Yogi Magnetite Project - EPA Referral Supporting Document

FI Joint Venture Pty Ltd (FIJV)

F05-J03

18 December 2017




DISCLAIMER, CONFIDENTIALITY AND COPYRIGHT STATEMENT

REPORT DETAILS

Project Number:
Report Name: Yogi Magnetite Project - EPA Referral Supporting Document

AUTHORISATION FOR ISSUE

Report Version Date: **18 December 2017**			
Approved for Issue Director	Name: Laura Todd	Signature: 	Date: 18/12/2017

Please Note: This document is considered uncontrolled once printed.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

INTRODUCTION, BACKGROUND AND CONTEXT

FI Joint Venture (FIJV) (the Proponent) proposes to construct and operate a magnetite iron ore project, with mining, processing and associated infrastructure proposed approximately 225 km east-northeast of Geraldton and 15 km northeast of Yalgoo. The proposal also includes a magnetite slurry pipeline and a water pipeline to Geraldton Port and a gas supply pipeline from the Dampier to Bunbury Natural Gas Pipeline network (Figures 1, 2 and 3).

The project has been designed to be highly water efficient with key water efficiency measures including:

- Mine dewatering water will be used as water supply for the processing plant.
- The wet waste stream within the processing plant will be dewatered and the water recovered recycled in the processing plant.
- The ore concentrate will be dewatered at Geraldton Port and recycled water will be returned to the Yogi site processing plant via a pipeline for re-use in ore processing.

This document has been prepared by EnviroWorks Consulting (EnviroWorks) on behalf of the FI Joint Venture (FIJV, the Proponent), to support the formal referral of the Yogi Mine Project (this Proposal) to the Environmental Protection Authority (EPA) under section 38 (Part IV) of the WA *Environmental Protection Act 1986* (EP Act).

The purpose of the document is to present a high level Environmental Review of the principal components of this Proposal, including a preliminary environmental impact assessment and description of proposed environmental management strategies for preliminary key environmental factors (Section 4).

OVERVIEW OF THE PROPOSAL

Table ES1: Summary of the Proposal

Summary of the proposal	
Proposal title	Yogi Mine Project
Proponent name	FI Joint Venture Pty Ltd
Short description	It is proposed to construct and operate a magnetite iron ore mine, approximately 95 km west of Mt Magnet and 16 km east of Yalgoo. The proposal includes construction of a processing plant, a pipeline corridor for a slurry pipeline, water pipeline and gas pipeline and associated infrastructure/activities (*mine pit; mining overburden and waste facilities; processing waste containment facilities; run mine pad; internal site roads; crusher; electricity generation and reticulation; fuel storage sites; treated ore stockpile pad; conveyors; processing plant; explosives warehouse; onsite buildings such as offices, storage, guard house, workshops and accommodation; wastewater treatment facilities; domestic and industrial tip; water borefield and storage facilities; water monitoring bore/s; equipment parking and laydown areas; and water ponds (fresh and drainage).*

Table ES2: Location and proposed extent of physical and operational elements

Element	Indicative location	Proposed extent authorised
Physical elements		
Mine Pits	Figure 2 (indicative layout may change)	Clearing of no more than 200 ha within an 8228 ha Development Envelope
Mining Overburden and Waste Facilities	Figure 2 (indicative layout may change)	Clearing of no more than 400 ha within an 8228 ha Development Envelope
Processing Waste Containment Facility	Figure 2 (indicative layout may change)	Clearing of no more than 500 ha within an 8228 ha Development Envelope
Mine and Processing Support Infrastructure	Figure 2 (indicative layout may change)	Clearing of no more than 2000 ha within a 8228 ha Development Envelope *(includes: internal site roads; electricity generation and reticulation; fuel storage sites; stockpiles and conveyors; crusher; processing plant; explosives warehouse; onsite buildings such as offices, storage, guard house, workshops and accommodation; sewage treatment facilities; landfill; water supply/monitoring bore/s; equipment parking and laydown areas; ponds (fresh, recycle and drainage); slurry pipeline (on site); gas pipeline (on site).*
Magnetite Slurry Pipeline, Water Pipeline and Gas Pipeline	Figure 3 (indicative pipeline alignment options may change)	Clearing of no more than 1500 ha within 383,850 ha Pipeline Development Envelope
Operational elements		
Groundwater Abstraction	Figure 2 (indicative location of borefield may change)	Up to 5 Gigalitres per annum (GLpa) from water supply borefield
Mine Site Dewatering	Figure 2 (mine pits)	Up to 5 GLpa
Power	Figure 2 (indicative location may change)	70 MW to be supplied by on-site Gas Power Station
Gas Supply	Figure 2 (indicative location may change)	Gas will be supplied to the power station via a buried steel pipeline at a rate of 23 TJ/day
Overburden/Waste Rock	Figure 2 (indicative location may change)	Disposal of up to 800 million tonnes (over the life of the project)
Ore Processing Waste	Figure 2 (indicative location may change)	Disposal of up to 40 million m^3 of wet processing waste Disposal of up to 80 million m^3 of dry processing waste (over the project life)

Pending satisfactory exploration results, feasibility assessment and other necessary stages in mine development, associated infrastructure is likely to include:

- Mine pit
- Processing plant
- Buildings (including offices and storage)
- Maintenance workshops and stores
- Run of mine pad
- Treated ore stockpile pad
- Mining and processing waste facilities
- Mining plant lay down area and workshops
- Fuel storage facilities
- Access roads
- Accommodation village and waste water treatment facility
- Power station
- Domestic and industrial tip
- Water borefield and storage facilities.

The project will implement maximum water efficiency and re-use measures including:

- Mine dewatering water will be used as water supply for the processing plant.
- The wet waste stream within the processing plant will be dewatered using a press filtration system and the water recovered recycled in the processing plant.
- The ore concentrate will be dewatered at Geraldton Port and recycled water will be returned to the Yogi site processing plant via a pipeline for re-use in ore processing.

ENVIRONMENTAL FACTORS

FIJV has identified the following key environmental factors for the Proposal:

- *LAND*
  - Flora and Vegetation
  - Subterranean Fauna
  - Terrestrial Environmental Quality
  - Terrestrial Fauna
- *WATER*
  - Hydrological Processes
  - Inland Waters Environmental Quality
- *AIR*
  - Air Quality
- *PEOPLE*
  - Social Surroundings

1 INTRODUCTION

1.1 PURPOSE AND SCOPE

FI Joint Venture (FIJV) (the Proponent) proposes to construct and operate a magnetite iron ore project, with mining, processing and associated infrastructure proposed approximately 225 km east-northeast of Geraldton and 15 km northeast of Yalgoo. The proposal also includes a magnetite slurry pipeline and a water pipeline to Geraldton Port and a gas supply pipeline from the Dampier to Bunbury Natural Gas Pipeline network (Figures 1, 2 and 3).

The purpose of the document is to present a high level Environmental Review of the principal components of this Proposal, including a preliminary environmental impact assessment and description of proposed environmental management strategies for preliminary key environmental factors (Section 4).

1.2 PROPONENT

EnviroWorks Consulting (EnviroWorks) has been engaged by FIJV to manage the Environmental Impact Assessment (EIA) and Approvals for the proposed Yogi Mine Project.

The Proponent for the Proposal is FI Joint Venture (FIJV) (ACN: 611 846 023) (ABN: 51 611 846 023)

Contact: Raquel Barreiro

Position: Managing Director

Address: Unit 2, 9
Glory Road
Gnangara WA 6077

Phone: (08) 6401 3861

Email: raquel@idevg.com.au

EnviroWorks Consulting contact details are as follows:

Contact: Laura Todd

Position: Managing Director

Address: Level 29 Number 221
St Georges Tce
Perth WA 6000

Phone: (08) 9221 9500

Email: laura.todd@enviroworks.com.au

1.3 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The key legislative requirements relating to this Proposal include assessment under Part IV of the EP Act (Section 1.3.1) and consideration of Commonwealth protected Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, Section 1.3.2).

1.3.1 ENVIRONMENTAL PROTECTION ACT 1986

Part IV Division 1 of the EP Act provides for the referral and assessment of Proposals which, if implemented, may have a significant impact on the environment. Part IV Division 2 of the EP Act provides for the implementation of Proposals after it is decided that a proposal may be implemented.

This Proposal has the potential to result in a significant impact on the environment and therefore warrants referral to the EPA under section 38 of the EP Act. Formal referral of this Proposal will enable the EPA to decide whether or not to assess the Proposal and the level of assessment if the Proposal is to be assessed.

The EPA uses environmental principles, factors and objectives as the basis for assessing whether a proposal's impact on the environment is acceptable. Guidance on the environmental principles, factors and objectives is provided in the *Statement of Environmental Principles, Factors and Objectives* (Environmental Protection Authority, 2016k) and in the associated Environmental Factor Guidelines and Environmental Factor Technical Guidance (available from the EPA website: http://www.epa.wa.gov.au/framework-environmental-considerations-eia).

This referral supporting document provides a review of environmental principles, factors and objectives relevant to this Proposal to enable the EPA to determine the level of assessment for this proposal. The Proponent considers that the preliminary key environmental factors to be:

- Flora and Vegetation (Section 4.3)
- Subterranean Fauna (Section 4.4)
- Terrestrial Environmental Quality (Section 4.5)
- Terrestrial Fauna (Section 4.6)
- Hydrological Processes (Section 4.7)
- Inland waters Environmental Quality (Section 4.8)
- Air Quality (Section 4.9)
- Social Surroundings (Section 4.10)

Other environmental factors relevant to this Proposal are addressed in Section 5.

At the completion of the assessment of a Proposal, the EPA prepares its Report and Recommendations for the Minister for Environment (the Minister). The Report and Recommendations sets out what the EPA considers are the key environmental factors relevant to the Proposal, the EPA's recommendations as to whether or not the Proposal may be implemented and the conditions to which implementation of the Proposal should be subject. The EPAs Report and Recommendations is published to the EPA website with a statutory two-week public comment period.

Subsequent to the determination of appeals (if any), the Minister will then decide whether or not the Proposal may be implemented and if so, under what conditions. If the Minister determines that the Proposal may be implemented a Ministerial Statement is issued under section 45(5) of the EP Act.

Further guidance on the procedures of Environmental Impact Assessment of Proposals is provided in the EPA's *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures* (Environmental Protection Authority, 2016i) and the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual* (Environmental Protection Authority, 2016j).

1.3.2 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the referral and assessment of Proposals which, if implemented, may have a significant impact on Matters of National Environmental Significance (MNES). The Proponent considers that the Proposal has the potential to impact upon the following MNES:

- Listed Threatened Species (Section 4.6).
- Listed Migratory Species (Section 4.6).

As a result, the Proposal has been referred the Department of the Environment and Energy (DoEE) under the EPBC Act. If the DoEE determines the Proposal to be a controlled action under the EPBC Act, PBC requests that the EPA assess the proposal under the assessment bilateral agreement made under section 45 of the EPBC Act between the State of Western Australia and the Commonwealth or as an accredited assessment.

1.4 OTHER APPROVALS AND REGULATION

This Proposal is also subject to compliance with other relevant state legislation and regulations and is guided by relevant key over-arching state policies and strategies. In addition, there are EPA Factor Guidelines and Technical Guidance documents that have been used to determine the significance of the environmental impacts of the Proposal. Other approvals and legislation relevant to this Proposal are outlined in Table 1.

Table 1: Other Approvals

Proposal activities	Type of approval	Legislation regulating the activity
Construct groundwater bores	Licence to Construct Wells	Section 26D of the *Rights in Water and Irrigation Act 1914* (Department of Water and Environmental Regulation)
Groundwater extraction	Licence to Take Groundwater	Section 5C of the *Rights in Water and Irrigation Act 1914* (Department of Water and Environmental Regulation)

Proposal activities	Type of approval	Legislation regulating the activity
Clearing native vegetation	*Native Vegetation Clearing Permit* (only if not assessed by the EPA)	Part V of the EP Act (Department of Water and Environmental Regulation)
Operation of a prescribed premise	Operating Licence	Part V of the EP Act (Department of Water and Environmental Regulation)
Emissions considered a prescribed activity not covered by other licenses	Works Approval	Part V of the EP Act (Department of Water and Environmental Regulation)
Installation of buildings and any other infrastructure	Planning and building approvals	*Building Act 2011* *Planning and Development Act 2005* (Shire of Yalgoo)
Sewage treatment or septic tanks	Licence for sewage treatment or septic tanks	*Building Act 2011* *Planning and Development Act 2005* (Shire of Yalgoo)
Disturbance of an Aboriginal heritage site	Consent to use the Land for a given Purpose is required under section 18	*Aboriginal Heritage Act 1972* (Department of Planning, Lands and Heritage)
Mining project on Mining Act Tenure	Mining Proposal	*Mining Act 1978* DMIRS
Works Approval (for construction) and Licence (to commence and continue operations)	Environmental Protection Works Approval and Licence	Part V of the EP Act (Department of Water and Environmental Regulation)

Additional decision-making authorities (DMAs) may be identified during the assessment process.

1.4.1 LAND TENURE

Proposed mining and processing will occur on granted tenements:

- Miscellaneous licence L59/156;
- Mining lease M59/740;
- Mining lease M59/637; and
- Prospecting licence P59/2133.

These tenements are considered appropriate tenure for all proposed mining and processing infrastructure.

The proposed magnetite slurry pipeline, water pipeline and gas pipeline will be located within the Pipeline Development Envelope shown on Figure 3. FIJV is currently investigating the most appropriate form of land tenure for these items, however it is likely tenure will be obtained as *Mining Act 1978* leases and/or easements under the *Land Administration Act 1997*.

1.4.2 NATIVE TITLE AGREEMENTS

Within Western Australia the *Native Title Act 1993* (Commonwealth), is administered by the State government. This legislation provides for Aboriginal people to claim native title and a process for negotiation and compensation where the land is to be leased out by the State. Native title negotiations for mineral exploration and mining projects are managed by the DMP, Petroleum and Royalties division.

There are no Native Title claims over the project's granted tenements.

Native Title obligations will be met where relevant for the proposed pipelines.

2 THE PROPOSAL

2.1 BACKGROUND

The project was historically owned by Ferrowest and has been purchase by FIJV (the project was not referred to the EPA historically).

FIJV's Yogi Magnetite Project is a new proposal, and this is the first time it has been referred to the EPA for assessment.

2.2 JUSTIFICATION

The projected long-term demand for iron ore is considered unlikely to decline. While the iron content of magnetite ore in the ground is generally around 20% to 30%, once the ore has undergone processing to produce a concentrate, iron content is often higher than that found in hematite ores. Magnetite concentrate is also lower in impurities. The higher grade and lower impurities of magnetite concentrate increases the efficiency of steel making furnaces, thereby reducing the energy and cost required to produce steel. This has resulted in magnetite concentrate being a preferred source of iron for many steel makers, making up about 30% of global furnace feed.

Implementation of the Project provides the opportunity to contribute to the creation of employment and training opportunities for local and indigenous community members, royalties and taxation payments from the sale of iron ore, and supports the development of ancillary industries in Western Australia.

2.3 PROPOSAL DESCRIPTION

FI Joint Venture (FIJV) (the Proponent) proposes to construct and operate a magnetite iron ore project, with mining, processing and associated infrastructure proposed approximately 225 km east-northeast of Geraldton and 15 km northeast of Yalgoo. The proposal also includes a magnetite slurry pipeline and a water pipeline to Geraldton Port and a gas supply pipeline from the Dampier to Bunbury Natural Gas Pipeline network (Figures 1, 2 and 3).

2.3.1 MINING

Mining will occur of the "Sam Deposit" a magnetite resource containing approximately 30% total iron (% Fe).

The mine will be a simple open cut operation with clearing and topsoil stockpiling, overburden drilling and blasting followed by conventional removal with truck and shovel.

2.3.2 MINE SITE INFRASTRUCTURE

Mine site infrastructure is likely to include:

- Mine pit
- Processing plant
- Buildings (including offices and storage)
- Maintenance workshops and stores
- Run of mine pad
- Treated ore stockpile pad
- Mining and processing waste facilities
- Mining plant lay down area and workshops
- Fuel storage facilities
- Access roads
- Accommodation village and waste water treatment facility
- Power station
- Domestic and industrial tip
- Water borefield and storage facilities.

2.3.3 MINING WASTE

Overburden and waste rock from the mining operation will be disposed in appropriately designed storage facilities adjacent to the mining operation.

Geochemical characterisation of the waste rock will be undertaken prior to its deposition to determine its acid-forming and elemental composition, and it will be disposed of appropriately in accordance with the results obtained.

2.3.4 MINE PIT DEWATERING

Dewatering of the mine pit will be required. Depth to groundwater in the local area ranges from 3.4 to 33.2 meters below ground level (mbgl) – refer to Section 4.7. The mine pit depth will exceed these groundwater levels and therefore will need to be dewatered for mining to progress.

It is anticipated that up to 5 gigalitres will be required to be dewatered per year. Dewatering water will be used as feed water for the processing plant.

2.3.5 PROCESSING

A 5 million tonne per annum Iron Ore Concentrate Plant will be located at the mine site.

The magnetite ore would be transported by truck to the Run of Mine (ROM) stock pile and then processed as follows:

- Primary Crushing
- Secondary Crushing
- Stockpile and Reclaim

- High Pressure Grinding Roll (HPGR) Grinding and Air Classification.
- Low Intensity Magnetic Separation (LIMS)
- Tertiary grinding
- Concentrate Filtration
- Wet processing waste thickening and dewatering.

2.3.6 PROCESSING WASTE

The wet processing waste will be slurried, thickened and dewatered within the processing plant.

Dewatering will be carried out using a press filtration system, to produce clean water for recycling to the processing plant for reuse. This press filtration system will include:

- Pressure filters for dewatering thickener underflow
- Clarifier for settling fine particles of filtrate which were passed through the porous of filter cloth.

