the skink is thought to be low based on studies of genetic analysis and recapture (Gardner <i>et al.</i> 2001; Gardner <i>et al.</i> 2007).</p> <p>Based on the results of the targeted survey, where possible, the proposed site layout will be revised to avoid habitat areas. Where colonies of Western Spiny-tailed Skinks are present, and avoidance is not appropriate, these animals will be relocated to new sites.</p>
Fragment an existing population into two or more populations	<p>A population of Western Spiny-tailed Skink is comprised of multiple family units, and is expected to extend across the entire suitable habitat area, i.e. granitic formations, BIF ridgeline, and may extend across both habitats if well connected.</p> <p>The proposal is expected to fragment the population present onsite into two or more populations, particularly due to the proposed linear infrastructure (road and utilities corridor).</p> <p>The significance of this is not well understood as a targeted survey has yet to be completed.</p>
Adversely affect habitat critical to the survival of a species	<p>While this BIF Ridgeline represents habitat for the Western Spiny-tailed Skink), the species does not rely solely on this habitat to persist in this region. A more important factor for this species is micro-habitat availability.</p> <p>Micro-habitat availability for the Western Spiny-tailed Skink is known to be sporadic within wider suitable fauna habitat types such as the BIF Ridgeline and Granitic Formations, with the species requiring specific features to facilitate its use of the area. This includes having sufficient hide structures such as smaller enclosed areas formed by rock piles and crevices. The sporadic nature of these micro-habitats demonstrates their occurrence is highly valuable to the species, with the removal of such micro-habitats likely to have a significant impact.</p> <p>Completion of a targeted survey and review of the mine layout will be completed to assist in minimising impacts to this species.</p>
Disrupt the breeding cycle of a population	<p>The proposal is not likely to impact and is unlikely to disrupt the breeding cycle of an important population of Western Spiny-Tail Skinks. Where colonies of Western Spiny-tailed Skinks are present, and avoidance is not appropriate, these animals will be relocated to new sites.</p>
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	<p>The proposed activity is expected to remove and destroy Western Spiny-tailed skink throughout the areas of BIF Ridgeline and Granitic Formations.</p> <p>However, prior to completing ground works, a targeted survey will be completed. Known micro-habitats of family units will be conserved within designated areas, and in areas where it is not</p>

Criteria for endangered species	Assessment of significant impact
	appropriate, individuals will be migrated to another location where suitable, comparable habitat has been identified.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered habitat	The proposed action is unlikely to introduce invasive species that are harmful to the Western Spiny-tailed Skink. Invasive species are not a known threat to the Western Spiny-tailed Skink. The principle threatening processes that has contributed to the decline of the black form of the species is overgrazing by livestock which reduces food availability for the species.
Introduce disease that may cause the species to decline	The proposed action is unlikely to introduce disease that may cause the Western Spiny-tailed Skink to decline. Disease is not a known threat to the Western Spiny-tailed Skink. The principle threatening processes that has contributed to the decline of the black form of the species is overgrazing by livestock which reduces food availability for the species.
Interfere with the recovery of the species	The proposed activity is not likely to interfere with the recovery of the species as a targeted survey will be completed, micro-habitat sites for the skink will be avoided and in areas where this is not appropriate, family units will be removed and relocated to a suitable, comparable habitat location.

### 13.2.2 Malleefowl

The Malleefowl (*Leipoa ocellata*) is listed as 'Vulnerable' under the EPBC Act. The Malleefowl inhabits semi-arid areas of Western Australia, from Carnarvon to south east of the Eyre Bird Observatory (south-east Western Australia).

#### 13.2.2.1 Relevant policy and guidelines




- *National Recovery Plan for Malleefowl* Leipoa ocellata (Benshemesh, J. 2007)
- *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* (Department of the Environment 2013).

#### 13.2.2.2 Survey effort

A targeted survey effort for the Malleefowl was completed in the eastern portion of the PDE in January 2020. The survey effort within the MDE and PDE is summarised in Table 9-3.

No individuals were identified during the fauna survey of the MDE, and no areas of suitable habitat were identified. No Malleefowl individuals and three old disused mounds were identified within the eastern portion of the PDE (Table 13-6). Historical habitat changes may account for current Malleefowl paucity. There may include feral predators, fire regime changes, and feral herbivore pressure.