The dewatered processing waste will be transferred to a dedicated and appropriately designed disposal facility within the Development Envelope.

Any dry waste processing waste will be placed within an appropriately designed waste disposal facility within the Development Envelope

2.3.7 ORE DEWATERING

The ore concentrate will be dewatered at Geraldton Port and recycled water will be returned to the Yogi site processing plant via a pipeline for re-use.

2.3.8 TRANSPORT AND SERVICES

The magnetite ore will be transported as a slurry within a pipeline to Geraldton Port. A return water pipeline will be used to transport water from the Port Dewatering Plant to the mine site for re-use in the processing plant. A gas pipeline will supply natural gas to the mine site from the Dampier to Bunbury Natural Gas Pipeline network.

A large Pipeline Development Envelope has been nominated as part of this referral (Figure 3), to allow the proponent flexibility to select final magnetite, water and gas pipeline routes which minimise the impact on the environment and have appropriate land tenure. It should be noted that route selection will:

- Avoid as many environmental values as possible.
- Take into account Environmentally Sensitive Areas (ESA's) and cultural heritage sites and avoid impacts to them as far as practicable.
- Give preference to cleared road reserves or other cleared corridors to avoid intersecting native vegetation and fauna habitat as far as practicable.

Where intersection of native vegetation is deemed necessary, appropriate flora and fauna studies will be conducted to determine site specific flora and fauna values and develop management measures. Pipeline design and management measures will ensure minimal impacts to hydrological processes, water quality and terrestrial environmental quality.

2.3.9 WATER EFFICIENCY AND RE-USE

The project will implement maximum water efficiency and re-use measures including those described above:

- Mine dewatering water will be used as water supply for the processing plant.
- The wet waste stream within the processing plant will be dewatered and the water recovered recycled in the processing plant.
- The ore concentrate will be dewatered at Geraldton Port and recycled water will be returned to the Yogi site processing plant via a pipeline for re-use.

2.3.10 PROPOSAL KEY CHARACTERISTICS

The key characteristics of the proposal are set out in Table 2 and 3. The key proposal characteristics may change as a result of the findings of studies conducted and the application of the mitigation hierarchy by the proponent.

Table 2. Summary of the Proposal

Summary of the proposal	
Proposal title	Yogi Mine Project
Proponent name	FI Joint Venture Pty Ltd
Short description	It is proposed to construct and operate a magnetite iron ore mine, approximately 95 km west of Mt Magnet and 16 km east of Yalgoo. The proposal includes construction of a processing plant, a pipeline corridor for a slurry pipeline, water pipeline and gas pipeline and associated infrastructure/activities (*mine pit; mining overburden and waste facilities; processing waste containment facilities; run mine pad; internal site roads; crusher; electricity generation and reticulation; fuel storage sites; treated ore stockpile pad; conveyors; processing plant; explosives warehouse; onsite buildings such as offices, storage, guard house, workshops and accommodation; wastewater treatment facilities; domestic and industrial tip; water borefield and storage facilities; water monitoring bore/s; equipment parking and laydown areas; and water ponds (fresh and drainage).*

Table 3: Location and proposed extent of physical and operational elements

Element	Indicative location	Proposed extent authorised
Physical elements		
Mine Pits	Figure 2 (indicative layout may change)	Clearing of no more than 200 ha within an 8228 ha Development Envelope
Mining Overburden and Waste Facilities	Figure 2 (indicative layout may change)	Clearing of no more than 400 ha within an 8228 ha Development Envelope
Processing Waste Containment Facilities	Figure 2 (indicative layout may change)	Clearing of no more than 500 ha within an 8228 ha Development Envelope
Mine and Processing Support Infrastructure	Figure 2 (indicative layout may change)	Clearing of no more than 2000 ha within an 8228 ha Development Envelope *(includes: internal site roads; electricity generation and reticulation; fuel storage sites; stockpiles and conveyors; crusher; processing plant; explosives warehouse; onsite buildings such as offices, storage, guard house, workshops and accommodation; sewage treatment facilities; landfill; water supply/monitoring bore/s; equipment parking and laydown areas; ponds (fresh, recycle and drainage); slurry pipeline (on site); gas pipeline (on site).*
Magnetite Slurry Pipeline, Water Pipeline and Gas Pipeline	Figure 3 (indicative pipeline alignment options may change)	Clearing of no more than 1500 ha within 383,850 ha Pipeline Development Envelope
Operational elements		
Groundwater Abstraction	Figure 2 (indicative location of borefield may change)	Up to 5 Gigalitres per annum (GLpa) from water supply borefield
Mine Site Dewatering	Figure 2 (mine pits)	Up to 5 GLpa
Power	Figure 2 (indicative location may change)	70 MW to be supplied by on-site Gas Power Station
Gas Supply	Figure 2 (indicative location may change)	Gas will be supplied to the power station via a buried steel pipeline at a rate of 23 TJ/day
Overburden/Waste Rock	Figure 2 (indicative location may change)	Disposal of up to 800 million tonnes (over the life of the project)
Ore Processing Waste	Figure 2 (indicative location may change)	Disposal of up to 40 million m^3 of wet processing waste Disposal of up to 80 million m^3 of dry processing waste (over the project life)

2.4 LOCAL AND REGIONAL CONTEXT

2.4.1 SOCIAL VALUES

The tenements occur within the Shire of Yalgoo (Figure 3), which covers approximately 28,000 square kilometres of the Murchison Goldfields area of the Mid-West region. The Yalgoo town itself has a population of around 120 people, with approximately 400 people living throughout the Shire (The Shire of Yalgoo, n.d.). The main industries are mining (approximately $122 million of production annually) and pastoralism (contributing approximately $5.5 million). Types of mining include gold, tantalite and bauxite (iron ore) (The Shire of Yalgoo, n.d.).

The Yogi Mine tenements overlap sheep-farming pastoral leases Carlaminda Station and Wagga Wagga station (Figure 4).

The Pipeline Development Envelope includes several Local Government Areas as follows (Figure 3):

- Shire of Yalgoo
- City of Greater Geraldton
- Shire of Murchison
- Shire of Chapman Valley

The Pipeline Development Envelope traverses a range of land types including:

- Road Reserves
- Reserves
- Easements
- Crown Land
- Rural Freehold Land
- Urban Freehold Land
- Pastoral Leases.

FIJV intend to select magnetite, water and gas pipeline routes which minimise social impacts and can obtain appropriate land tenure.

2.4.2 ENVIRONMENTAL VALUES

This section focuses on environmental values of the project tenements and surrounding area.

The environmental values of the Pipeline Development Envelope are not explored in detail in this section because:

- FIJV intend to select the final pipeline routes to avoid as many environmental values as possible.
- The pipeline routes will take into account Environmentally Sensitive Areas (ESA's) and cultural heritage sites and avoid impacts to them as far as practicable.
- The pipelines will be located in cleared road reserves or other cleared corridors to avoid intersecting native vegetation and fauna habitat as far as practicable.
- Where intersection of native vegetation is deemed necessary, appropriate flora and fauna studies will be conducted to determine site specific flora and fauna values and develop management measures.
- Pipeline design and management measures will ensure minimal impacts to hydrological processes, water quality and terrestrial environmental quality.

2.4.2.1 CONSERVATION FLORA AND FAUNA

Previous flora surveys covering a small portion of the tenements recorded (ATA Environmental, 2006 & 2007; Coffey Environments, 2010; Ecoscape, 2008; and Maia, 2011)

- two priority flora species within the Development Envelope - *Acacia subsessilis* (Priority 3) and *Dodonaea amplisemina* (Priority 4); and
- three additional species in close proximity to the Development Envelope *Acacia speckii* (Priority 4) *Gunniopsis divisa* (Priority 3) and *Verticordia penicillaris* (Priority 4).

A Department of Biodiversity Conservation and Attractions (DBCA) database search within 15 km of the tenements and an EPBC Protected Matters Search within 50 km identified 83 conservation flora species:

- all of these species are listed under State regulation (73 priority, 4 vulnerable, 5 endangered and 1 critically endangered)
- 9 of these species are listed under Federal regulation (4 vulnerable and 5 endangered)
- only *Acacia speckii* (Priority 4), *Acacia subsessilis* (Priority 3), and *Dodonaea amplisemina* (Priority 4) records intersect the Development Envelope.

For further information on significant flora refer to Section 4.3.

Previous fauna studies covering a small portion of the tenements (ATA Environmental, 2006 and (Coffey Environments, 2008), recorded the presence of the Rainbow Bee-eater (*Merops ornatus*), declared as Schedule 5 (Migratory) under the *Wildlife Conservation (Rare Fauna) Notice 2016*. A DBCA and EPBC Protected Matters database search covering a 50 km buffer around the tenements determined 26 fauna species of conservation significance may be present 25 of which are listed under State regulation and 17 under Federal regulation. Endangered or critically endangered species from the database search include the Black-flanked Rock-Wallaby, Night Parrot and Minnivale trapdoor spider, whilst vulnerable species include the Western Spiny-tailed Skink, Gilled Slender Blue-tongue, Chuditch, Malleefowl, Shield-backed Trapdoor Spider and Curlew Sandpiper.

For further information on conservation significant fauna values refer to Section 4.6.

2.4.2.2 PRIORITY ECOLOGICAL COMMUNITIES

Based on a DBCA database search, eight Priority Ecological Community (PEC) records occur within 50 km of the Development Envelope.

The boundary of the DBCA polygon for the Priority 1 PEC called “Yalgoo Banded Ironstone Formation (BIF)” intersects the western tenements. In addition, the DBCA polygon for the Priority 1 PEC called “Wagga Wagga and Yalgoo Calcrete” occurs approximately 4.7 km northeast of the tenements.

FIJV intend to undertake appropriate studies to determine potential impacts to these PEC’s resulting from the project.

For further information, refer to Section 4.3.4.4.

3 STAKEHOLDER ENGAGEMENT

3.1 KEY STAKEHOLDERS

FIJV has identified the following government agencies and non-government organisations as key stakeholders for this proposal:

- **Government Agencies:**
  - Environmental Protection Authority (EPA)
  - Department of Water and Environmental Regulation (DWER)
  - Department of Mines, Industry Regulation and Safety (DMIRS)
  - Department of Biodiversity Conservation and Attractions (DBCA)
  - Shire of Yalgoo
- **Pastoral Leases:**
  - Carlaminda Station
  - Wagga Wagga Station

3.2 STAKEHOLDER ENGAGEMENT PROCESS

FIJV will continue to consult with relevant stakeholders during the environmental approval process and implementation of this Proposal. This includes decision-making authorities, other relevant State (and Commonwealth) government agencies and local government authorities, the local community, and environmental non-government organisations.

FIJV is in the process of developing a comprehensive stakeholder communication and engagement plan that will include the following stakeholder consultation activities:

- providing information on the Proposal;
- providing the results of key environmental studies;
- seeking feedback from key stakeholder on environmental impacts relevant to them; and
- incorporating stakeholder feedback into the Proposal design and proposed environmental management.

3.3 STAKEHOLDER CONSULTATION

To date stakeholder communication and engagement has focussed on providing information to key stakeholders and the general community regarding:

- proposed Project location and scale;
- FIJV's commitment to environmental management;
- proposed approach for minimising and mitigating environmental impacts and risks; and anticipated Project timing.

The table below outlines the specific stakeholder consultation that has been undertaken.

Table 4: Stakeholder consultation

Date	Issues/topics raised	Proponent response / outcome
Department of Water and Environmental Regulation (DWER)		
2017	• Met with DWER EPA Services to discuss referral of project to EPA	• DWER EPA Services advised that referral to the EPA was warranted.
Department of Mines, Industry Regulation and Safety		
2016-2016	• Applications for tenements, changes to tenements	• Tenements issued as required
Shire of Yalgoo		
2016-2017	• Meetings to provide an overview of the project.	• Shire confirmed the project was compatible with land uses in the Shire
Department of Biodiversity Conservation and Attractions (DBCA) and previous entities		
Pre-2015	• Lodgement of priority flora records for historical flora surveys (by Ferrowest)	• Priority flora records are now reflected in DBCA databases
Carlaminda Station		
2016 - 2017	• Ongoing discussions regarding site access	• Site access granted for exploration activities
Wagga Wagga Station		
2016-2016	• Ongoing discussions regarding site access	• Site access granted for exploration activities

4 ENVIRONMENTAL PRINCIPLES AND FACTORS

4.1 PRINCIPLES

A summary of the EP Act principles considered in relation to the proposal is provided in Table 5.

Table 5: EP Act Principles

Principle	Consideration
1. The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In application of this precautionary principle, decisions should be guided by:* *a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* b) *an assessment of the risk-weighted consequences of various options.*	FIJV will undertake hydrogeology studies, investigations and modelling as well as targeted flora and fauna surveys for conservation significant species to understand and assess potential threats of serious or irreversible damage to the surrounding environment. A precautionary approach will be taken where threats to the surrounding environment are uncertain. Where threats of serious or irreversible damage are identified, management strategies will be implemented to avoid or minimise those threats wherever possible.
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*	Environmental management of the operation will ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.
3. The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	FIJV will undertake comprehensive baseline studies to understand and assess potential threats to biological diversity and ecological integrity. Management strategies will be implemented to avoid or minimise threats to biological diversity and ecological integrity wherever possible.
4. Principles relating to improved valuation, pricing and incentive mechanisms *(1) Environmental factors should be included in the valuation of assets and services.* *(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* *(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.*	FIJV has, and will continue to, evaluate (and implement wherever possible) opportunities to reduce impact to land, reduce waste and improve efficiencies in water, fertiliser and energy use during the implementation and operation of the pivot irrigation project. The Proposal will be subject to a Mine Closure Plan prepared in accordance with the *Guidelines for Preparing Mine Closure Plans* (Department of Mines and Petroleum & Environmental Protection Authority, 2015) FIJV will continue to operate under an operating licence, issued under Part V of the

Principle	Consideration
Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.	EP Act, that will ensure that pollution (when or if generated) is paid for in line with legislation.
5. The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	All reasonable and practicable measures have been and will continue to be undertaken by FIJV to minimise the generation of waste. FIJV will operate under an operating licence, issued under Part V of the EP Act, that will manage wastes.

4.2 FACTORS

The Proponent has assessed the environmental factors relevant to this Proposal, in accordance with the approach in the EPA's Statement of Environmental Principles, Factors and Objectives (Environmental Protection Authority, 2016k) and the EPA's Environmental Factor Guidelines and Environmental Factor Technical Guidance (available from the EPA website: http://www.epa.wa.gov.au/framework-environmental-considerations-eia).

FIJV has identified the following key environmental factors for the Proposal:

- **LAND**
  - Flora and Vegetation (Section 4.3)
  - Subterranean Fauna (Section 4.4)
  - Terrestrial Environmental Quality (Section 4.5)
  - Terrestrial Fauna (Section 4.6)
- **WATER**
  - Hydrological Processes (Section 4.7)
  - Inland Waters Environmental Quality (Section 4.8)
- **AIR**
  - Air Quality (Section 4.9)
- **PEOPLE**
  - Social Surroundings (Section 4.10)

For each of these factors the following information has been described in the sub-sections below.

FIJV considers that the remaining environmental factors are not of significance to warrant further assessment by the EPA, or are impacts that can be regulated by other statutory processes to meet the EPA's objectives, outlined in the EPA's Statement of Environmental Principles, Factors and Objectives (Environmental Protection Authority, 2016k) and have therefore been classed as 'other environmental factors'.

4.3 FLORA AND VEGETATION

4.3.1 EPA OBJECTIVE

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

4.3.2 POLICY AND GUIDANCE

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth)
- *Environmental Protection Act 1986* (EP Act) (WA)
- *Biodiversity and Conservation Act 2016* (WA)
- "Appendix B: Potentially contaminating industries, activities and land uses" in *Assessment and management of contaminated sites: Contaminated sites guidelines* (Department of Environmental Regulation, 2014).
- *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority, 2016b).
- *Environmental Protection Bulletin 20 - Protection of naturally vegetated areas through planning and development* (Environmental Protection Authority, 2013b).
- *Guidance Statement 6 – Rehabilitation of Terrestrial Ecosystems* (Environmental Protection Authority, 2006).
- *Statement of Environmental Principles, Factors and Objectives* (Environmental Protection Authority, 2016k).
- *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (Environmental Protection Authority, 2016l).
- *WA Environmental Offsets Guidelines* (Government of Western Australia, 2014).
- *WA Environmental Offsets Policy* (Government of Western Australia, 2011).

4.3.3 CONSULTATION

Consultation with regulatory agencies, stakeholders and the community will be required regarding:

- studies proposed;
- methodology of studies;
- results of studies;
- predicted impacts;
- proposed management measures; and
- residual impacts and risks.

Consultation to date has included broad information provision to stakeholders.

4.3.4 RECEIVING ENVIRONMENT

4.3.4.1 REGIONAL CONTEXT

IBRA Bioregions

The IBRA7 classification divides Australia into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information (Department of the Environment and Energy, n.d.).

The Yogi Mine Project Development Envelope is located entirely within the Tallering subregion (YAL2) of the Yalgoo bioregion. The Pipeline Development Envelope crosses three subregions: Tallering (YAL2; Yalgoo bioregion), Merredin subregion (AW1; Avon Wheatbelt bioregion) and Geraldton Hills (GS2; Geraldton Sandplains). These regions are displayed in Figure 5 and described in Table 6 below.