Table 13-6 Malleefowl mounds recorded in the eastern portion of the PDE

Mound ID	Location	Photo and comments
MF1	116.0879 ; -28.4295	 <p>Very old, long unused mound (extinct) .Profile score 6</p>
MF2	116.0547; -28.4349	 <p>Very old, long unused mound (extinct). Profile score 6</p>
MF3	116.0371; -28.4374	 <p>Very old, long unused mound (extinct). Profile score 6</p>

### 13.2.2.3 Habitat

Suitable habitat for the Malleefowl was not identified within the MDE, however it was identified within the eastern portion of the PDE. This included Mallee and shrublands sandplains and Mixed Shrubland on Sandplain habitats, which comprises 277.35 ha and 385.79 ha of the PDE respectively.

In Western Australia, the species occupies shrublands and low woodlands that are dominated by mallee vegetation, native pine *Callitris* woodlands, *Acacia* shrublands, Broombush vegetation or coastal heathlands.

The habitat requirements of Malleefowl anywhere in Australia are poorly understood, due to the difficulty of efficiently assessing the abundance of the birds at different sites, and have as yet received limited study (Benshemesh, J. 2007). However, a known dominant requirement is a sandy substrate and abundance of leaf litter for the construction of the Malleefowl mounds (Frith 1959, 1962a; as cited in Benshemesh, J. 2007).

### 13.2.2.4 Local population

There were no individuals sighted and three old disused Malleefowl mounds within the eastern portion of the PDE. Malleefowl are known to be elusive and rare, and their presence may be easily missed (Benshemesh, J. 2007).

The Malleefowl was originally distributed over much of the southern half of the continent, and was widespread in every mainland state except Queensland (Benshemesh, J. 2007). More recently, the range of the Malleefowl has reduced in arid areas and at the periphery of its range (Benshemesh, J. 2007).

In the semi-arid zone, where Malleefowl densities are highest, the clearing of habitat has been the major cause of the marked decline in the distribution of the species. Apart from removing much of the habitat supporting high densities of the species, this clearing has fragmented the distribution of Malleefowl, and over much of its range the species now persists in small patches of habitat that are inadequate for its long-term conservation without careful planning and management.

### 13.2.2.5 Threats

Threats to the Malleefowl, as outlined in the Recovery Plan (DEC 2012) with relevance to this proposal are discussed in Table 13-3. These threats are considered in the assessment of the impact of the proposal to the Malleefowl Section 13.2.2.6.

Table 13-7 Threats to the Malleefowl

Threat	Relevance to the Malleefowl
Habitat loss due to clearing for mining purposes	Clearing for mining purposes is a growing threat to Malleefowl populations in Australia. Numerous mining operations have been proposed or undertaken where extensive areas of mallee shrubland has been removed. Mining also results in a major disturbance to the underlying substrate, which may have long lasting effects despite revegetation efforts.
Habitat fragmentation and isolation	Remaining habitat for the Malleefowl is often very small and isolated, with the larger pockets only remaining due to being generally unsuitable for agricultural or pastoral purposes and are often of marginal quality for malleefowl. The fragmentation of the mallee habitats has resulted in a large number of small populations with little opportunity for dispersal between them.

Threat	Relevance to the Malleefowl
Predation by animals	<p>Predation by feral animals is a major cause of malleefowl mortality, with foxes known to take malleefowl at all stages of this life cycle including their eggs. Mortality was found to be greatest during the first few days and 80% of chicks were dead within ten days.</p> <p>In areas where fox abundance has been greatly reduced, juvenile Malleefowl have nonetheless suffered high mortality from raptors.</p>
Changed fire regimes	<p>Fire is a significant threat to malleefowl as it can instantly eliminate large swathes of suitable habitat, with recovering to pre-fire population densities often 30 to 60 years (Benshemesh, J. 2007).</p> <p>Mining activities have the potential to cause fires through the introduction of ignition sources into the area.</p>

### 13.2.2.6 Potential impacts

Potential impacts on the Malleefowl are detailed in Table 13-8.