Table 6: IBRA subregions

Land System	Description
Tallering	Desmond and Chant (2003a) describes the 3,498,943 ha Tallering subregion climate as arid to sem-arid warm Mediterranean. The bioregion "is an interzone between South-western Bioregions and Murchison…. characterised by low woodlands to open woodlands of Eucalyptus, Acacia and Callitris on red sandy plains…particularly rich in ephemerals" (Desmond & Chant, 2003a, p. 656).
Merredin	Beecham (2003) describes the 6,524,175 ha Merredin subregion climate as semi-arid warm Mediterranean. The subregion "is an ancient peneplain with low relief, gently undulating landscape. There is no connected drainage; salt lake chains occur as remnants of ancient drainage systems that now only function in very wet years. Lateritic uplands are dominated by yellow sandplain" (Beecham, 2003, p. 7).
Geraldton Hills	Desmond and Chant (2003b) describes the 1,969,997 ha Geraldton Hills subregion climate as warm semi-arid to Mediterranean climate, receiving 400-500 mm of rain annually. The subregion: *"incorporates the southern end of Carnarvon Basin and northern end of the Perth Basin, with exposed areas of Permian/Silurian siltstone and Jurassic sandstones, mostly overlainby sandplains, alluvial plains, and coastal limestones. Sand heaths with emergent Banksia and Actinostrobus, York Gum woodlands on alluvial plains, proteaceous heath and Acacia scrubs on limestones depending on depth of coastal-sand mantle, low closed forest of Acacia rostellifera (now cleared) on alluvial plains of Greenough and Irwin River (behind beach dune system south of Geraldton). Also includes the Pinjarra Orogen which is an area of Hill country with a Proterozoic basement, and comprises extensive, undulating, lateritic uplands mantled in sandplain supporting proteaceous shrublands and mallees while valleys support York Gum and Jam"* (Desmond & Chant, 2003b, p. 265).

Land Systems

Land Systems (Rangeland) mapping covering Western Australia has been prepared by the Western Australian Department of Agriculture from data in van Vreeswyk, Leighton, Payne and Hennig

(2004). Land Systems are comprised of repeating patterns of topography, soils, and vegetation (i.e. a series of “land units” that occur on characteristic physiographic types within the Land Systems).

The Yogi Development Envelope intersects five land systems (Figure 6) as described in Table 7 below.

Table 7: Land Systems (DAFWA) intersecting the Yogi Development Envelope

Land System	Description
Challenge (CHL)	Gently undulating gritty-surfaced plains, occasional granite hills, tors and low breakaways, with acacia shrublands.
Gabanintha (GAB)	Ridges, hills and footslopes of various metamorphosed volcanic rocks (greenstones), supporting sparse acacia and other mainly non-halophytic shrublands.
Hamilton (HAM)	Hardpan plains, stony plains and incised drainage lines supporting mulga shrublands.
Tindalarra (TIN)	Near level hardpan wash plains, narrow drainage lines and moderately saline drainage floors; supporting tall mixed acacia shrublands with wanderrie grasses, also minor saltbush/bluebush low shrublands.
Violet (VIO)	Gently undulating gravelly plains on greenstone, laterite and hardpan, with low stony rises and minor saline plains; supporting groved mulga and bowgada shrublands and patchy halophytic shrublands.

The Pipeline Development Envelope covers a large number of land systems as presented in Figure 10b with the soil-land system descriptions in the accompanying legend.

4.3.4.2 PRE-EUROPEAN VEGETATION

The pre-European vegetation mapping of Western maps original natural vegetation presumed to have existed prior to European settlement in Western Australia. The major sources of data in this database are the published and unpublished mapping of J.S. Beard at 1:250,000 scale. A system association was assigned as per Shepherd (2003) linking to the NVIS Information Hierarchy (2003).

The Yogi Project Development Envelope intersects four vegetation associations as shown in Figure 7a, with their corresponding Sub-Formation (NVIS level IV) described in Table 8 below.

Table 8: Pre-European System Associations intersecting the Development Envelope

System Association	Sub-Formation Description
18	Acacia woodland
326.3	MOSAIC of: Acacia open shrubland / Senna mixed sparse shrubland / Chamaexeros mixed open forbland; and Acacia open shrubland
420.5	Allocasuarina mixed sparse shrubland

The Pipeline Development Envelope covers a large number of vegetation associations as shown in Figure 7b, with the Sub-Formation (NVIS level IV) descriptions in the accompanying legend.

4.3.4.3 CONSERVATION SIGNIFICANT FLORA

Previous Flora Surveys

Previous flora studies are outlined below in **Table 9** with the extent of the survey areas shown in Figure 8. These survey areas only covered a small portion of the western tenements (Figure 8). Whilst some of the project area has been covered by previous flora studies providing useful contextual information, new flora studies will be required over the remainder of the tenements and within any areas of native vegetation clearing for pipelines.

Previous flora surveys recorded:

- two priority flora species within the Development Envelope - *Acacia subsessilis* (Priority 3) and *Dodonaea amplisemina* (Priority 4); and
- three additional species in close proximity to the Development Envelope *Acacia speckii* (Priority 4) *Gunniopsis divisa* (Priority 3) and *Verticordia penicillaris* (Priority 4).

Table 9: Previous Yogi Mine Flora Studies

Survey Date	Area	Type	Reference	Results
29 May – 2 June 2006	Tenements: P59/1508, E59/642, P59/1397	Flora – Part one of detailed (level 2) survey	(ATA Environmental, 2006a)	No Declared Rare Flora (DRF) One Priority 1 Species (*Acacia speckii*)
6 – 8 September 2006	Tenements: P59/1508, E59/642, P59/1397	Flora – Part two of detailed (level 2) survey	(ATA Environmental, 2007)	No Declared Rare Flora (DRF) One Priority Species (*Acacia speckii*)
29 August – 1 September 2007	Selected Areas	Targeted Flora Survey	(Coffey Environments, 2010)	No Declared Rare Flora (DRF) Two Priority Species (*Acacia speckii & Acacia subsessilis*)
6 – 9 October 2008	Tenement E59/1097	Targeted Flora Survey	(Ecoscape, 2008)	No Declared Rare Flora (DRF) Two Priority Species (*Acacia speckii & Acacia subsessilis*)
2 - 11 November 2011	Selected Areas	Targeted Flora Survey	(Maia, 2011)	No Declared Rare Flora (DRF). Five Priority species (*Acacia subsessilis*, *Gunniopsis divisa*, *Acacia speckii*, *Dodonaea amplisemina* and *Verticordia penicillaris)*.

Database searches

An EPBC Protected Matters Search was conducted on the 18th August 2016 for a 50 km buffer of the Yogi Project Development Envelope (Appendix A) (Department of the Environment and Energy, 2017a), and returned two endangered flora species as potentially occurring (Table 10).

A search was undertaken on the 25th August 2017 of the DBCA databases for conservation significant flora occurring within 15 km of the Yogi Project Development Envelope (Department of Biodiversity, Conservation and Attractions, 2017a), which included searches of:

- DBCA's Threatened (Declared Rare) and Priority Flora database (TPFL)
- Western Australian Herbarium Specimen database for Threatened and Priority flora (WAHERB)
- DBCA's Threatened and Priority Flora List (search uses 'place names' rather than the buffer) (TP LIST)

These database searches identified 83 conservation flora species:

- all of these species are listed under State regulation (73 priority, 4 vulnerable, 5 endangered and 1 critically endangered)
- 9 of these species are listed under Federal regulation (4 vulnerable and 5 endangered)
- only *Acacia speckii* (Priority 4), *Acacia subsessilis* (Priority 3), and *Dodonaea amplisemina* (Priority 4) records intersect the Development Envelope.

Table 10 below documents all species identified by the above database searches. Of these taxa, only *Acacia speckii* (Priority 4), *Acacia subsessilis* (Priority 3), and *Dodonaea amplisemina* (Priority 4) records intersect the Development Envelope. Records are mapped in Figure 8.

Table 10: Conservation Significant Flora potentially occurring within 50 km

Flora Species	State Status	EPBC Act Status	ATA	Coffey	Ecoscape	Maia	TPFL	WAHERB	TP LIST	EPBC
Acacia dilloniorum	Priority 1	-	-	-	-	-	-	-	*	-
Acacia formidabilis	Priority 3	-	-	-	-	-	-	-	*	-
Acacia isoneura subsp. *nimia*	Priority 3	-	-	-	-	-	-	-	*	-
Acacia plautella	Priority 3	-	-	-	-	-	-	-	*	-
Acacia ridleyana	Priority 3	-	-	-	-	-	-	-	*	-
Acacia speckii	Priority 4	-	*	*	*	*	-	*	*	-
Acacia subsessilis	Priority 3	-	-	*	*	*	-	*	*	-
Amanita lesueurii	Priority 2	-	-	-	-	-	-	-	*	-
Androcalva adenothalia	Threatened (Critically Endangered)	-	-	-	-	-	-	-	*	-
Angianthus microcephalus	Priority 2	-	-	-	-	-	-	-	*	-
Baeckea sp. Paynes Find (S. Patrick 1095)	Priority 1	-	-	-	-	-	-	-	*	-
Beyeria cinerea subsp. *cinerea*	Priority 3	-	-	-	-	-	-	-	*	-
Beyeria gardneri	Priority 3	-	-	-	-	-	-	-	*	-
Beyeria lapidicola	Priority 1	-	-	-	-	-	-	-	*	-
Beyeria lepidopetala	Threatened (Vulnerable)	Endangered	-	-	-	-	-	-	*	-
Blackallia nudiflora	Priority 3	-	-	-	-	-	-	-	*	-
Calandrinia butcherensis	Priority 1	-	-	-	-	-	-	-	*	-
Calytrix harvestiana	Priority 2	-	-	-	-	-	-	-	*	-
Chamelaucium sp. Coolcalalaya (A.H. Burbidge 4233)	Priority 1	-	-	-	-	-	-	-	*	-
Chamelaucium sp. Warriedar (A.P. Brown & S. Patrick APB 1100)	Priority 1	-	-	-	-	-	-	-	*	-
Chamelaucium sp. Yalgoo (Y. Chadwick 1816)	Priority 1	-	-	-	-	-	-	-	*	-

Flora Species	State Status	EPBC Act Status	ATA	Coffey	Ecoscape	Maia	TPFL	WAHERB	TP LIST	EPBC
Cryptandra nola	Priority 3	-	-	-	-	-	-	-	*	-
Cuphonotus humistratus	Priority 1	-	-	-	-	-	-	-	*	-
Cyanicula fragrans	Priority 3	-	-	-	-	-	-	-	*	-
Darwinia sp. Canna (R. Davis 11241)	Priority 2	-	-	-	-	-	-	-	*	-
Darwinia sp. Morawa (C.A. Gardner 2662)	Priority 3	-	-	-	-	-	-	-	*	-
Dodonaea amplisemina	Priority 4	-	-	-	-	*	-	*	*	-
Drakaea concolor	Threatened (Endangered)	Vulnerable	-	-	-	-	-	-	*	-
Enekbatus dualis	Priority 1	-	-	-	-	-	-	-	*	-
Eremophila ballythunnensis	Priority 1	-	-	-	-	-	-	-	*	-
Eremophila graciliflora	Priority 1	-	-	-	-	-	-	-	*	-
Eremophila grandiflora	Priority 3	-	-	-	-	-	-	-	*	-
Eremophila muelleriana	Priority 3	-	-	-	-	-	-	-	*	-
Eremophila rhegos	Priority 1	-	-	-	-	-	-	-	*	-
Eremophila viscida	Threatened (Endangered)	Endangered	-	-	-	-	-	-	-	*
Eucalyptus crucis subsp. *praecipua*	Threatened (Endangered)	Endangered	-	-	-	-	-	-	*	-
Eucalyptus cuprea	Threatened (Endangered)	Endangered	-	-	-	-	-	-	*	-
Eucalyptus synandra	Threatened (Vulnerable)	Vulnerable	-	-	-	-	-	-	*	-
Goodenia berringbinensis	Priority 4	-	-	-	-	-	-	*	*	-
Goodenia neogoodenia	Priority 4	-	-	-	-	*	*	-	*	-
Goodenia sericostachya	Priority 3	-	-	-	-	-	-	-	*	-
Grevillea globosa	Priority 3	-	-	-	-	-	-	-	*	-
Grevillea tenuiloba	Priority 3	-	-	-	-	-	-	-	*	-
Gunniopsis divisa	Priority 3	-	-	-	-	-	-	*	-	-
Haegiela tatei	Priority 4	-	-	-	-	-	-	-	*	-
Hemigenia saligna	Priority 3	-	-	-	-	-	-	-	*	-
Hibbertia cockertoniana	Priority 3	-	-	-	-	-	-	-	*	-
Homalocalyx echinulatus	Priority 3	-	-	-	-	-	-	-	*	-
Hypocalymma longifolium	Threatened (Vulnerable)	Vulnerable	-	-	-	-	-	-	*	-
Labichea obtrullata	Priority 1	-	-	-	-	-	-	-	*	-
Lasiopetalum oppositifolium	Priority 3	-	-	-	-	-	-	-	*	-
Lepidium scandens	Priority 3	-	-	-	-	-	-	-	*	-
Menkea draboides	Priority 3	-	-	-	-	-	-	-	*	-
Micromyrtus acuta	Priority 3	-	-	-	-	-	-	-	*	-
Micromyrtus placoides	Priority 3	-	-	-	-	-	-	-	*	-
Micromyrtus trudgenii	Priority 3	-	-	-	-	-	-	-	*	-
Mirbelia corallina	Priority 3	-	-	-	-	-	-	-	*	-
Persoonia papillosa	Priority 2	-	-	-	-	-	-	-	*	-
Petrophile pauciflora	Priority 3	-	-	-	-	-	-	-	*	-
Polianthion collinum	Priority 3	-	-	-	-	-	-	-	*	-
Prostanthera pedicellata	Priority 1	-	-	-	-	-	-	-	*	-
Prostanthera petrophila	Priority 3	-	-	-	-	-	-	-	*	-
Psammomoya implexa	Priority 3	-	-	-	-	-	-	-	*	-
Rhodanthe collina	Priority 3	-	-	-	-	-	-	-	*	-
Ricinocarpos brevis	Threatened (Endangered)	Endangered	-	-	-	-	-	-	-	*

Flora Species	State Status	EPBC Act Status	ATA	Coffey	Ecoscape	Maia	TPFL	WAHERB	TP LIST	EPBC
Ricinocarpos oliganthus	Priority 1	-	-	-	-	-	-	-	*	-
Roebuckiella halophila	Priority 3	-	-	-	-	-	-	-	*	-
Scaevola oldfieldii	Priority 3	-	-	-	-	-	-	-	*	-
Scholtzia sp. East Yuna (A.C. Burns 6)	Priority 2	-	-	-	-	-	-	-	*	-
Scholtzia sp. Eradu (R.D. Royce 8016)	Priority 2	-	-	-	-	-	-	-	*	-
Scholtzia sp. Eurardy (J.S. Beard 6886)	Priority 2	-	-	-	-	-	-	-	*	-
Scholtzia sp. Murchison River (A.S. George 7908)	Priority 2	-	-	-	-	-	-	-	*	-
Stachystemon nematophorus	Priority 4	Vulnerable	-	-	-	-	-	-	*	-
Stenanthemum poicilum	Priority 3	-	-	-	-	-	-	-	*	-
Stylidium pendulum	Priority 1	-	-	-	-	-	-	-	*	-
Stylidium scintillans	Threatened (Vulnerable)	-	-	-	-	-	-	-	*	-
Triglochin protuberans	Priority 3	-	-	-	-	-	-	-	*	-
Triodia bromoides	Priority 4	-	-	-	-	-	-	-	*	-
Verticordia cooloomia	Priority 3	-	-	-	-	-	-	-	*	-
Verticordia jamiesonii	Priority 3	-	-	-	-	-	-	-	*	-
Verticordia lepidophylla var. *quantula*	Priority 1	-	-	-	-	-	-	-	*	-
Verticordia penicillaris	Priority 4	-	-	-	-	*	-	-	-	-
Wurmbea murchisoniana	Priority 4	-	-	-	-	-	-	-	*	-

4.3.4.4 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The DBCA maintain a database of Threatened and Priority Ecological Communities (TECs and PECs) and their locations. A search of this database was undertaken on 8th September 2017 for known TEC and PEC records within a 50 km buffer of the Yogi Project Development Envelope. The search returned three vegetation PECs, as detailed in Table 11 and mapped in Figure 9.

The boundary of the DBCA polygon for the Priority 1 PEC called “Yalgoo Banded Ironstone Formation (BIF)” intersects the western tenements.

FIJV intend to undertake appropriate studies to determine potential impacts to PEC’s resulting from the project.

Table 11: Priority Ecological Communities
(Department of Biodiversity, Conservation and Attractions, 2017b)

Short Name	Community Name	Priority	Buffer (m)*	Distance from tenements (km)
Gullewa BIF	Gullewa vegetation complexes (banded ironstone formation)	Priority 1	500	37.3
Minjar and Chulaar Hills BIF	Minjar and Chulaar Hills vegetation complexes (banded ironstone formation)	Priority 1	500	34.7
Yalgoo BIF	Yalgoo vegetation complexes (banded ironstone formation)	Priority 1	500	Intersects

4.3.4.5 INTRODUCED FLORA

A EPBC Protected Matters Search conducted on the 18th August for a 50 km buffer of the Yogi Mine Development Envelope (Appendix A) listed two invasive flora as potentially occurring in the area. These species are either a Weed of National Significance (WoNS) or an introduced plant considered to pose a particularly significant biodiversity threat. These are:

- *Carrichtera annua* (Ward's Weed)
- *Cenchrus ciliaris* (Buffel-grass, Black Buffel-grass).

4.3.5 PROPOSAL ACTIVITIES

Activities that may impact on flora and vegetation include:

- Clearing of terrestrial vegetation (e.g. mining and infrastructure development areas);
- Excavation and construction activities;
- Groundwater abstraction;
- Drainage diversions;
- Operational activities (e.g. mining, vehicle movement);
- Storage and handling of contaminants (hydrocarbons and chemicals); and
- Altered fire regimes.

4.3.6 MITIGATION

The mitigation hierarchy will be applied as described below:

- Avoid:
    - Identify and map the distribution of any conservation significant flora / vegetation / community within or near the Development Envelopes (building on the contextual information provided through previous flora studies and database searches).
    - Identify and map the distribution of any groundwater dependent vegetation / community potentially affected by groundwater abstraction.
    - Identify and map the distribution of any weeds within the Development Envelope.
    - Avoid (where feasible) direct and indirect flora and vegetation of conservation significance.
- Minimise:
    - Minimise the disturbance footprint during the study and mine planning phase.
    - Minimise direct and indirect flora and vegetation of conservation significance.
    - Identify any PAF materials that could be present in mining wastes and develop an appropriate management and disposal strategy.
    - Undertake a Hydrocarbon and Chemical Spill Risk Assessment and implement, as appropriate, a Hydrocarbon and Chemical Spill Management Plan
    - Implement vehicle hygiene procedures to prevent the introduction and spread of weeds.
    - Develop of a vegetation monitoring and management plan, with trigger and threshold levels and actions, to ensure no significant detrimental impact results from dust deposition or groundwater abstraction.

- Rehabilitate:
    - The area will be rehabilitated at the end of the project life in accordance with the Mine Closure Plan (to be submitted with the Mining Proposal to the DMIRS).

4.3.7 IMPACTS

Potential impacts to flora and vegetation include:

- Direct loss of vegetation and conservation significant flora through clearing (area to be reviewed during EIA process)
- Indirect impacts resulting from:
    - Introduction and spread of weeds
    - Dust deposition causing localised vegetation stress
    - Altered hydrology (groundwater abstraction, drainage diversions altering surface water flows)
    - Erosion
    - Fire
    - Contamination through:
        - Potentially Acid Forming (PAF) materials
        - Hydrocarbon spills from mining and transport equipment
        - Chemical spills
        - Waste disposal

Vegetation clearing will be required for the various project components. The maximum footprint of the project will be:

- 3,100 ha within the 9,140 ha Development Envelope for mining, processing and associated infrastructure.
- 1500 ha within the 383,850 ha Pipeline Development Envelope for magnetite, water and gas pipelines.

The project will likely result in clearing (not yet quantified) of Priority Flora species *Acacia subsessilis* (Priority 3) and *Dodonaea amplisemina* (Priority 4) and potential direct or indirect impacts to *Acacia speckii* (Priority 4) *Gunniopsis divisa* (Priority 3) and *Verticordia penicillaris* (Priority 4).

The project may result in direct or indirect impacts (not yet quantified) to the Priority 1 PEC “Yalgoo Banded Ironstone Formation (BIF)”.

FIJV intend to undertake appropriate studies to determine potential impacts to these priority flora species and PEC.

The pipelines will be located in cleared road reserves or other cleared corridors to avoid intersecting native vegetation and fauna habitat as far as practicable. Where intersection of native vegetation is deemed necessary, appropriate flora and fauna studies will be conducted to determine site specific flora and fauna values and develop management measures

Cleared areas will be appropriately rehabilitated.

4.3.8 ASSUMPTIONS

Surveys and studies will be undertaken by specialist consultants to ensure an appropriate level of independent rigour and ensure that EPA guidance, methodologies and industry standards have been adopted. Study assumptions will be documented within resulting reports.

4.4 SUBTERRANEAN FAUNA

4.4.1 EPA OBJECTIVE

To protect subterranean fauna so that biological diversity and ecological integrity are maintained.

4.4.2 POLICY AND GUIDANCE

- *Environmental Factor Guideline - Subterranean Fauna* (Environmental Protection Authority, 2016f).
- *Statement of Environmental Principles, Factors and Objectives* (Environmental Protection Authority, 2016k).
- *Technical Guidance - Sampling methods for subterranean fauna* (Environmental Protection Authority, 2016m).
- *Technical Guidance - Subterranean fauna survey* (Environmental Protection Authority, 2016p).
- *WA Environmental Offsets Guidelines* (Government of Western Australia, 2014).
- *WA Environmental Offsets Policy* (Government of Western Australia, 2011).

4.4.3 CONSULTATION

Consultation with regulatory agencies, stakeholders and the community will be required regarding:

- studies proposed;
- methodology of studies;
- results of studies;
- predicted impacts;
- proposed management measures; and
- residual impacts and risks.

Consultation to date has included broad information provision to stakeholders.

4.4.4 RECEIVING ENVIRONMENT

As described in the *Environmental Factor Guideline - Subterranean Fauna* (Environmental Protection Authority, 2016f), subterranean fauna live their entire lives (obligate) below the surface of the earth, and may be defined as stygofauna (aquatic and living in groundwater) or troglofauna (air-breathing and living in caves and voids). Subterranean fauna often display evolutionary adaptations to underground life, such as reduced pigment (pale colouring or transparent) and reduced, poorly functioning or non-existent eyes.

> *"The presence of subterranean fauna is strongly linked to geology and hydrology and the availability of suitable micro-habitats, e.g. air-filled voids or caves for troglofauna, and aquifers that are not hypersaline for stygofauna. Despite these known associations between subterranean fauna, geology and hydrology, it can be difficult to predict the presence of subterranean fauna with confidence due to the lack of understanding of habitat requirements".*
> (Environmental Protection Authority, 2016f).

The DBCA maintain a database of Threatened and Priority Ecological Communities (TECs and PECs) and their locations. A search of this database was undertaken on 8th September 2017 for known TEC and PEC records within a 50 km buffer of the Yogi Project Development Envelope. The search returned five subterranean fauna PECs, as detailed in Table 12 and mapped in Figure 9.

The DBCA polygon for the Priority 1 Subterranean Fauna PEC called "Wagga Wagga and Yalgoo Calcrete" occurs approximately 4.7 km southwest of the tenements (Figure 9).

A further 3 Subterranean Fauna PEC's occur from 22 - 37 km to the southwest of the tenements (Figure 9, Table 12).

No subterranean fauna surveys have been conducted for the Yogi Mine.

Table 12: Priority Ecological Communities
(Department of Biodiversity, Conservation and Attractions, 2017b)

Short Name	Community Name	Priority	Buffer (m)*	Distance from tenements (km)
Badja Calcrete	Badja calcrete groundwater assemblage type on Moore palaeodrainage on Badja Station	Priority 1	2000	38.6
Bunnawarra Calcrete	Bunnawarra calcrete groundwater assemblage type on Moore palaeodrainage on Bunnawarra Station	Priority 1	2000	36.0
Gabyon Calcrete	Gabyon calcrete groundwater assemblage type on Moore palaeodrainage on Gabyon Station	Priority 1	2000	22.1
Muralgarra Calcrete	Muralgarra calcrete groundwater assemblage type on Murchison palaeodrainage on Muralgarra Station	Priority 1	2000	33.3
Wagga Wagga and Yalgoo Calcrete	Wagga Wagga and Yalgoo calcrete groundwater assemblage type on Yalgoo palaeodrainage on Wagga Wagga Station and Moore Palaeodrainage on Yoweragabbie Station	Priority 1	2000	4.7

4.4.5 PROPOSAL ACTIVITIES

Activities that may impact upon subterranean fauna include:

- Mining of the subterranean environment;
- Groundwater abstraction;
- Storage and use of contaminants;
- Disposal of PAF materials.

4.4.6 MITIGATION

The mitigation hierarchy will be applied as described below:

- Avoid:
    - Conduct troglofauna and stygofauna fauna surveys to identify subterranean taxa occurring within the project area of influence.
    - Identify and map the troglofauna and stygofauna species and habitat present.
    - Assess the local and regional conservation significance of troglofauna and stygofauna from the above studies).
    - Avoid disturbance of troglofaunal and stygofauna habitat where possible.
    - Avoid groundwater drawdown in areas of significant stygofauna habitat.
    - Identify any PAF materials that could be present in mining wastes and develop an appropriate management and disposal strategy to avoid acid generation.
- Minimise:
    - Minimise disturbance of troglofaunal and stygofauna habitat where avoidance is not possible.
    - Avoid groundwater drawdown in areas of stygofauna habitat where avoidance is not possible.
    - Backfill of mine pits to assist where possible to retain troglofaunal habitat.
    - Monitor and minimise groundwater drawdown to maintain stygofauna habitat.
    - Monitor groundwater quality to maintain stygofauna habitat.
    - Prepare and implement a monitoring and management programme, with trigger and threshold levels and actions.
    - Undertake a Hydrocarbon and Chemical Spill Risk Assessment and implement, as appropriate, a Hydrocarbon and Chemical Spill Management Plan
- Rehabilitate:
    - The area will be rehabilitated at the end of the project life in accordance with the Mine Closure Plan (to be submitted with the Mining Proposal to the DMIRS).

4.4.7 IMPACTS

Potential impacts to subterranean fauna include:

- Removal of habitat
- Drawdown of groundwater
    - Groundwater extraction
    - Dewatering below water table

- Excavation of geologies supporting subterranean fauna
- Contamination of subterranean environment / altered groundwater chemistry through
    - Inappropriate disposal of PAF materials
    - Hydrocarbon and chemical spills
    - Intrusion of saline water into freshwater aquifers

The Proposal may result in the direct mortality of subterranean fauna and reduction in subterranean habitat due to pit excavation and groundwater drawdown. These impacts are expected to be localised to the pit area and drawdown areas.

The risk of contamination is considered low if appropriate prevention and management measures are implemented.

The proponent intends to conduct subterranean fauna studies and hydrogeological modelling to assess and minimise potential impacts to subterranean fauna.

4.4.8 ASSUMPTIONS

Surveys and studies will be undertaken by specialist consultants to ensure an appropriate level of independent rigour and ensure that EPA guidance, methodologies and industry standards have been adopted. Study assumptions will be documented within resulting reports.

4.5 TERRESTRIAL ENVIRONMENTAL QUALITY

4.5.1 EPA OBJECTIVE

To maintain the quality of land and soils so that environmental values are protected.

4.5.2 POLICY AND GUIDANCE

- *Environmental Factor Guideline: Terrestrial Environmental Quality* (Environmental Protection Authority, 2016g).
- *Guidance Statement 6 – Rehabilitation of Terrestrial Ecosystems* (Environmental Protection Authority, 2006).
- *Statement of Environmental Principles, Factors and Objectives* (Environmental Protection Authority, 2016k).
- *WA Environmental Offsets Guidelines* (Government of Western Australia, 2014).
- *WA Environmental Offsets Policy* (Government of Western Australia, 2011).

4.5.3 CONSULTATION

Consultation with regulatory agencies, stakeholders and the community will be required regarding:

- studies proposed;
- methodology of studies;
- results of studies;
- predicted impacts;

- proposed management measures; and
- residual impacts and risks.

Consultation to date has included broad information provision to stakeholders.

4.5.4 RECEIVING ENVIRONMENT

4.5.4.1 SOILS

Figure 10a shows soil landscape mapping within the tenements from the soil landscapes mapping dataset (Department of Primary Industries and Regional Development, 2017). The mapping conforms to a nested hierarchy established to deal with the varying levels of information resulting from the variety of mapping scales (Payne & Schoknecht, 2011).

The Development Envelope intersects four soil-landscapes systems (Figure 10a) as described in Table 13 below.

Table 13: Soil-Landscapes (at Land System scale) intersecting the Development Envelope

Land System	Description
273Ch (Challenge)	Gently undulating gritty-surfaced plains, occasional granite hills, tors and low breakaways, with acacia shrublands.
270Ga (Gabanintha)	Ridges, hills and footslopes of various metamorphosed volcanic rocks (greenstones), supporting sparse acacia and other mainly non-halophytic shrublands.
273Ha (Hamilton)	Hardpan plains, stony plains and incised drainage lines supporting mulga shrublands.
273Ti (Tindalarra)	Near level hardpan wash plains, narrow drainage lines and moderately saline drainage floors; supporting tall mixed acacia shrublands with wanderrie grasses, also minor saltbush/bluebush low shrublands.

The Pipeline Development Envelope covers a large number of soil types as presented in Figure 10b with the soil-land system descriptions (for soil units intersecting the Pipeline Development Envelope) in the accompanying legend.

4.5.4.2 ACID SULPHATE SOILS

Background Information

Potentially Acid Forming Material (PAFM) is naturally occurring soil or rock which contains iron sulfides, most commonly pyrite. When PAFM is exposed to air the iron sulfides in the soil react with oxygen and water to produce a variety of iron compounds and sulfuric acid. The resulting acid can release other substances, including heavy metals, from the soil and into the surrounding environment. These materials are characterised by bright yellow or straw coloured mottles of the mineral jarosite and often contain dark reddish coloured streaks (Department of Environment, 2003).

For PAFM to present a risk of acid generation, it needs to contain iron sulfides and/or other sulfidic minerals that have not been oxidised (by exposure to air), due to waterlogging. The waterlogged layer may be rock, peat, clay, loam or silty sand. PAFM are not known to be associated with

environmental problems in their undisturbed state. While the natural exposure of such soils or sediments to air (e.g. during severe droughts) is associated with the generation of acid, the acidity tends to occur as low frequency, low magnitude, short duration events after drought breaking rains (Department of Environment, 2003).

If disturbed, PAFM have the capacity to directly impact upon the basic natural assets of soil, water, biota and air, and thus upon most human endeavours, including agriculture, fishing, aquaculture, recreation, tourism, as well as human health and visual amenity. Impacts can include:

- Soil acidification
- Degradation of water-dependent ecosystems and ecosystem services
- Loss of habitat and biodiversity
- Invasion and dominance of wetlands.

PAF Material Occurrence and Management

The entire Yogi Project Development Envelope lies within an area mapped as low acid sulphate soil probability (CSIRO Land and Water, 2013; 2017), comprising the zone “Kandosols, Ferrosols, Tenosols, Rudosols, Podosols and Kurosols”, where acid sulphate soils generally occur within the upper 1 m in wet / riparian area (Fitzpatrick, Powell, & Marvanek, 2011) – Figure 11.

It is possible that waste rock generated by the mining process may contain PAF. This will be further investigated as part of ongoing exploration work. If PAF material exists within the waste rock, it will be appropriately disposed in a dedicated facility which is constructed in a way which will prevent acid generation.

The Pipeline Development Envelope is predominantly the same zone and probability with some areas of potential high probability coinciding with surface water bodies (Figure 11). Acid sulphate soil risk will be considered and appropriate managed as part of pipeline route planning and construction strategies.

4.5.4.3 GEOLOGY

Surface geology units (1M) of the Yogi Project Development Envelope and immediate vicinity are shown in Figure 12a and described in Table 14 below (Geological Survey of WA, 2017). Only geology units Ady, Agh, Asy and Qrc intersect the Development Envelope.

Table 14: Surface Geology

Unit	Description
Ady*	Mafic intrusive rocks, medium to coarse-grained; layered mafic to ultramafic intrusions; metadolerite; medium to coarse-grained metagabbro, dolerite and granophyre, local ultramafic bases
Asy*	Conglomerate, chert, small amounts felsic volcaniclastic rocks, sandstone, quartzite, siltstone, phyllite, schist, pelite, shale. Includes the former Hatfield Formation.
Agh*	Monzogranite, granodiorite, tonalite, quartz monzonite; in places recrystallised and foliated; some mixed granite and country rock assemblages; high-Ca granite
Qrc*	Colluvium and/or residual deposits, sheetwash, talus, scree; boulder, gravel, sand; may include minor alluvial or sand plain deposits, local calcrete and reworked laterite

Unit	Description
Aby	Metabasalt, high-Mg basalt, tholeiitic basalt, carbonated basalt, agglomerate, mafic schist, dolerite, amphibolite; porphyritic basalt and dolerite; komatiitic basalt; mafic pyroclastics; minor mafic schist with granite intercalations
Adyw	Layered intrusion - some original minerals preserved
Aey	Metamorphosed komatiite, pyroxenite, chlorite-tremolite schist, talc-chlorite schist, anthophyllite-tremolite-talc rock; olivine-cummingtonite schist; talc-carbonate-tremolite-chlorite rock, serpentinite; amphibole schist after pyroxenite
Afy	Felsic volcanic and volcaniclastic rocks, locally amygdaloidal or fragmental; dacite, quartz-feldspar porphyry, tuff, agglomerate, andesitic lava, quartz-muscovite schist, felsic schist, felsic gneiss
Agl	Syenogranite, alkali-feldspar granite, monzogranite; in places recrystallised; some mixed granite and country rock assemblages; low-Ca granite
Aty	Amphibolite, mafic schist, mafic rock intercalated with granite, para-amphibolite; metabasalt, metagabbro, metapyroxenite and metadolerite; Youanmi Terrane
Ayy	Metasandstone, metashale, metasiltstone, metaconglomerate and meta-volcaniclastics, pelitic schists, phyllite, fuchsitic quartzite with clasts quartzite and felsic volcanic rock; quartzite; pelitic and psammitic gneiss
Qa	Channel and flood plain alluvium; gravel, sand, silt, clay; may be locally calcreted

*** Intersects Development Envelope**

The Pipeline Development Envelope covers a number of surface geology types as presented in Figure 12b with the surface geology descriptions (for geology units intersecting the Pipeline Development Envelope) in the accompanying legend (Geological Survey of WA, 2017).

4.5.5 PROPOSAL ACTIVITIES

Activities that may impact upon terrestrial environmental quality:

- Mining areas and related infrastructure (where any terrestrial soil is to be disturbed);
- Excavation and construction activities;
- Operational activities (e.g. mining, vehicle movement);
- Storage and handling of contaminants (hydrocarbons and chemicals); and
- Waste disposal.

4.5.6 MITIGATION

The mitigation hierarchy will be applied as described below:

- Avoid:
  - Areas of high risk for acid sulphate soils will be avoided where possible.
  - Characterisation of overburden and waste rock properties, in particular acid generating properties and management of PAF to prevent acid generation.
- Minimise:
  - Define hazardous materials to be generated/stored/transported and broad management, storage and disposal methods.
  - Develop detailed Management Plans for the procurement, storage, use, transport and disposal of hazardous substances and materials.
  - Define quality of dewatering water, its likely utilisation on site and disposal quantities/methods.