Table 13-8 Impacts to the Malleefowl

Impact	Relevance to the Malleefowl
Habitat loss	Suitable habitat within the eastern portion of the PDE represents 665.14 ha, of which 29.42 ha is proposed to be removed (4.4%).
Habitat fragmentation	The proposed PDE presents as a long linear item of infrastructure, albeit narrow. While it may fragment the landscape and malleefowl habitat, once the pipeline is established, it is not likely to represent a significant barrier to the dispersal of the malleefowl north and south of the pipeline.
Fauna death	<p>Malleefowl death directly related to the project is likely to be due to initial clearing efforts. While no suitable habitat was identified within the MDE, the same management measures will be implemented within the MDE and PDE.</p> <p>Impacts due to clearing will be managed according to the measures outlined in Table 13-9 and the Environmental and Rehabilitation Plan (GHD 2020e, Appendix C).</p>
Secondary impacts to dust, noise and light emissions	Following completion of initial construction, secondary impacts relating to dust, noise and light within the PDE are not anticipated to be a significant threat. This is due to there being minimal vehicles and equipment operating within and along the route. The only exception to this will be potential dust and noise relating to service and light vehicles for maintenance of the pipeline corridor.
Altered fire regimes	Following completion of initial construction, changed fire regimes within the PDE are not anticipated to be a significant threat. This is due to there being no source of ignition from

Impact	Relevance to the Malleefowl
	infrastructure and activities occurring along the route. The only exception to this will be potential ignition sources relating to service and light vehicles for maintenance of the pipeline corridor.
Introduction to feral animals and weeds	The incidence of predation by feral animals along the PDE is not likely to increase, as the EMP (GHD 2020d, Appendix C).developed for the project will include measures to manage feral animal populations, including foxes and cats. These measures are anticipated to reduce the population of these feral species in the region, and the number of conservation significant fauna predated upon.

### 13.2.2.7 Proposed management

Impacts to Malleefowl will be managed under the Environmental and Rehabilitation Management Plan (GHD 2020e, Appendix C). The management actions outlined in the Plan address the significant main threats identified in Table 13-7 and are listed in Table 13-9 below.

Table 13-9 Proposed management for the Malleefowl

Threat	Proposed management measures
Habitat loss due to clearing for mining purposes	<ul style="list-style-type: none"> <li>• Pre-clearance surveys for Malleefowl mounds within areas of potential Malleefowl habitat for pipeline development envelope will be undertaken, allowing for the pipeline route to be modified to avoid all active mounds that be present. Where avoidance of suitable habitat is not able to achieved, the route will be proposed to pass through sections with the least extent of remnant vegetation.</li> <li>• Prior to clearing, areas of malleefowl habitat will be logged on the project's GIS database.</li> </ul>
Habitat fragmentation and isolation	<ul style="list-style-type: none"> <li>• Minimise clearing and vegetation disturbance within malleefowl habitat is minimally affected.</li> <li>• Conduct clearing in accordance with the permit and clearing procedure (to be developed).</li> <li>• Conduct progressive rehabilitation of disturbed areas, particularly those areas with known conservation significant fauna and associated habitat, in accordance with the Yogi MCP.</li> </ul>
Predation by animals	<ul style="list-style-type: none"> <li>• Develop and implement a Feral Animal Program to effectively manage and control feral animals within FIJV controlled sites to minimise impacts on conservation significant fauna.</li> <li>• Implement biannual weed monitoring and targeted spraying program at the Proposal following completion of land clearing activities and during operations and closure activities.</li> </ul>
Changed fire regimes	<ul style="list-style-type: none"> <li>• Vehicle access will be restricted to access tracks and all vehicles will be fitted with spark arrestor technology.</li> </ul>

Threat	Proposed management measures
	<ul style="list-style-type: none"> <li>• A hot work permit system will be implemented to ensure that the appropriate control measures are implemented and site conditions assessed for each event.</li> </ul>
Fauna death	<ul style="list-style-type: none"> <li>• During initial clearing, machinery will be sat idle for at least half an hour to allow fauna to migrate away from the disturbance area. A fauna spotter will also be employed to watch for fauna to ensure that they can be moved to a safe location.</li> <li>• Implement appropriate mitigation measures such as speed limit restrictions, right of way for fauna and the prohibition of off-road driving.</li> <li>• Where possible, clearing should be undertaken on one front only, to provide an opportunity for the fauna to move out of the proposal area.</li> </ul>

### 13.2.2.8 Significance test

A summary of the assessment of the proposal against the Significant Impact Guidelines 1.1 (DotEE 2013) is provided in Table 13-10. The assessment takes into account the mitigation measures outlined above in Table 13-9.

Table 13-10 Significance test for the Malleefowl

Criteria for endangered species	Assessment of significant impact
Lead to a long-term decrease in the size of the population	Individuals will only occasionally visit the project area. Little, if any, important habitat will be affected.
Reduce the area of occupancy of the species	The small size of the impact area and similar habitat present in the surrounding area will not significantly reduce the area of occupancy for this species
Fragment an existing population into two or more populations	No individuals or evidence of their occurrence were recorded within the MDE of the PDE and MDE.
Adversely affect habitat critical to the survival of a species	The habitat that occurs within the PDE is not thought to be regionally significant due to its limited extent and availability of similar habitat in the surrounding region.
Disrupt the breeding cycle of a population	All potential habitat areas within the PDE were surveyed and Malleefowl mounds were not recorded. This project is not considered likely to disrupt any breeding cycles for this species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The area of suitable habitat that is expected to be affected does not constitute regionally significant habitat and the removal of this vegetation is not expected to result in further decline of the species.

Criteria for endangered species	Assessment of significant impact
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered habitat	The proposed action is unlikely to introduce invasive species that are harmful to the malleefowl. Invasive species are not a known threat to the malleefowl. The principle threatening processes that has contributed to the decline of the malleefowl is clearing of suitable habitat.
Introduce disease that may cause the species to decline	The proposed action is unlikely to introduce disease that may cause the Malleefowl to decline. Disease is not a major threat for this species (Benshemesh 2007). The principle threatening processes that has contributed to the decline of the malleefowl is clearing of suitable habitat.
Interfere with the recovery of the species	The proposed activity is not likely to interfere with the recovery of the species as the area contains minimal suitable habitat and is not assessed to be important for the recovery of this species.

### 13.3 Threatened flora species

#### 13.3.1 *Eremophila viscida*

*Eremophila viscida* is listed as 'Endangered' under the EPBC Act and 'Threatened' under the BC Act. *E. viscida* has a historical range of some 290 km between Latham, Koorda, Carnamah, Ballidu, Pindar and Merredin (Phillimore *et al* 2003).

##### 13.3.1.1 Relevant policy and guidelines

- Varnish Bush (*Eremophila viscida*) Interim Recovery Plan 2003-2008. Interim Recovery Plan No. 137 (Phillimore *et al* 2003)
- Threatened Species Scientific Committee (2017). *Conservation Advice Eremophila viscida (varnish bush)*. Canberra: Department of the Environment and Energy.

##### 13.3.1.2 Survey effort

A site reconnaissance survey was completed by GHD throughout the eastern portion of the PDE and a detailed survey was completed between August and October 2018 within the MDE.

##### 13.3.1.3 Habitat

Records of the species on FloraBase list the suitable habitat for the species as grown in granitic soils and sandy loam in stony gullies and sandplains. (Flora Base 2019 as cited in GHD 2020c). *E. viscida* appears to prefer areas that are associated with granite and salt lake systems and plants are particularly frequent in runoff areas, including drainage lines or ephemeral creeks connected to granite outcrops (Phillimore *et al* 2003).

Preferred habitat is brown, sandy-loam or red brown clay-loam soils, in open woodland in association with *Eucalyptus loxophleba* and scrub vegetation (Phillimore *et al* 2003). Suitable habitat for the *E. viscida* was only identified within the PDE, and not the MDE.

#### 13.3.1.4 Local population

No individuals of this species were identified within the MDE or PDE, however *E. viscida* is considered possible to occur within the eastern portion of the PDE area due to close proximity of records (DBCA 2018) and/or suitable habitat within the PDE.

*E. viscida* has a historical range of some 290 km between Latham, Koorda, Carnamah, Ballidu, Pindar and Merredin (Phillimore *et al* 2003), with 16 populations recorded throughout this area, as of 2003 (Phillimore *et al*). These populations are noted to range between moderate to disturbed condition, with many of these populations having less than ten individuals (Phillimore *et al* 2003).

#### 13.3.1.5 Threats

Threats to the *Eremophila viscida*, as outlined in the Recovery Plan (Phillimore *et al* 2003) with relevance to this proposal are discussed in Table 13-11. These threats are considered in the assessment of the impact of the proposal to *E. viscida* in Section 13.2.1.6.