- Develop detailed Waste Management Plan for the management and disposal of all wastes.
- Prepare and implement a monitoring and management programme, with trigger and threshold levels and actions.
- Undertake a Hydrocarbon and Chemical Spill Risk Assessment and implement, as appropriate, a Hydrocarbon and Chemical Spill Management Plan

- Rehabilitate:
  - The area will be rehabilitated at the end of the project life in accordance with the Mine Closure Plan (to be submitted with the Mining Proposal to the DMIRS).

4.5.7 IMPACTS

Potential impacts to terrestrial environmental quality include:

- Contamination through:
  - Disturbance of acid sulphate soils.
  - Inappropriate PAF material management and disposal.
  - Hydrocarbon spills from generators, mining, processing and transport equipment.
  - Inappropriate waste disposal

With appropriate management measures implemented the risk of the above impacts occurring is low.

4.5.8 ASSUMPTIONS

Surveys and studies will be undertaken by specialist consultants to ensure an appropriate level of independent rigour and ensure that EPA guidance, methodologies and industry standards have been adopted. Study assumptions will be documented within resulting reports.

4.6 TERRESTRIAL FAUNA

4.6.1 EPA OBJECTIVE

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

4.6.2 POLICY AND GUIDANCE

- *Environmental Factor Guideline: Terrestrial Fauna* (Environmental Protection Authority, 2016).
- *Technical Guidance: Terrestrial fauna surveys* (Environmental Protection Authority, 2016).
- *Technical Guidance: Sampling methods for terrestrial vertebrate faun*a (Environmental Protection Authority, 2016).
- *Technical Guidance - Sampling of short range endemic invertebrate fauna* (Environmental Protection Authority, 2016).
- *Significant impact guidelines for 36 migratory shorebird species (EPBC Act Policy Statement 3.21)* (Department of the Environment, Water, Heritage and the Arts, 2009).
- *Survey Guidelines for Australia's Threatened Bats* **Invalid source specified.**.
- *Survey Guidelines for Australia's Threatened Birds***Invalid source specified.**.

- *Survey Guidelines for Australia's Threatened Mammals* (Department of Sustainability, Environment, Water, Population and Communities, 2011).
- *Survey Guidelines for Australia's Threatened Reptiles* (Department of Sustainability, Environment, Water, Population and Communities, 2011).
- *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Department of the Environment and Energy, 2017).
- *National Recovery Plan for the Northern Quoll Dasyurus hallucatus* (Hill & Ward, 2010).
- *Threat Abatement Plan for Predation by the European Red Fox* (Department of the Environment, Water, Heritage and the Arts, 2008).
- *Threat abatement plan for predation by feral cats* (Department of the Environment, 2015).
- *WA Environmental Offsets Policy* (Government of Western Australia, 2011).
- *WA Environmental Offsets Guidelines* (Government of Western Australia, 2014).
- "Appendix B: Potentially contaminating industries, activities and land uses" in *Assessment and management of contaminated sites: Contaminated sites guidelines* (Department of Environmental Regulation, 2014).

4.6.3 CONSULTATION

Consultation with regulatory agencies, stakeholders and the community will be required regarding:

- studies proposed;
- methodology of studies;
- results of studies;
- predicted impacts;
- proposed management measures; and
- residual impacts and risks.

Consultation to date has included broad information provision to stakeholders.

4.6.4 RECEIVING ENVIRONMENT

4.6.4.1 TERRESTRIAL CONSERVATION SIGNIFICANT FAUNA

Previous Fauna Surveys

Previous fauna studies covering a small portion of the tenements (ATA Environmental, 2006 and (Coffey Environments, 2008), recorded the presence of the Rainbow Bee-eater (*Merops ornatus*), declared as Schedule 5 (Migratory) under the *Wildlife Conservation (Rare Fauna) Notice 2016*. Refer to Table 15 and survey areas are shown in Figure 13.

Table 15: Previous Yogi Mine Fauna Studies

Survey Date	Area	Type	Company	Results
14 June 2006	Tenements: P59/1508, E59/642, P59/1397	Fauna - Reconnaissance	(ATA Environmental, 2006b)	No Threatened or Priority species were recorded. 7 conservation significant species could be present
21 - 27 Nov 2007 & 5 - 11 Feb 2008	Tenements: P59/1508, E59/642, P59/1397	Level 2 Fauna Survey	(Coffey Environments, 2008)	1 conservation significant species recorded 7 conservation significant species likely be present

Database searches

Database searches for conservation significant fauna included:

- A EPBC Protected Matters Search was conducted on the 18th August 2016 for a 50 km buffer of the Yogi Project Development Envelope (Appendix A) (Department of the Environment and Energy, 2017a).
- A search was undertaken on the 30th August 2017 of the DBCA's Threatened and Priority Fauna Database within 50 km of the Yogi Project Development Envelope (Department of Biodiversity, Conservation and Attractions, 2017c).

These searches determined 26 fauna species of conservation significance may be present 25 of which are listed under State regulation and 17 under Federal regulation. Endangered or critically endangered species from the database search include the Black-flanked Rock-Wallaby, Night Parrot and Minnivale trapdoor spider, whilst vulnerable species include the Western Spiny-tailed Skink, Gilled Slender Blue-tongue, Chuditch, Malleefowl, Shield-backed Trapdoor Spider and Curlew Sandpiper.

The results of these searches are presented in Table 16 and Figure 13.

Table 16: Conservation significant fauna (Database search results)
(Department of Biodiversity, Conservation and Attractions, 2017c; Department of the Environment and Energy, 2017a)

Common Name	Species Name	State Status	EPBC Act Status	DBCA	EPBC
Reptiles					
Western Spiny-tailed Skink	*Egernia stokesii badia*	Schedule 3 (Vulnerable)	Endangered	*	*
Gilled Slender Blue-tongue	*Cyclodomorphus branchialis*	Schedule 3 (Vulnerable)	-	*	-
Mammals					
Chuditch	*Dasyurus geoffroii*	Schedule 3 (Vulnerable)	Vulnerable	-	*
Western Brush Wallaby	*Macropus irma*	Priority 4	-	*	-
Black-flanked Rock-Wallaby	*Petrogale lateralis lateralis*	Endangered	Endangered	*	-

Common Name	Species Name	State Status	EPBC Act Status	DBCA	EPBC
Long-tailed Dunnart	*Sminthopsis longicaudata*	Priority 4	-	*	-
Birds					
Common Sandpiper	*Actitis hypoleucos* (previously: *Tringa hypoleucos*)	Schedule 5 (Migratory)	Migratory, Marine	-	*
Western Grasswren	*Amytornis textilis textilis*	Priority 4	-	*	-
Fork-tailed Swift	*Apus pacificus*	Schedule 5 (Migratory)	Migratory, Marine	*	*
Cattle Egret	*Ardea ibis*	Schedule 5 (Migratory)	Marine	-	*
Great Egret	*Ardea modesta* (previously: *Ardea alba*)	Schedule 5 (Migratory)	Marine	*	*
Sharp-tailed Sandpiper	*Calidris acuminata*	Schedule 5 (Migratory)	Migratory, Marine	*	*
Curlew Sandpiper	*Calidris ferruginea*	Schedule 3 (Vulnerable), Schedule 5 (Migratory)	Critically Endangered, Migratory, Marine	-	*
Pectoral Sandpiper	*Calidris melanotos*	Schedule 5 (Migratory)	Migratory, Marine	-	*
Peregrine Falcon	*Falco peregrinus*	Schedule 7 (Other Specially Protected)	-	*	-
Malleefowl	*Leipoa ocellata*	Schedule 3 (Vulnerable)	Vulnerable	*	*
Rainbow Bee-eater	*Merops ornatus*	Schedule 5 (Migratory)	Marine	*	*
Grey Wagtail	*Motacilla cinerea*	Schedule 5 (Migratory)	Migratory, Marine	-	*
Blue-billed Duck	*Oxyura australis*	Priority 4	-	*	-
Night Parrot	*Pezoporus occidentalis*	Schedule 1 (Critically Endangered)	Endangered	*	*
Hooded Plover	*Thinornis rubricollis*		Marine	-	*
Common Greenshank	*Tringa nebularia*	Schedule 5 (Migratory)	Migratory, Marine	*	*
Masked Owl (southwest)	*Tyto novaehollandiae novaehollandiae*	Priority 3	-	*	-
Invertebrates					
a fairy shrimp	*Branchinella wellardi*	Priority 1	-	*	-
Shield-backed Trapdoor Spider	*Idiosoma nigrum*	Schedule 3 (Vulnerable)	Vulnerable	*	*
Minnivale trapdoor spider	*Teyl* sp. (BY Main 1953/2683, 1984/13)	Schedule 1 (Critically Endangered)	-	*	-

4.6.4.2 INTRODUCED FAUNA

A EPBC Protected Matters Search conducted on the 18th August for a 50 km buffer of the Yogi Project Development Envelope (Appendix A) (Department of the Environment and Energy, 2017a) listed five feral fauna species as potentially occurring in the area. These are:

- *Columba livia* (Rock Pigeon)
- *Streptopelia senegalensis* (Laughing Turtle-dove)
- *Capra hircus* (Goat)
- *Felis catus* (Domestic Cat)
- *Mus musculus* (House Mouse)
- *Oryctolagus cuniculus* (Rabbit)
- *Vulpes vulpes* (Red Fox).

The fauna assessment conducted by Coffey Environments (2008) found that general habitat of the area is in poor condition having been grazed over a long period by sheep, as well as supporting a large number of feral animals including goats, cats, foxes and wild dogs.

Neighbouring Wagga Wagga pastoral station (Figure 4) was recently destocked of sheep due to an "escalating wild dog problem" (Shire of Yalgoo, 2017a) and wild dog sightings around mine sites and camps are also reportedly increasing, with local pastoralists and mining companies contracting professional Doggers to control numbers (The Shire of Yalgoo, 2017b). A 480 km vermin proof-fence, meeting the existing State barrier fences, is underway, aiming to enclose a 7.5 million hectare area (The Shire of Yalgoo, 2017b).

4.6.5 PROPOSAL ACTIVITIES

Activities that may impact upon the receiving environment include:

- Clearing of vegetation (fauna habitat) (e.g. mining and related infrastructure areas);
- Excavation and construction activities;
- Roads;
- Any other habitat areas impacted by the proposal;
- Groundwater abstraction;
- Drainage diversions;
- Operational activities (e.g. mining, vehicle movement, noise and lighting);
- Storage and handling of contaminants (hydrocarbons and chemicals);
- Altered fire regimes; and
- Waste disposal.

4.6.6 MITIGATION

The mitigation hierarchy will be applied as described below:

- Avoid:
    - Conducted appropriate vertebrate fauna and habitat surveys of the project areas.
    - Conduct an appropriate short-range endemic (SRE) survey.
    - Identify and record the location of any rare or priority fauna (and/or significant fauna habitat) found across the project area.
    - Avoid disturbance of any significant fauna habitat (identified through the above studies).
    - Fencing to prevent fauna access to mine pit and operational areas.
    - Ensure all drill holes are capped and recorded.
    - Aligning access routes with existing roads, tracks and other barriers (where possible).
- Minimise:
    - Prepare and implement a Fauna Management Plan that addresses issues such as:
        - minimising vegetation clearing and habitat fragmentation;
        - limiting and controlling fires;
        - weed management;
        - waste management;

        - appropriate waste management to ensure that feral or other animals are not attracted to the site;
        - minimising dust, noise, vibration and spillage of light into adjacent areas;
        - placing physical barriers around mining voids and waste facilities;
        - minimising road fauna deaths; and
        - a feral animal monitoring and control program.
    - Implement a staff induction program to make staff aware of the on-site protection and preservation of fauna.
    - Implement an appropriate speed limit on site, with cautionary signage erected to indicate the potential for wildlife crossing roads.
- Rehabilitate:
    - The area will be rehabilitated at the end of the project life in accordance with the Mine Closure Plan (to be submitted with the Mining Proposal to the DMIRS).

4.6.7 IMPACTS

Potential impacts to fauna and habitat include:

- Direct impacts resulting from:
    - Habitat loss, degradation or fragmentation as a result of vegetation clearing for mining and ancillary infrastructure (area to be reviewed during EIA process).
    - Loss or injury of fauna during clearing or as a result of vehicle and/or equipment strikes.
    - Fauna entrapment in excavated pits, trenches and behind fences.
- Indirect impacts resulting from:
    - Habitat loss, degradation or fragmentation as a result of:
        - Introduction and/or spread of weeds
        - Disturbance from operational activities (noise, light, vibration, dust etc.)
        - Altered fire regimes
        - Altered hydrology (groundwater abstraction, drainage diversions, altering surface water flows)
        - Contamination (hydrocarbon spills, mining and domestic wastes, disturbance of acid sulphate soils).
    - Loss or injury of fauna as a result of altered fire regimes.
    - Altered fauna behaviour as a result of noise, lighting, access to water and food waste.
    - Increase in feral fauna placing predation and competition pressure upon native fauna
    - Barrier effects caused by project infrastructure and the impacts of habitat and population fragmentation.

With appropriate management measures the above impacts should not be significant.

4.6.8 ASSUMPTIONS

Surveys and studies will be undertaken by specialist consultants to ensure an appropriate level of independent rigour and ensure that EPA guidance, methodologies and industry standards have been adopted. Study assumptions will be documented within resulting reports.

4.7 HYDROLOGICAL PROCESSES

4.7.1 EPA OBJECTIVE

To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

4.7.2 POLICY AND GUIDANCE

- *Environmental Factor Guideline: Hydrological Processes* (Environmental Protection Authority, 2016c).
- *Statement of Environmental Principles, Factors and Objectives* (Environmental Protection Authority, 2016k).
- *Australian groundwater modelling guidelines (Waterlines Report Series No. 82)* (Barnett, et al., 2012).
- *Operational Policy 5.12 - Hydrogeological reporting associated with a groundwater well licence* (Department of Water, 2009).
- *Rights in Water and Irrigation Act 1914*.
- *Western Australia water in mining guideline (Water licensing delivery report series: Report No. 12)* (Department of Water, 2013).
- *A Directory of Important Wetlands in Australia* (Australian Nature Conservation Agency, 1993).
- *WA Environmental Offsets Policy* (Government of Western Australia, 2011).
- *WA Environmental Offsets Guidelines* (Government of Western Australia, 2014).

4.7.3 CONSULTATION

Consultation with regulatory agencies, stakeholders and the community will be required regarding:

- studies proposed;
- methodology of studies;
- results of studies;
- predicted impacts;
- proposed management measures; and
- residual impacts and risks.

Consultation to date has included broad information provision to stakeholders.

4.7.4 RECEIVING ENVIRONMENT

4.7.4.1 TOPOGRAPHY

A Digital Elevation Model (DEM) was used for mapping of topography of the Yogi Project Development Envelope, as shown in Figure 14. The topography of the Yogi Project Development Envelope ranges from 331 to 455 m AHD.

4.7.4.2 CLIMATE

The climate of the Yalgoo area varies from semiarid to Mediterranean. The Yalgoo Bureau of Meterology (BOM) site (7091) located in the town of Yalgoo has recorded meteorological statistics since 1896. The area records hot dry summers with mean maximum temperatures around 36°C and mean monthly rainfall of 8 – 15 mm. Winters are cool with mean maximum temperatures around 19°C and minimum temperatures around 7°C, with mean monthly rainfall of 25 – 41 mm. Climate data is summarised in the table below (Bureau of Meteorology, 2017).

Table 17: Climate Statistics BOM Site 7091 Yalgoo

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Mean maximum temperature (°C)	37.2	36.3	33.5	28.5	23.0	19.2	18.2	20.0	24.0	27.5	32.1	35.5	27.9	78	1897 1975
Mean minimum temperature (°C)	20.7	20.7	18.6	14.5	10.1	7.7	6.2	6.8	8.7	11.4	15.2	18.4	13.2	79	1897 1975
Rainfall															
Mean rainfall (mm)	15.8	25.0	25.0	20.7	31.6	41.3	34.8	25.5	11.7	8.1	8.0	11.8	258.0	103	1896 2014
Decile 5 (median) rainfall (mm)	8.6	11.9	10.2	8.6	24.1	35.6	29.0	20.5	8.9	4.2	3.0	5.3	239.9	103	1896 2014
Mean number of days of rain ≥ 1 mm	1.9	2.0	2.3	2.1	3.7	5.5	5.3	4.2	2.3	1.4	1.3	1.2	33.2	102	1898 2015

4.7.4.3 SURFACE WATER CATCHMENTS

Hydrographic catchment boundaries have been defined by the Department of Water (DoW) for more than 3400 key sites on watercourses throughout Western Australia. The sub-catchments dataset contains polygons from which the catchment boundaries are derived. The Yogi Project Development Envelope is within the Salt River (Yarra Yarra) subcatchment (Figure 15a) and the Yarra Monger catchment (Figure 17b). The Pipeline Development Envelope crosses the Coastal, Chapman River, Greenough River, Irwin River and Yarra Monger catchments (Figure 15b).

4.7.4.4 SURFACE FLOWS

The Development Envelope lies within a sloping gully (Figure 14 and Figure 16). Minor ephemeral creeks flow through minor depressions in the landscape across the Development Envelope. The general flow direct of these creeks is south west where water appears to pool in ephemeral lakes located approximately 8 km to the southwest of Development Envelope (Figure 16).

The Pipeline Development Envelope includes a number of major watercourses including Salt River, Butterabby Creek, Kockatea Gully, Greenough River and Chapman River (Figure 15b) (and many smaller flow paths). Pipeline design methods will include appropriate management of surface water flows to minimise impacts to surface water.