Table 13-11 Threats to the *Eremophila viscida*

Threat	Relevance to the <i>E. viscida</i>
Poor recruitment	Changes to site conditions are typical in modified landscapes such that appropriate disturbance to generate recruitment is not likely to be supported.
Weed invasion	Weeds present a threat to <i>Eremophila viscida</i> particularly in degraded habitats, as they often suppress early plant growth by competing with resources
Inappropriate fire regimes	Changes to the fire regimes may affect <i>E. viscida</i> populations through inhibiting recruitment, with increasing fire frequency thought to reduce juvenile recruitment and retard proper establishment of a seed bank.
Silting	Silting due to changes to ground cover and surface water management are anticipated to affect populations that occur along water courses negatively, as it may result in changes to water flow and water levels; effectively altering the hydrology that the <i>E. viscida</i> is dependent upon.
Soil erosion	Clearing of land can change a site's surface hydrology, resulting in larger quantities of water moving through a landscape and increasing soil erosion. Soil erosion can wash away areas with seed banks of <i>E. viscida</i> and destabilise soil.
Road, track, firebreak maintenance	Application of herbicides, usage of maintained tracks and roads by livestock, and changes to drainage, which are typical along roads and tracks, are all considered threats to <i>E. viscida</i> .
Chemical drift	Even targeted application of herbicide can result in chemical drift, which may impact on populations of <i>E. viscida</i> .

#### 13.3.1.6 Potential impacts

Potential impacts on the *E. viscida* are detailed in Table 13-3.

Table 13-12 Impacts to the *Eremophila viscida*

Impact	Relevance to the <i>Eremophila viscida</i>
Loss of individuals and/or populations	Implementation of the proposal will not have result in direct loss of individuals or populations of <i>E. viscida</i> as there were none identified within the proposal area.
Dust generation	<p>Dust generation within the MDE will not impact on the <i>E. viscida</i> as there are no individuals within this area, and they are unlikely to occur in the area.</p> <p>Dust generation within the eastern portion of the PDE is likely to be more severe during construction, with dust generation during operation expected to be minimal.</p>
Introduction and spread of weeds	<p>Introduction and spread of weeds within the MDE will not impact on the <i>E. viscida</i> as there are no individuals within this area, and they are unlikely to occur in the area.</p> <p>Introduction and spread of weeds within the eastern portion of the PDE, particularly in the areas denoted as suitable habitat for the plant species, are likely to compete with the recruitment of individuals.</p>
Increased edge effects	<p>The implementation of the proposal is not anticipated to increase the magnitude of edge effects on <i>E. viscida</i>.</p> <p><i>E. viscida</i> is not likely to occur within the MDE, and the area of suitable habitat intersected within the PDE is limited.</p>
Habitat loss and fragmentation	<p>The implementation of the proposal is not anticipated to result in the removal of a significant area of suitable habitat or fragment suitable habitat of <i>E. viscida</i>.</p> <p><i>E. viscida</i> is not likely to occur within the MDE, and the area of suitable habitat intersected within the PDE is limited. Given that no individuals were identified during the site survey, impacts are not assessed to be significant.</p>
Altered fire regimes	<p>Following completion of initial construction, changed fire regimes within the PDE are not anticipated to be a significant impact. This is due to there being no source of ignition from infrastructure and activities occurring along the route. The only exception to this will be potential ignition sources relating to service and light vehicles for maintenance of the pipeline corridor.</p>
Decline of species abundance and diversity	<p>Implementation of the proposal will not have result in direct loss of individuals or populations of <i>E. viscida</i> as there were none identified within the proposal area.</p> <p>Further, suitable habitat within the proposal area is also limited, so its implementation is not anticipated to result in the decline of species abundance or diversity.</p>
Alteration of hydrology and hydrogeology	<p>Changes to surface hydrology and groundwater within the MDE is not anticipated to impact on <i>E. viscida</i> as it is not likely to occur within the MDE.</p>

Impact	Relevance to the <i>Eremophila viscida</i>
	<p>Increase soil erosion due to changes in surface hydrology along the pipeline route has the potential to impact on suitable habitat of <i>E. viscida</i>, due to the modification of ground cover and land form.</p> <p>However, surface water management controls will be included into the design of the pipeline to minimise impacts. These are discussed further in the <i>Environmental Management Plan</i> (GHD 2020d).</p>

### 13.3.1.7 Proposed management

Impacts to *E. viscida* will be managed under the EMP (GHD 2020d, Appendix C). The management actions outlined in the Plan address the significant main threats identified in Table 13-7 and are listed in Table 13-13 below.

Table 13-13 Proposed management for the *Eremophila viscida*

Threat	Proposed management measures
Poor recruitment	<ul style="list-style-type: none"> <li>Disturbance within the PDE will be minimised to reduce the affect that construction of the pipeline is likely to have. This will inherently reduce the impact the proposal might have on the recruitment of new individuals.</li> </ul>
Weed invasion	<ul style="list-style-type: none"> <li>Implement biannual weed monitoring and targeted spraying program at the Proposal following completion of land clearing activities and during operations and closure activities.</li> <li>Continued biannual weed monitoring and targeted spraying program along the pipeline route to minimise existing weed populations and reduce potential spread into adjacent land.</li> </ul>
Inappropriate fire regimes	<ul style="list-style-type: none"> <li>Vehicle access will be restricted to access tracks and all vehicles will be fitted with spark arrestor technology.</li> <li>A hot work permit system will be implemented to ensure that the appropriate control measures are implemented and site conditions assessed for each event.</li> </ul>
Silting	Surface water management controls will be implemented throughout the proposal area to minimise potential changes to surface water flow, such as quantity, flow pathways, and velocity. This will assist in reducing the likelihood of silting within natural waterways present within and adjacent to the proposal area.
Soil erosion	Surface water management controls will be implemented along the PDE to ensure that received water is retained within the PDE and to minimise potential changes to surface water flow, such as quantity, flow pathways, and velocity. This will assist in reducing the likelihood of soil erosion.
Road, track, firebreak maintenance	Application of herbicides will be closely monitored to ensure using an appropriate management system to ensure that

Threat	Proposed management measures
	herbicides are only applied on days when wind speeds are low to minimise the potential for overspray.  As described above, drainage controls will be implemented to minimise the potential for changes to surface hydrology which are likely to result in silting and soil erosion.
Chemical drift	As described above, application of herbicides will be closely monitored to ensure using an appropriate management system to ensure that herbicides are only applied on days when wind speeds are low to minimise the potential for overspray.

### 13.3.1.8 Significance test

A summary of the assessment of the proposal against the *Significant Impact Guidelines 1.1* (DotEE 2013) is provided in Table 13-14. The assessment takes into account the mitigation measures outlined above in Table 13-12.

Table 13-14 Significance test for the *Eremophila viscida*

Criteria for endangered species	Assessment of significant impact
Lead to a long-term decrease in the size of the population	Implementation of the proposal will not lead to a long-term decrease in the size of the population. No individuals or populations of <i>E. viscida</i> were identified within the proposal area. Little, if any, important habitat will be affected.
Reduce the area of occupancy of the species	The small size of the impact area and similar habitat present in the surrounding area will not significantly reduce the area of occupancy for this species
Fragment an existing population into two or more populations	No individuals or evidence of their occurrence were recorded within the MDE or the PDE.
Adversely affect habitat critical to the survival of a species	The habitat that occurs within the pipeline corridor is not thought to be regionally significant due to its limited extent and availability of similar habitat in the surrounding region.
Disrupt the breeding cycle of a population	All potential habitat areas within the eastern portion of the pipeline corridor were surveyed and no individuals of <i>E. viscida</i> were recorded. This project is not considered likely to disrupt any breeding cycles for this species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The area of suitable habitat that is expected to be affected does not constitute regionally significant habitat and the removal of this vegetation is not expected to result in further decline of the species.
Result in invasive species that are harmful to a critically endangered or endangered species	The implementation of the Proposal may result in the spread of invasive species (i.e. weeds) such they compete with resources and occupy suitable habitat. The implementation of

Criteria for endangered species	Assessment of significant impact
becoming established in the endangered or critically endangered habitat	the weed control program is anticipated to reduce the incidence of weeds.
Introduce disease that may cause the species to decline	<p>The proposed action is unlikely to introduce disease that may cause the <i>E. viscida</i> to decline. Disease is not a major threat for this species (Phillimore 2003).</p> <p>The principle threatening processes that has contributed to the decline of the <i>E. viscida</i> is clearing of suitable habitat, competition from weeds and predation by feral animals (such as rabbits).</p>
Interfere with the recovery of the species	The proposed activity is not likely to interfere with the recovery of the species as the area contains minimal suitable habitat and is not assessed to be important for the recovery of this species.