4.7.4.5 SURFACE WATER REGULATION

Approximately 3 km east of the Development Envelope is the Greenough River and Tributaries Catchment Area, a RIWI Proclaimed Surface Water Area (Figure 16). A Surface Water Area is proclaimed for the purposes of regulating the taking of water from watercourses and wetlands, and are areas from which the Water Corporation (or other service provider) may supply water to land owners for irrigation purposes. This means that the taking of water from creeks or rivers within the Surface Water Area cannot occur without an appropriate licence under the *Rights in Water and Irrigation (RIWI) Act, 1914*.

4.7.4.6 GROUNDWATER DEPTH

DWER maintains a Water Information Network (WIN) which provides groundwater monitoring information for available sites. Numerous WIN groundwater sites occur in the Yalgoo area, with 12 stock watering bores occurring within or in close proximity to the Development Envelope (Figure 17, Table 18). Depth to surficial groundwater in the local area ranges from 3.4 to 33.2 meters below ground level (mbgl). The mine pit depth will exceed these groundwater levels and therefore will need to be dewatered for mining to progress.

Table 18: Available Depth Data for Local Groundwater Bores

Id.	Easting	Northing	Depth of Groundwater (mbgl)	Details	Purpose
61812064	481665	6884958	33.223	Colluvium. Weathered granite. 1 tank, 2 troughs. Water table 109ft.	Livestock
61812065	476562	6882984	18.186	Colluvium. 1 tank, 1 trough. Pwd wa 3432 states wl at time of drilling 51ft.	Livestock
61812182	475265	6882540	19.507	Colluvium.	Not Available
61812067	481676	6879318	21.692	Colluvium. 1 tank, 1 trough.	Livestock
61812184	475577	6883026	Not Available	Not Available	Not Available
61812080	478084	6874534	21.641	2 tanks. 3 troughs. Colluvium.	Livestock
61812081	482637	6873379	10.82	1 tank, 1 trough.	Not Available
61812076	490800	6861594	3.353	2 tanks 3 troughs. Calcrete.	Livestock
61812068	488891	6867060	13.716	2 tanks 3 troughs.	Livestock
61812083	482806	6864200	8.738	1 tank 2 troughs. Colluvium/weathered basics.	Livestock
61812075	489269	6863854	5.969	1 tank, 2 troughs: colluvium.	Livestock
61812084	484018	6861440	13.056	2 tanks 3 troughs: laterite, weathered basics.	Livestock

Yalgoo Borefield, located in the Yalgoo Water Reserve (Figure 17), provides water to the Yalgoo scheme supply. The borefield is located approximately 4.5 km north-east of the townsite and abstracts water from an unconfined, fractured rock aquifer. FIJV reports that exploration drilling has encountered significant groundwater supplies in fractured bedrock. Hydrogeological investigations will be conducted during the EIA process with respect to mine dewatering and the water supplies available from this source and the proposed borefield (Figure 2).

4.7.4.7 GROUNDWATER REGULATION

The Yalgoo Water Reserve (Figure 17) was proclaimed in 1990 to help protect the public drinking water source from such contamination. Approximately 2 km to the south west of the Development Envelope is the boundary of the Yalgoo Water Reserve a Public Drinking Water Source protection area (Figure 17). The main objective of the Yalgoo Water Reserve is to protect the rainfall recharge area for the Yalgoo Town Borefield to ensure drinking water quantity and quality is not compromised by surrounding land uses Yalgoo Borefield, located in the Yalgoo Water Reserve, provides water to the Yalgoo scheme supply. The borefield is located approximately 4.5 km north-east of the townsite and abstracts water from an unconfined, fractured rock aquifer. The unconfined nature of the aquifer means the groundwater resource is vulnerable to contamination from land uses occurring within the borefield recharge area (Department of Water, 2010).

Wellhead protection zones (WHPZs) are defined to protect drinking water sources from contamination in the immediate vicinity of water extraction facilities. Specific conditions may apply within these zones such as restrictions on the storage of chemicals. They are generally circular (with a 500 m radius around each production bore in a P1 area. WHPZs do not extend outside the boundary of the water reserve. There are three bores within the Yalgoo Water Reserve. Each has a WHPZ with a 500m radius (see Figure 17).

As shown in Figure 17, the Development Envelope lies within the Gascoyne RIWI Proclaimed Groundwater Area. A Groundwater Area is proclaimed for the purposes of regulating the taking of groundwater, and are areas from which the Water Corporation (or other service provider) may supply water to land owners for irrigation purposes. This means that the taking of water from bores within the groundwater area cannot occur without an appropriate licence under the *Rights in Water and Irrigation (RIWI) Act, 1914*.

The Development Envelope also occurs within the Gascoyne – Mullewa Groundwater Management Unit (Figure 17). A Groundwater Management Unit (GMU) is a hydraulically connected groundwater system that is defined and recognised by State and Territory agencies. This definition allows for management of the groundwater resource at an appropriate scale at which resources issues and intensity of use can be incorporated into groundwater management practices.

4.7.5 PROPOSAL ACTIVITIES

Activities that may impact upon hydrological processes include:

- Drainage diversions;
- Pit dewatering;
- Groundwater abstraction; and
- Mining, excavation and construction activities.

4.7.6 MITIGATION

The mitigation hierarchy will be applied as described below:

- Avoid:
    - Broadly identify local hydrogeology characteristics in the project area.

- Broadly identify surface water catchments in the project area.
- Undertake a preliminary hydrogeology analysis of geological drilling data available.
- Undertake surface water quality and flow monitoring in the wet season.
- Undertake ongoing groundwater quality and level monitoring to understand seasonal fluctuations and groundwater flows.
- Undertake groundwater investigations.
- Develop a hydrogeological (groundwater) model for the project area.
- Develop a hydrological (surface water) model for the project area.
- Investigate the interaction of groundwater and surface water at the site.
- Identify potential impacts of the project (including the borefield and mine dewatering) including changes to groundwater levels, flows and quality.
- Identify potential impacts of the project on hydrological process and design the project to avoid these impacts.
- Groundwater assessment and modelling to determine sustainable groundwater abstraction levels and potential for contamination.
- Assess and avoid potential impacts to creeks, springs/soaks, salt lake ecology, water flats, vegetation and other users.

- Minimise:
  - Implement appropriate management measures to mitigate any potential impacts on surface water and groundwater hydrological processes and consequent impacts on the surrounding environment.
  - Monitoring of groundwater levels and abstraction rates (with ongoing validation of the hydrogeological modelling).
  - Monitoring of surface water hydrological processes.
- Rehabilitate:
  - The area will be rehabilitated at the end of the project life in accordance with the Mine Closure Plan (to be submitted with the Mining Proposal to the DMIRS).

4.7.7 IMPACTS

Potential impacts upon hydrological processes include:

- Mining and infrastructure and associated earthworks causing changes in surface water flows and consequential impacts including:
  - Erosion; could result in scouring of the landscape or loss of soil structure and topsoil therefore degrading adjacent habitat for native flora and fauna.
  - Water starving or excess inundation of ecosystems.
- Groundwater abstraction may impact upon neighbouring properties and other groundwater users, as well as subterranean fauna and groundwater dependent ecosystems.

The results of hydrology and hydrogeological modelling will be used to assess and mitigate potential impacts.

4.7.8 ASSUMPTIONS

Surveys and studies will be undertaken by specialist consultants to ensure an appropriate level of independent rigour and ensure that EPA guidance, methodologies and industry standards have been adopted. Study assumptions will be documented within resulting reports.

4.8 INLAND WATERS ENVIRONMENTAL QUALITY

4.8.1 EPA OBJECTIVE

To maintain the quality of groundwater and surface water so that environmental values are protected.

4.8.2 POLICY AND GUIDANCE

- *Environmental Factor Guideline: Inland Waters Environmental Quality* (Environmental Protection Authority, 2016d)
- *Environmental Factor Guideline: Hydrological Processes* (Environmental Protection Authority, 2016c).
- *Statement of Environmental Principles, Factors and Objectives* (Environmental Protection Authority, 2016k).
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, 2000).
- *Australian groundwater modelling guidelines (Waterlines Report Series No. 82)* (Barnett, et al., 2012).
- *Rights in Water and Irrigation Act 1914*.
- *State Water Quality Management Strategy No. 6: Implementation Framework for Western Australia for the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and Water Quality Monitoring and Reporting (Guidelines Nos. 4 & 7: National Water Quality Management Strategy) (Report No. SWQ 6)* (Government of Western Australia, 2004).
- *Western Australia water in mining guideline (Water licensing delivery report series: Report No. 12)* (Department of Water, 2013).
- "Appendix B: Potentially contaminating industries, activities and land uses" in *Assessment and management of contaminated sites: Contaminated sites guidelines* (Department of Environmental Regulation, 2014)
- *A Directory of Important Wetlands in Australia* (Environment Australia, 2001).

4.8.3 CONSULTATION

Consultation with regulatory agencies, stakeholders and the community will be required regarding:

- studies proposed;
- methodology of studies;
- results of studies;
- predicted impacts;
- proposed management measures; and
- residual impacts and risks.

Consultation to date has included broad information provision to stakeholders.

4.8.4 RECEIVING ENVIRONMENT

4.8.4.1 SURFACE WATER QUALITY

Surface water quality data is not available in the vicinity of the Development Envelope. It is likely that ephemeral creeks will be relatively fresh after rainfall replenishes them and the receiving low-lying lakes will accumulate salts due to evaporation processes.

Baseline surface water quality information will be collected during the EIA process.

4.8.4.2 GROUNDWATER QUALITY

DWER maintains a Water Information Network (WIN) which provides groundwater monitoring information for available sites. Numerous WIN groundwater sites occur in the Yalgoo area, with 12 stock watering bores occurring within or in close proximity to the Development Envelope (Figure 17, Table 19). Total Dissolved Solids (TDS) within the bores ranges from 1000 – 9600 mg/L and can be described as fresh to brackish.

Table 19: Available Water Quality Data for Local Groundwater Bores

Id.	Easting	Northing	Details	Purpose	TDS (in situ) mg/L
61812064	481665	6884958	Colluvium. Weathered granite. 1 tank, 2 troughs. Water table 109ft.	Livestock	1000
61812065	476562	6882984	Colluvium. 1 tank, 1 trough. Pwd wa 3432 states wl at time of drilling 51ft.	Livestock	1040
61812182	475265	6882540	Colluvium.	Not Available	1500
61812067	481676	6879318	Colluvium. 1 tank, 1 trough.	Livestock	1350
61812184	475577	6883026	Not Available	Not Available	1800
61812080	478084	6874534	2 tanks. 3 troughs. Colluvium.	Livestock	1250
61812081	482637	6873379	1 tank, 1 trough.	Not Available	1900
61812076	490800	6861594	2 tanks 3 troughs. Calcrete.	Livestock	4300
61812068	488891	6867060	2 tanks 3 troughs.	Livestock	4600
61812083	482806	6864200	1 tank 2 troughs. Colluvium/weathered basics.	Livestock	1350
61812075	489269	6863854	1 tank, 2 troughs: colluvium.	Livestock	9600
61812084	484018	6861440	2 tanks 3 troughs: laterite, weathered basics.	Livestock	4500

Available groundwater quality data for raw water from the Yalgoo Town Drinking Water Supply bores is presented in Table 20 below. Exceedances of the Australian Drinking Water Guidelines are highlighted. This water undergoes purification in a water treatment plant prior to reticulation to the town (Department of Water, 2010).

Baseline groundwater quality information will be collected during the EIA process.

Table 20: Yalgoo Town Borefield Water Quality

Parameter	Units	ADWG Guideline	Yalgoo Borefield Raw Water	
			Range	Median
Chloride	mg/L	250	265 - 315	300
Colour - True	TCU	15	<1 – 3	<1
Fluoride	mg/L	1.5	0.2 – 0.25	0.2
Hardness as CaCO3	mg/L	200	320 – 362	339
Iron unfiltered	mg/L	0.3	<0.003 – 0.01	<0.003
Sodium	mg/L	180	155 – 190	175
Total filterable solids	mg/L	500	985 - 1060	1020
Turbidity	NTU	5	<0.1 – 1.2	<0.1
Zinc	mg/L	3	0.04 – 0.06	0.05
pH	NO UNIT	8.5	7.02 – 7.72	7.17
Arsenic	mg/L	0.007	<0.002 – 0.03	0.009
Barium	mg/L	0.7	0.02 – 0.035	0.02
Boron	mg/L	4	0.34 – 0.42	0.38
Copper	mg/L	2	0.018 – 0.02	0.019
Fluoride	mg/L	1.5	0.2 – 0.25	0.25
Molybdenum	mg/L	0.05	<0.0005 – 0.0015	0.0012
Nitrate plus nitrite as N	mg/L	11.29	14 – 20.3	18.5

4.8.5 PROPOSAL ACTIVITIES

Activities that may impact upon the receiving environment include:

- Mining;
- Magnetite slurry pipeline;
- Construction and operational activities;
- Groundwater abstraction;
- Drainage diversions;
- Storage and handling of contaminants (hydrocarbons and chemicals); and
- Development and operation of waste facilities (landfill, sewage).

4.8.6 MITIGATION

The mitigation hierarchy will be applied as described below:

- Avoid:
  - Undertake a comprehensive study of potential impacts to inland groundwater and surface water quality and development management measures to avoid these impacts.
- Minimise:
  - Development of surface water and groundwater monitoring and management plans, with trigger and threshold levels and actions, to ensure no significant detrimental impact.

    - Designing all Project infrastructure and activities so that potential for contamination of inland groundwater and surface water is avoided and minimised.
    - Undertaking a Hydrocarbon Spill Risk Assessment and implementing an appropriate Hydrocarbon and Spill Management Plan.
- Rehabilitate:
    - The area will be rehabilitated at the end of the project life in accordance with the Mine Closure Plan (to be submitted with the Mining Proposal to the DMIRS).

4.8.7 IMPACTS

Potential impacts of the project which may cause deterioration in the quality of surface water or groundwater include:

- Surface and groundwater contamination / altered water chemistry from:
    - Disturbance of Potential Acid Forming (PAF) material;
    - Hydrocarbon spills due to fuel storage and handling activities (e.g. mining, construction and transport equipment);
    - Potential leaks or leaching including waste water resulting in alterations to ground water chemistry and quality;
    - Intrusion of saline water into freshwater aquifers;
    - Leaching from pit voids;
    - Landfill and waste management activities;
    - Biological contamination from sewage treatment facilities; and
    - Spills of magnetite slurry.
- Erosion and scouring at drainage diversions leading to surface water contamination with sediment.

With appropriate management measures the above impacts should not be significant.

4.8.8 ASSUMPTIONS

Surveys and studies will be undertaken by specialist consultants to ensure an appropriate level of independent rigour and ensure that EPA guidance, methodologies and industry standards have been adopted. Study assumptions will be documented within resulting reports.

4.9 AIR QUALITY

4.9.1 EPA OBJECTIVE

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

4.9.2 POLICY AND GUIDANCE

- *Environmental Factor Guideline: Air Quality* (Environmental Protection Authority, 2016a).
- *Statement of Environmental Principles, Factors and Objectives* (Environmental Protection Authority, 2016k).
- *National Greenhouse and Energy Reporting Act 2007* (NGER Act).

4.9.3 CONSULTATION

Consultation with regulatory agencies, stakeholders and the community will be required regarding:

- studies proposed;
- methodology of studies;
- results of studies;
- predicted impacts;
- proposed management measures; and
- residual impacts and risks.

Consultation to date has included broad information provision to stakeholders.

4.9.4 RECEIVING ENVIRONMENT

4.9.4.1 WIND

Predominant wind directions vary according to the time of day and year. Windroses for the Yalgoo BOM Site 7091 in the Town of Yalgoo are provided in Appendix B. Mean 9am wind speeds range from 11.1 – 17.4 km per hour, whilst mean 3pm wind speeds range from 14 – 17.5 km per hour. Table 21 below provides a summary of wind speed information.

Table 21: Climate Statistics BOM Site 7091 Yalgoo

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Wind Speed															
Mean 9am wind speed (km/hr)	15.4	15.4	14.8	13.8	12.2	11.6	11.1	12.6	15.6	16.2	17.4	15.9	14.3	17	1957 to 1975
Mean 3pm wind speed (km/hr)	4.8	14.1	14.0	15.1	15.3	14.8	15.5	15.7	17.4	16.5	17.5	15.3	15.5	16	1897 to 1975

4.9.4.2 TOWNS AND RESIDENTS

The Town of Yalgoo is located approximately 15 km west / south west of the Development Envelope (Figure 2) and is separated from the project area by a ridge line of hills (Figure 14).

Carlawinda Station Homestead is located approximately 8 km west of the Development Envelope and is also separated from the project area by a ridge line of hills (Figure 4).

Noongal Homestead (an old homestead located on Carlawinda Station) is located approximately 6 km to the north of the Development Envelope and is also separated from the project area by a ridge line of hills (Figure 1). It is not known if this homestead is occupied.

Wagga Wagga Station Homestead is located approximately 3 km to the east of the Development Envelope on relatively flat terrain (Figure 4).

4.9.5 PROPOSAL ACTIVITIES

Activities that may impact upon the receiving environment include:

- Mining
- Power generation (burning of fossil fuels for the production of energy)
- Stockpiling of bulk material
- Crushing and processing of ore
- Construction of waste storage faclities
- Handling and transport (both road and rail) of materials, including the loading and unloading of bulk materials.

4.9.6 MITIGATION

The mitigation hierarchy will be applied as described below:

- Avoid:
  - Conduct a dust risk assessment to determine impacts on surrounding residents and implement effective management measures to avoid impacts.
- Minimise:
  - Use energy efficient vehicles, equipment and processes where possible to minimise greenhouse emissions.
  - Implement a dust management and monitoring plan.
- Rehabilitate:
  - The area will be rehabilitated at the end of the project life in accordance with the Mine Closure Plan (to be submitted with the Mining Proposal to the DMIRS).