## 14. **Holistic impact assessment**

The preliminary key environmental factors relevant to this Proposal include Flora and Vegetation, Landforms, Subterranean Fauna, Terrestrial Environmental Quality, Terrestrial Fauna, Inland Waters, Air Quality and Social Surroundings. This ERD provides a detailed assessment of the potential environmental impacts associated with the Proposal, the management and mitigation strategies, and predicted outcome for each factor. The Proponent recognises the connections and interactions between the preliminary key environmental factors, and has considered these interrelationships when applying the mitigation hierarchy (avoid, minimise, rehabilitate) and developing mitigation and management measures for this Proposal. Where possible, the management and mitigation measures described throughout this ERD have considered a holistic perspective; they are also considered sufficient to meet the principles contained in the EP Act and the EPA's objectives for individual factors.

Table 14-1 presents a holistic impact assessment regarding the key themes of Land, Water, Air and People. The assessment also demonstrates how the EP Act Principles have been considered.

Table 14-1 Holistic Assessment

Theme	Potential Impacts	Relevant Management and Mitigation	Predicted outcome	EP Act Principles
Land	The Proposal will directly impact Land through native vegetation and associated fauna habitat clearing including loss of significant vegetation, flora and fauna. Clearing may also result in a range of indirect impacts on Land and People (visual amenity) aspects. Permanent alteration to the BIF landform structure which also supports significant vegetation, individuals of conservation significant flora and habitats (and/or populations) of terrestrial and subterranean fauna will be directly impacted by the Proposal. Alteration of the BIF landform structure may also indirectly alter the ecological function and environmental values of the landform. Construction and operation of the Proposal has the potential to impact on terrestrial environmental quality through soil acidification and contamination. Whilst these impacts are considered negligible/minimal, any impacts may also affect other Land (e.g. biological) and Water aspects. Waste management (including waste rock and overburden facilities) is also a key consideration in the closure phase of the Proposal.	Disturbance footprint designed to reduce clearing and disturbance to BIF landform structure as far as practical. Areas of potential conservation significant fauna habitat searched prior to ground disturbance, demarcated and logged. Site layout revised where required and/or possible. Progressive rehabilitation of disturbed areas will be undertaken in accordance with the MCP so that native vegetation is re-established. Rehabilitation of the waste rock dump and remnant ridgeline.	Loss of native vegetation and association fauna (terrestrial and subterranean) habitat, significant vegetation and conservation significant flora. Permanent impacts to the BIF landform. Indirect impacts associated with vegetation clearing and fauna habitat loss are anticipated to be minimal and will be able to be adequately managed. Implementation of the Proposal is unlikely to have significant residual impacts on Land (Vegetation and flora, Landforms, Terrestrial Environmental Quality, Subterranean Fauna and Terrestrial Fauna).	<p><b>Precautionary Principle</b></p> <p>Technical investigations and studies have been completed for Land, Water, Air and People aspects across the Proposal area to ensure impact assessments and/or modelling has been carried out with scientific certainty. Technical investigations and studies have been carried out by specialists with adequate reviews of results and conclusions drawn.</p> <p>A precautionary approach has been taken where residual risk to the surrounding environment is uncertain.</p> <p><b>Intergenerational Equity</b></p> <p>The environmental management of the construction, operation and closure of the Proposal will be conducted in a manner which ensures the health and diversity of the surrounding environment is maintained and enhanced for the benefit of future generations. The management and mitigation measures proposed reduce impact to the environment to as low as practicable. Progressive closure and rehabilitation of disturbed areas to restore ecological function where possible.</p>
Water	The Proposal has the potential to alter hydrology, both surface water and groundwater through Proposal construction and operation, and groundwater abstraction. Alteration of surface water and/or groundwater may also indirectly impact Land aspects such as flora and vegetation, terrestrial fauna and subterranean fauna potential habitats and species. The Proposal also has the potential to impact on surface water and groundwater quality through contamination. However the likelihood of contamination is not considered significant.	Disturbance to watercourses will be minimised and local drainage will be considered when constructing and maintaining infrastructure. Abstraction of water will be minimised through the design of water efficient infrastructure and reuse of water where possible.	It is anticipated that the potential impacts on Water (surface water and groundwater) will be able to be adequately managed. Implementation of the Proposal is unlikely to have significant residual impacts on Water (Inland Waters).	<p><b>Conservation of biological diversity and ecological integrity</b></p> <p>Comprehensive baseline studies have been undertaken to understand existing biological diversity in the area and to assess potential threats to the diversity and ecological integrity. Clearing of vegetation has been avoided or minimised where possible. Environmental management strategies will be implemented to minimise impacts to biological diversity and ecological integrity.</p>
Air	The Proposal will directly impact Air through dust generation and pollutant emissions from mining and power generation activities. Dust generation may also indirectly impact Land aspects.	Dust associated with the Proposal will be managed in accordance with the EMP.	Implementation of the Proposal is unlikely to have significant residual impacts on Air (Air Quality).	
People	The Proposal is not expected to impact (either directly or indirectly) Aboriginal or European heritage sites. The Proposal will impact areas covered by Native Title and Native Title negotiations will be required. Whilst the Proposal is located within Pastoral lease operations, no direct or indirect impacts to amenity values are anticipated.	Disturbance footprint designed to reduce impacts on environmental and cultural values as far as practical. FIJV continue to consult with the relevant Native Title groups. Minimise impacts to the BIF ridgeline as far as reasonably practicable.	The Proposal will not have significant residual impacts on People (Social Surroundings).	<p><b>Improved valuation and pricing mechanism</b></p> <p>The Proponent has, and will continue to, evaluate (and implement wherever possible) opportunities to reduce impact to Land, Water, Air and People and improve efficiencies during the implementation, operation and closure of Yogi mine.</p>