4.9.7 IMPACTS

It is unlikely that the Town of Yalgoo, Carlawinda Homestead or Noongal Homestead would be impacted by dust from the mining operation due to distance and topographic separation.

Wagga Wagga Homestead could potentially be impacted by dust from the mining operation under strong winds, if dust emissions sources are not appropriately managed.

Vegetation surrounding the project could be impacted by dust.

A dust impact study will be conducted as part of the EIA and an appropriate dust management and monitoring plan developed.

At this preliminary stage, it is uncertain what quantity of carbon dioxide equivalent (CO_2-e) greenhouse gas emissions will be produced. A Greenhouse Emissions assessment based on projected fuel consumption and power generation details will be conducted as part of the EIA process, and the greenhouse intensity of the Yogi Project (i.e. tonnes of CO_2-e greenhouse gas emissions per tonne of magnetite produced) will be benchmarked against similar magnetite mining and processing facilities.

With appropriate management measures air quality impacts should not be significant.

4.9.8 ASSUMPTIONS

Surveys and studies will be undertaken by specialist consultants to ensure an appropriate level of independent rigour and ensure that EPA guidance, methodologies and industry standards have been adopted. Study assumptions will be documented within resulting reports.

4.10 SOCIAL SURROUNDINGS

4.10.1 EPA OBJECTIVE

To protect social surroundings from significant harm.

4.10.2 POLICY AND GUIDANCE

- *Environmental Factor Guideline: Social Surroundings* (Environmental Protection Authority, 2016e).
- *Statement of Environmental Principles, Factors and Objectives* (Environmental Protection Authority, 2016k).
- *Guidance Statement 41 – Assessment of Aboriginal Heritage* (Environmental Protection Authority, 2004).
- *Aboriginal Heritage - Due Diligence Guidelines (Version 3.0)* (Department of Aboriginal Affairs & Department of the Premier and Cabinet, 2013).
- *Aboriginal Heritage Act 1972.*

4.10.3 CONSULTATION

Consultation with regulatory agencies, stakeholders and the community will be required regarding:

- studies proposed;
- methodology of studies;
- results of studies;
- predicted impacts;
- proposed management measures; and
- residual impacts and risks.

Consultation to date has included broad information provision to stakeholders.

4.10.4 RECEIVING ENVIRONMENT

4.10.4.1 ABORIGINAL RESERVES AND COMMUNITIES

There are no Aboriginal settlements or communities within the Development Envelope or the Pipeline Development Envelope. There are two reserves located within the town of Mullewa (Reserve 25296, 'MULLEWA' at 17 and 19 Mills St, and Reserve 24334, 'DIANDI' at 19 Darlot St). While the town of Mullewa is located within the Pipeline Development Envelope, the pipeline routes themselves do not intersect Mullewa.

4.10.4.2 ABORIGINAL HERITAGE SITES

Database Search

Aboriginal sites are places of importance and significance to Aboriginal people and to the cultural heritage of Western Australia. Aboriginal sites include:

- Archaeological – places where material remains associated with past Aboriginal land use.
- Anthropological - places of spiritual importance and significance to Aboriginal people.

The WA *Aboriginal Heritage Act 1972* protects places and objects that may be of importance and significance to Aboriginal people in Western Australia. The Department of Planning, Lands, and Heritage (DPLH) (formerly the Department of Aboriginal Affairs (DAA)) maintains a register of Aboriginal sites that are protected under the *Aboriginal Heritage Act 1972*. The *Aboriginal Heritage Act 1972* states it is an offence under this legislation to "excavate, destroy, damage, conceal, or in any way alter any Aboriginal site", without prior authorisation of the Registrar of Aboriginal sites and/or consent of the Minister for Indigenous Affairs.

An online search for relevant Aboriginal Heritage information was performed using the DPLH Aboriginal Heritage Inquiry System. The system incorporates both the Heritage Site Register and the Heritage Survey Database. The Heritage Site Register is held pursuant to Section 38 of the State's *Aboriginal Heritage Act 1972* and contains information on over 22,000 Aboriginal sites throughout Western Australia. The Heritage Survey Database is a catalogue of the heritage survey

reports held by the DPLH. It holds a description of each survey, its boundaries, proponent and participants.

The search revealed that there are ten Aboriginal heritage sites within 10 km of the Yogi Mine Development Envelope. Only one of these sites (Yalgoo 1, an artefacts scatter) occurs within the Development Envelope boundary (Figure 18; Table 22).

Table 22: Aboriginal Heritage Sites (DPLH database)

Name	Status*	Type
Yalgoo 1	Lodged	Artefacts / Scatter
YALGOO	Registered Site	Artefacts / Scatter, Painting
YALGOO	Registered Site	Painting
Yalgoo 3	Lodged	Artefacts / Scatter, Quarry
Yalgoo 2	Lodged	Artefacts / Scatter, Quarry
NOONGAL STONE ARRANGEMENT	Registered Site	Man-Made Structure
Yalgoo Quarry	Lodged	Quarry
Yalgoo Artefact Scatter 1	Lodged	Artefacts / Scatter
Yalgoo Rockhole	Lodged	Water Source
Yalgoo Artefact Scatter 2	Lodged	Artefacts / Scatter

***Registered Site:** The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972*.
Lodged: Information has been received in relation to the place, but an assessment has not been completed.

Discussions with the DPLH and searches of the above data base do not necessarily rule out the possibility of Aboriginal heritage sites within the area. These searches provide an effective indication of existing and potential sites in an area and assists in decisions made in relation to disturbing new development sites.

Previous Heritage Surveys

Heritage surveys were undertaken by Western Heritage Research in 2006, 2007, 2009 and 2012, as described in Table 23, with the survey areas shown in Figure 18. These survey areas only partially intersected the Development Envelope.

Table 23: Previous Heritage Studies

Survey Date	Area	Type	Reference	Results
18 Aug 2006	NS Corridor (10 km x 200 m)	Heritage	(Western Heritage Research, 2006)	3 sites quarry reductions and artefact scatters (Yalgoo 1, Yalgoo 2 & Yalgoo 3)
25 Jul 2007	5 selected areas	Heritage	(Western Heritage Research, 2007 (reported 2011))	1 new site (in addition to those in DIA database)
4 Sep & 2 Oct 2009	Selected area and Haul Road (2.6 km x 30 m)	Heritage	(Western Heritage Research, 2009)	2 new sites (grinding stone and quarry)

Survey Date	Area	Type	Reference	Results
2 - 4 Apr 2012	Selected Areas	Heritage	(Ferrowest Limited, 2012)	Several new sites (no report available - only a memo describing the survey)

As shown on Figure 18, some parts of the disturbance footprint (including most of the proposed Sam Mining Pit) is covered by historic cultural heritage surveys, which will be acceptable for use as part of the approvals process.

However, disturbance areas which have not been previously surveyed for heritage, will need to be covered by new heritage surveys.

The results of these surveys are shown in Figure 18, and detailed in Table 24 below.

Table 24: Heritage Survey Results

Survey	Site Name	Site Type	Easting	Northing	Distance (km)
WHR Heritage 2006	Yalgoo 1	Artefacts	482,819	6,873,509	intersects
WHR Heritage 2006	Yalgoo 2	Artefacts	483,167	6,867,501	2.69
WHR Heritage 2006	Yalgoo 3	Artefacts	483,142	6,867,354	2.62
WHR Heritage 2007	Wownaminya Hill	Ethnographic	483,832	6,851,985	12.16
WHR Heritage 2009	Yalgoo 2	Basalt basal grinding stone at rockshelter entrance	480,905	6,873,967	0.73
WHR Heritage 2009	Yalgoo 3	Low density artefact scatter	480,886	6,873,050	1.25

4.10.4.3 EUROPEAN HERITAGE

The following databases were searched for features of European Heritage significance:

- World Heritage Sites;
- National Heritage Sites;
- Commonwealth Heritage Sites;
- Register of the National Estate;
- Heritage Council WA State Register; and
- Municipal Inventories (WA) (SHO-005)

The National Heritage List and Commonwealth Heritage List are established under the EPBC Act and include natural, historic and Indigenous places of outstanding heritage value to the nation and the Commonwealth respectively. The State Register of Heritage Places was established under the *Heritage of Western Australia Act 1990*, and includes buildings, structures, gardens, cemeteries, memorials, landscapes and archaeological sites.

In the vicinity of the project Development Envelope the following European Heritage Sites exist (Figure 19):

- Approximately 6 km to the north the Noongal Homestead and associated buildings (a historical homestead located on Carlawinda Pastoral Lease) is listed both on the Municipal Inventory and Stage Register.
- Approximately 8 km west of the Development Envelope, Carlawinda Station Homestead is listed on the Municipal Inventory.
- Approximately 15 km to the south west several items associated with the historical railway are listed on the Municipal Inventory and Stage Register.

There are two Commonwealth heritage sites within the town of Geraldton within the Pipeline Development Envelope, however these are listed buildings and outside of the Geraldton Southern Transport Corridor. There are Municipal historic sites located within the town of Yalgoo and Barnong Station, Wurarga, which are within the Pipeline Development Envelope, however all are avoided by the actual proposed pipeline routes (the closest is MR Railway at Yalgoo, approximately 850 m north of pipeline options 1 and 2). Likewise, the 42 historic sites on the State Register within the Pipeline Development are located predominantly within the towns of Yalgoo, Pindar, Mullewa and Geraldton, which the indicative pipeline routes either avoid or make of pre-existing tenure corridors (the closest site outside of these towns is Windarra at 34 Glengarry Rd, Moonyoonooka, approximately 250 m south of pipeline options 1 and 2).

The only site that is close to pipeline alignment options, is the Bringo Railway Cutting (Mount Magnet Rd, Bringo via Moonyoonooka) approximately 13 m from pipeline options 1 and 2. This is a natural heritage site on the Register of National Estate, which as of February 2012 is maintained on a non-statutory basis as a public archive.

4.10.5 PROPOSAL ACTIVITIES

Activities that may impact upon the receiving environment include:

- All land disturbance, excavation and construction activities
- Prevention or change of access to a site.
- Alterations to hydrological processes.

4.10.6 MITIGATION

The mitigation hierarchy will be applied as described below:

- Avoid:
  - Meeting all responsibilities and requirements under the *Aboriginal Heritage Act 1972.*
  - Conducting appropriate cultural heritage surveys over any areas of disturbance not covered by previous surveys.
  - Avoid disturbance of aboriginal heritage sites where possible.
- Minimise:
  - In the event disturbing an aboriginal heritage site is unavoidable, consulting with Aboriginal stakeholders and obtaining all relevant approvals under the *Aboriginal Heritage Act 1972,* prior to undertaking the disturbance.
- Rehabilitate:
  - The area will be rehabilitated at the end of the project life in accordance with the Mine Closure Plan (to be submitted with the Mining Proposal to the DMIRS).

4.10.7 IMPACTS

Potential impacts as a result of implementing the proposal include:

- Loss/disturbance to Aboriginal heritage sites.
- Disturbance to cultural associations within the area.
- Temporary and/or permanent constraint on traditional cultural activities.

Aboriginal Heritage surveys will be conducted as part of the EIA process.

With appropriate management impacts to cultural heritage should be minimal.

4.10.8 ASSUMPTIONS

Surveys and studies will be undertaken by specialist consultants to ensure an appropriate level of independent rigour and ensure that EPA guidance, methodologies and industry standards have been adopted. Study assumptions will be documented within resulting reports.

5 OTHER ENVIRONMENTAL FACTORS OR MATTERS

FIJV is aware that other environmental factors or matters may be identified during the course of the environmental review process and stakeholder engagement that were not apparent at the time that this referral was prepared. If this situation arises, FIJV will consult with the EPA and DoEE to determine how (and to what extent) these factors and/or matters are to be addressed.

6 GLOSSARY

6.1 UNITS, SYMBOLS AND PREFIXES

Not necessarily referenced

6.1.1 UNITS

g	Gram; a unit used to express weight
L	Litre; a unit used to express volume
m	Metre; a unit used to express length
bcm	Bank cubic meters; a unit used to describe the volume of in-situ rock
dB	Decibel; unit used to express sound intensity
h	Hour; a unit used to express time
ha	Hectare; a unit used to express area
m2	Square metre; a unit used to express area
m3	Cubic metre; unit used to express volume.
NTU	Nephelometric Turbidity Units.
V	Volt; a unit used to express the potential difference across a conductor
VA	Volt-amp; a unit used to express apparent power; is equal to voltage applied multiplied by current drawn
VPD	Vehicles per day
yr	Year
s	Second; a unit used to express time
ppm	Parts per million; a unit used to express concentration
ppt	Parts per thousand; a unit used to express concentration
T	Tonne

6.1.2 SYMBOLS

%	percentage (proportion out of one hundred)
/	Per
p	per
$	Australian dollars
a	annum; year
°C	degree Celsius

6.1.3 PREFIXES

G	10^{9}
M	10^{6}
k	10^{3}
d	10^{-1}
c	10^{-2}
m	10^{-3}.
µ	10^{-6}
n	10^{-9}

6.2 WORDS AND ABBREVIATIONS

Not necessarily referenced

Term	Definition/expansion
AHD	Australian Height Datum.
amenity	The desirability of an area.
amphibians	Animals (such as frogs) adapted to live both on land and in water.
ARI	Average Recurrence Interval; a measure of the rarity of a rainfall event.
artefact	Anything made by human workmanship, particularly by previous cultures (such as chipped and modified stones used as tools).
background	The conditions (e.g., noise levels, bird populations) already present in an area before the commencement of a specific activity (e.g., a mining operation).
best practice	A best practice is a process, technique, or use of technology, equipment or resource that has a proven record of success.
bioregion	A complex land area composed of a cluster of interacting ecosystems that are repeated in similar form. It describes the dominant landscape scale attributes of climate, lithology, geology, landforms and vegetation. It is based on the Interim Biogeographic Regionalisation for Australia (see IBRA).
biodiversity	The diversity of different species of plants, animals and microorganisms, including the genes they contain, in the ecosystem of which they are part.
bore	A well, usually of less than 20 cm diameter, sunk into the ground and from which water is pumped.
bund	An earth, rock, or concrete embankment constructed to prevent the in-flow or outflow of liquids or the transmission of noise.
catchment	The entire land area from which water (e.g., rainfall) drains to a specific water course or waterbody.
clay	A discrete mineral species, belonging to the layered silicate group of less than 2 microns in diameter.
compaction	The process of close packing of individual grains in a soil or sediment as a response to pressure.
compensation basin	A low lying area of land that is inundated with water during rainfall events, drawing water from the surrounding higher elevation land, thereby having a water compensation effect.
concentration	The amount of a substance per unit of mass or volume of the medium in which it occurs.
conservative	A prediction, assumption, or measurement that errs on the side of safety.
contractor	A specialist brought in to perform a specific task, such as the construction of mine infrastructure or the excavation (mining) of the open pit.
DER	Department of Environment Regulation (WA).
DoTEE	Department of the Environment and Energy (Federal).
DPaW	Department of Parks and Wildlife (WA).
density	The mass of a substance divided by its volume.
DoCEP	Department of Consumer and Employment Protection (WA).
DoW	Department of Water (WA).
DRF	Declared Rare Flora.
ecosystem	An interacting system of animals, plants, other organisms and non-living parts of the environment.
emission	A discharge of a substance (e.g., dust) into the environment.
endemic	Native to, or restricted to, a certain country or area.

Term	Definition/expansion
environment	A general term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms (including human beings) exists.
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority.
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth).
erosion	The wearing away of the land surface (whether natural or artificial) by the action of water, wind and ice.
fauna	A general term for animals (birds, reptiles, marsupials, fish etc.), particularly in a defined area or over a defined time period.
feed	Material being fed into a process.
flora	A general term for plants, particularly those found in a defined area or characteristic of a defined time period.
foraging	Searching for food over a wide area.
grade	The concentration of metal, e.g., iron either in an individual rock sample or averaged over a specified volume of rock.
gradient	Rate of change of a given variable (such as temperature or elevation) with distance.
greenhouse gases	Carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulphur hexafluoride.
ground vibration	Vibration transmitted through the ground following blasting.
groundwater	All waters occurring below the land surface; the upper surface of the soils saturated by groundwater in any particular area is called the water table.
habitat	The particular local environment occupied by an organism.
hydrology	The study of water, particularly its movement in streams, rivers, or underground.
infrastructure	The supporting installations and services that supply the needs of a project.
introduced	Introduced to a particular environment; exotic.
invertebrates	Commonly, animals without a backbone (jellyfish, worms, molluscs, etc.).
irrigation	The artificial flooding of agricultural land to promote cultivation.
landform	A specific feature of a landscape (such as a hill) or the general shape of the land.
load	The amount of a substance discharged into a body of water (e.g., salt or sediment); usually expressed as mass over a specified time (e.g., tonnes per year).
MBGL	Meters Below Ground Level.
model	A mathematical simulation of a natural system (such as the variation of particulate levels within a lake) used to predict how the system will change with time, particularly where external changes have been imposed upon it (such as from mining operations).
monitoring	Systematic sampling and, if appropriate, sample analysis to record changes over time caused by impacts such as mining.
native	Belonging to, or found naturally, in a particular environment.
natural	Existing in, or formed by, nature (generally excludes anything obviously modified by human beings).
neutral	Neither acidic nor basic (e.g., a pH equal to 7.0).
nutrients	Generally, refers to nitrogen and phosphorus, which are essential for biological growth.
operations	Mining and mineral/ore processing activities.
ORV	Off road vehicles.
passive	Performing a function without electrical or mechanical action or movement.
PER	Public environmental review.