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# Appendices

# Appendix A – Environmental Scoping Document

*Environmental Scoping Document (GHD 2019a).*

## Appendix B – Supporting Documents

*Yogi Magnetite Project, Pipeline Corridor Flora and Fauna Assessment* (GHD 2020c)

*Yogi Magnetite Project, Flora and Vegetation Assessment* (GHD 2019b)

*Dual Phase Survey for Subterranean Fauna for the Yogi Magnetite Project, Yalgoo, Western Australia* (Invertebrate Solutions Pty Ltd 2020)

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*Yogi Magnetite Project, Fauna Assessment* (GHD 2020b)

*Yogi Magnetite Project, Materials characterisation assessment* (GHD 2019d)

*Yogi Magnetite Project, Surface water assessment* (GHD 2019e)

*Yogi Magnetite Project, Groundwater assessment* (GHD 2019f)

*Yogi Magnetite Project, Air Quality assessment* (GHD 2019g)

*Due diligence risk assessment advice for a mine proposal at Yalgoo and an infrastructure corridor between Yalgoo and Geraldton Western Australia* (Brad Goode & Associates Pty Ltd 2019a)

*Report of an Aboriginal Heritage survey for the Yogi Magnetite Project in the Shire of Yalgoo, Western Australia* (Brad Goode & Associates Pty Ltd 2019b)

*Yogi Magnetite Project, Yogi Western Pipeline Desktop Assessment* (GHD, 2020a)

# Appendix C – Management Plans

*Yogi Magnetite Project, Environmental Management Plan (GHD 2020d)*

*Yogi Magnetite Project, Environmental Management and Rehabilitation Plan (GHD 2020e)*

# Appendix D – Mine Closure Plan

*Yogi Magnetite Project, Mine Closure Plan (GHD 2019c)*

GHD

Level 10

999 Hay Street

Perth WA 6000

T: +61 (8) 6222 8222 F: +61 (8) 6222 8555 E: [permail@ghd.com](mailto:permail@ghd.com)



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1	S. Nind, N. Barratt, M. Brook, J. Tindiglia	M. Brook J Tindiglia		M. Brook		11/07/2019
2	S. Nind, N. Barratt, M. Brook, J. Tindiglia A.Imbergamo K.Frehill	M.Brook		M.Brook		25/10/2019
3	S. Nind, N. Barratt, M. Brook, J. Tindiglia A.Imbergamo K.Frehill	M Brook		M Brook		05/04/2020
4	N. Feeley	D. Farrar		D. Farrar		09/04/2020

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