Term	Definition/expansion
pH	Potential of hydrogen; a measure of the degree of acidity or alkalinity of a solution; expressed numerically (logarithmically) on a scale of 1 to 14, on which 1 is most acid, 7 is neutral and 14 is most basic (alkaline).
Prescribed Premise	A premise that falls into the categories prescribed in Schedule 1 of the *Environmental Protection Regulations 1987*.
Project area	the total area covered by the project, including clearing, processing plant, stockpiles, haul road, rail siding, port facilities etc.
quadrat	A square measuring area used in ecological studies such as the distribution of plants or animals in an area. Quadrats can vary in size depending largely on the focus of the study.
receptor	A designated place at which an impact may occur (e.g., a dwelling).
recharge	The addition of water to an aquifer, directly from the surface, indirectly from the unsaturated zone, or by discharge from overlying or underlying aquifer systems.
rehabilitation	The restoration of a landscape and especially the vegetation following its disturbance.
reptiles	Cold-blooded vertebrates, including lizards, snakes, turtles, and crocodiles.
residual impacts	Impacts from an activity (e.g., mining) that remain after mitigation measures.
richness (of fauna or flora)	A measure of the diversity of species in a given area or assemblage.
runoff	That portion of precipitation (rain, hail and snow) that flows from a specific area as water.
silt	Sediment with particles finer than ore and coarser than clay, i.e., 2 to 63 microns.
species	A taxonomic grouping of organisms that is able to interbreed with each other but not with members of other species.
stockpile	A pile used to store material (such as salt) for future use.
stockpiled	Stored in a stockpile.
stripping	Removal of vegetation and topsoil.
surface water	Water flowing over, or contained on, a landscape (e.g., runoff, streams, lakes, etc.).
taxa	Plural of taxon.
taxon	A group or category, at any level, in a system for classifying plants or animals. An animal or plant group having natural relations.
TEC	Threatened Ecological Community.
topography	Physical relief and contour of a region.
topsoil	Upper layer of soil, usually containing more organic material and nutrients than the subsoil beneath it.
TPS	Town Planning Scheme.
variable	Not constant, subject to change.
vibration	Oscillating movement.
WAPC	Western Australian Planning Commission.
water balance	The sum of the inputs and outputs and changes in storage levels of water in a given locality.
water quality	Degree of the lack of contamination of water.
water table	The surface of the groundwater, below which soil and rock are saturated.
watercourse	Stream or river, running water.
weed	Any plant (in particular an herbaceous one) that survives in an area where it is harmful or troublesome to the desired land use.
wetland	A low-lying area regularly inundated or permanently covered by shallow water.

7 REFERENCES

ATA Environmental. (2006a). *Flora and Vegetation Assessment Yalgoo Iron Project.* Perth: Report prepared for Ferrowest Ltd.

ATA Environmental. (2006b). *Vertebrate Fauna Assessment Yalgoo Iron Project.* Perth: Report prepared for Ferrowest Ltd.

ATA Environmental. (2007). *Spring Flora and Vegetation Assessment Yalgoo Iron Project.* Perth: Report prepared for Ferrowest Ltd.

Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Volume 1.* Canberra: ANZECC & ARMCANZ.

Australian Nature Conservation Agency. (1993). *A Directory of Important Wetlands in Australia.* Canberra: Government of Australia.

Barnett, B., Townley, L. R., Post, V., Evans, R. E., Hunt, R. J., Peeters, L., . . . Boronkay, A. (2012). *Australian groundwater modelling guidelines (Waterlines Report Series No. 82).* Canberra: National Water Commission.

Beecham, B. (2003). Avon Wheatbelt 1 (AW1 - Ancient Drainage subregion). In *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002* (pp. 7-35). Perth: Department of Environment and Conservation.

Bureau of Meteorology. (2017). *Climate Statsitics for Yalgoo BOM Site.* http://www.bom.gov.au/climate/averages/tables/cw_007091.shtml.

Coffey Environments. (2008). *Yalgoo Iron Ore Project Vertebrate Fauna Survey.* Perth: Report prepared for Ferrowest Limited.

Coffey Environments. (2010). *Targeted Rare Flora Survey, Exploration Leases, Yalgoo Iron Project.* Perth: Report prepared for Ferrowest Ltd.

CSIRO Land and Water. (2013, April 18). *Atlas of Australian Acid Sulfate Soils*. Retrieved from ASRIS: Australian Soil Resource Information System: http://www.asris.csiro.au/themes/AcidSulfateSoils.html

CSIRO Land and Water. (2017). *Atlas of Australian Acid Sulphate Soils*. doi:10.4225/08/512E79A0BC589

Department of Aboriginal Affairs & Department of the Premier and Cabinet. (2013). *Aboriginal Heritage Due Diligence Guidelines (Version 3.0).* Perth: Government of Western Australia.

Department of Biodiversity, Conservation and Attractions. (2017a). *Threatened and Priority Flora Database Search for the Yalgoo area accessed on the 25th August 2017.* Perth: Department of Biodiversity, Conservation and Attractions.

Department of Biodiversity, Conservation and Attractions. (2017b). *Threatened and Priority Ecological Community buffers in WA.* Perth: Department of Biodiversity, Conservation and Attractions.

Department of Biodiversity, Conservation and Attractions. (2017c). *Threatened and Priority Fauna Database Search for Yogi Mine Development Envelope accessed on the 30th August 2017.* Perth: Prepared by the Species and Communities Branch for EnviroWorks Consulting for Desktop Mapping.

Department of Environment. (2003). *General Guidance on Managing Acid Sulfate Soils.* Retrieved October 2009, from Department of Environment: http://portal.environment.wa.gov.au/pls/portal/docs/PAGE/DOE_ADMIN/GUIDELINE_REPOSITORY/ASSMP%20_FINAL_.PDF.

Department of Environmental Regulation. (2014). *Assessment and management of contaminated sites: Contaminated sites guidelines.* Perth: State of Western Australia.

Department of Mines and Petroleum & Environmental Protection Authority. (2015). *Guidelines for Preparing Mine Closure Plans.* Perth: Department of Mines and Petroleum & Environmental Protection Authority.

Department of Primary Industries and Regional Development. (2017). *Soil Landsapes Mapping - Best Available.* https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-best-available.

Department of Sustainability, Environment, Water, Population and Communities. (2011). *Survey Guidelines for Australia's Threatened Reptiles.* Canberra: Commonwealth of Australia.

Department of Sustainability, Environment, Water, Population and Communities. (2011). *Survey guidelines for Australia's threatened mammals.* Canberra: Commonwealthy of Australia.

Department of the Environment. (2015). *Threat abatement plan for predation by feral cats.* Canberra: Commonwealth of Australia.

Department of the Environment and Energy. (2017). *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (EPBC Act Policy Statement 3.21).* Canberra: Commonwealth of Australia.

Department of the Environment and Energy. (2017a). *EPBC Act Protected Matters Search (created 18th August 2017).* Canberra: Department of the Environment and Energy.

Department of the Environment and Energy. (n.d.). *Australia's bioregions (IBRA)*. Retrieved August 17, 2017, from Department of the Environment and Energy: http://www.environment.gov.au/land/nrs/science/ibra

Department of the Environment, Water, Heritage and the Arts. (2008). *Threat Abatement Plan for Predation by the European Red Fox.* Canberra: Commonwealth of Australia.

Department of the Environment, Water, Heritage and the Arts. (2009). *Significant impact guidelines for 36 migratory shorebird species (EPBC Act Policy Statement 3.21).* Canberra: Commonwealth of Australia.

Department of Water. (2009). *Operational policy no. 5.12 – Hydrogeological reporting associated with a groundwater well licence.* Perth: Department of Water.

Department of Water. (2010). *Yalgoo Water Reserve Drinking Water Source Protection Plan: Yalgoo Town Water Supply [WRP118].* Perth: Department of Water.

Department of Water. (2013). *Western Australian water in mining guideline (Water licensing delivery report series: Report No. 12).* Perth: Department of Water.

Desmond, A., & Chant, A. (2003a). Yalgoo (YAL). In *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002* (pp. 656-667). Perth: Department of Conservation and Land Management.

Desmond, A., & Chant, A. (2003b). Geraldton Sandplains 2 (GS2 - Geraldton Hills subregion). In *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002* (pp. 265-292). Perth: Department of Environment and Conservation.

Ecoscape. (2008). *Western Haematite Deposit, Yalgoo Spring Flora Survey (Draft).* Perth: Report prepared for Ferrowest Ltd.

Environment Australia. (2001). *A Directory of Important Wetlandsin Australia* (3rd ed.). Canberra: Environment Australia.

Environmental Protection Authority. (2004). *Guidance Statement 41: Assesssment of Aboriginal Heritage.* Perth: Environmental Protection Authority.

Environmental Protection Authority. (2006). *Guidance Statement 6 – Rehabilitation of Terrestrial Ecosystems.* Perth: Government of Western Australia.

Environmental Protection Authority. (2013b). *Environmental Protection Bulletin 20: Protection of naturally vegetated areas through planning and development.* Perth: Environmental Protection Authority.

Environmental Protection Authority. (2016). *Environmental Factor Guideline: Terrestrial Fauna.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016). *Technical Guidance - Sampling of short range endemic invertebrate fauna.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016). *Technical Guidance: Sampling methods for terrestrial vertebrate fauna.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016). *Technical Guidance: Terrestrial fauna surveys.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016a). *Environmental Factor Guideline: Air Quality.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016b). *Environmental Factor Guideline: Flora and Vegetation.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016c). *Environmental Factor Guideline: Hydrological Processes.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016d). *Environmental Factor Guideline: Inland Waters Environmental Quality.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016e). *Environmental Factor Guideline: Social Surroundings.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016f, December 13). *Environmental Factor Guideline: Subterranean Fauna.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016g). *Environmental Factor Guideline: Terrestrial Environmental Quality.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016i). *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016.* Perth: Western Australian Government Gazette.
Environmental Protection Authority. (2016j). *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual 2016.* Perth: Government of Western Australia.
Environmental Protection Authority. (2016k). *Statement of Environmental Principles, Factors and Objectives.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016l). *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016m). *Technical Guidance: Sampling methods for subterranean fauna.* Perth: Environmental Protection Authority.
Environmental Protection Authority. (2016p). *Technical Guidance: Subterranean fauna survey.* Perth: Environmental Protection Authority.
Executive Steering Committee for Australian Vegetation Information (ESCAVI) . (2003). *Australian Vegetation Attribute Manual: National Vegetation Information System [v6].* Canberra: Department of the Environment and Heritage.
Ferrowest Limited. (2012). *Memo - Notes on recent Heritage Survey - WHP North Heritage Survey.*
Fitzpatrick, R., Powell, B., & Marvanek, S. (2011). *Atlas of Australian Sulphate Soils. v2. CSIRO. Data Collection.* CSIRO Australia. doi:10.4225/08/512E79A0BC589
Geological Survey of WA. (2017). *Surface Geology Mapping.* Perth: GIS Data Files Accessed.
Government of Western Australia. (2004). *State Water Quality Management Strategy No. 6: Implementation Framework for Western Australia for the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and Water Quality Monitoring and Reporting (Report No. SWQ 6).* Perth: Government of Western Australia.
Government of Western Australia. (2011). *WA Environmental Offsets Policy.* Perth: Government of Western Australia.

Government of Western Australia. (2011). *WA Environmental Offsets Policy.* Perth: Government of Western Australi.

Government of Western Australia. (2014). *WA Environmental Offsets Guidelines.* Perth: Government of Western Australia.

Hill, B. M., & Ward, S. J. (2010). *National Recovery Plan for the Northern Quoll Dasyurus hallucatus.* Darwin: Northern Territory Department of Natural Resources, Environment, The Arts and Sport.

Maia. (2011). *Yalgoo Iron Project (Tenements E59/1097 and M59740): Targeted Flora Survey – November 2-7, 2011.* Perth: Report prepared for Ferrowest Ltd.

Payne, A., & Schoknecht, N. (2011). *Land systems of the Kimberley Region, Western Australia [Technical Bulletin No. 98].* Perth: Department of Agriculture and Food.

Shepherd, D. P. (2003). *Implementation of the National Vegetation System model in Western Australia. Milestone 6 Report. Final report on the implementation of the National Vegetation System model in Western Australia.* Canberra: Unpublished Report to the Bureau of Rural Sciences.

Shire of Yalgoo. (2017a, September 13). *Wagga Wagga Station*. Retrieved from Shire of Yalgoo: http://www.yalgoo.wa.gov.au/pastoral-leasesstations/wagga-wagga-station.aspx

The Shire of Yalgoo. (2017b, September 18). *The Murchison Regional Vermin Council (MRVC)*. Retrieved from The Shire of Yalgoo: http://www.yalgoo.wa.gov.au/pastoral-leasesstations/the-murchison-regional-vermin-council-mrvc.aspx

The Shire of Yalgoo. (n.d.). *The Shire of Yalgoo*. Retrieved September 13, 2017, from History: http://www.yalgoo.wa.gov.au/the-shire/history.aspx

van Vreeswyk, A. M., Leighton, K. A., Payne, A. L., & Hennig, P. (2004). *An inventory and condition survey of the Pilbara region, Western Australia [Technical Bulletin 92].* Perth: Department of Agriculture and Food, Western Australia.

Western Heritage Research. (2006). *Report of an Aboriginal Heritage Survey of a Proposed Exploration Drilling Project at Yalgoo.* Perth: Unpublished report prepared for Ferrowest Ltd.

Western Heritage Research. (2007 (reported 2011)). *Report of an Aboriginal Heritage Survey of a Proposed Exploration Drilling Project at Yalgoo with the Wadjari Yamatji and Hodder Family.* Perth: Unpublished report prepared for Ferrowest Ltd.

Western Heritage Research. (2009). *A Report of an Aboriginal Heritage Survye of the Proposed Western Haematite Project Near Yalgoo.* Perth: Unpublished report prepared for Ferrowest Ltd.

8 FIGURES

FIJV

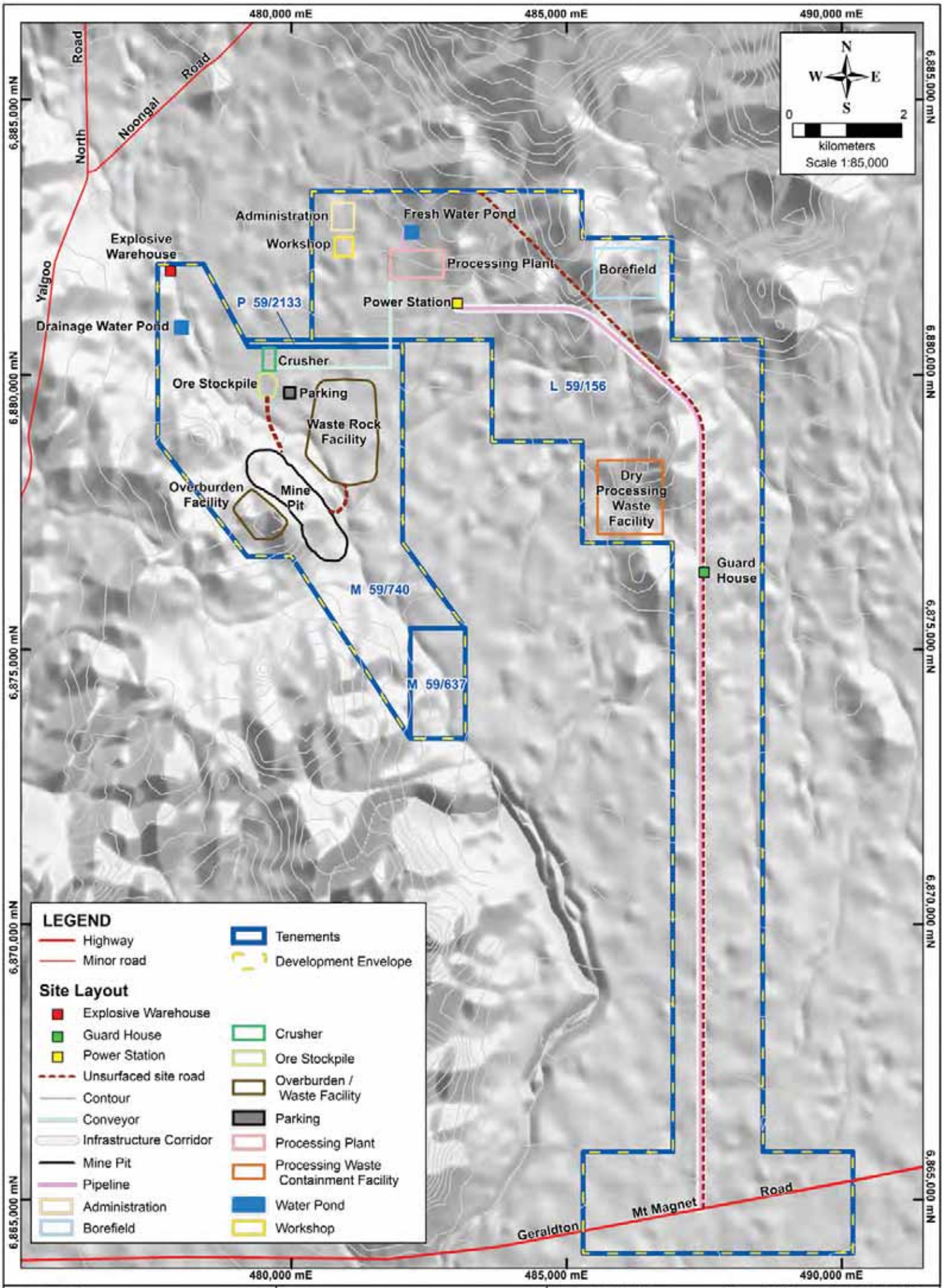
EnviroWorks CONSULTING

Figure 1: Location

Date: 25/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 4A, 4D, 4E, 9A, 15I, 17A

File Info:F05-J03_Location_20171024



FIJV

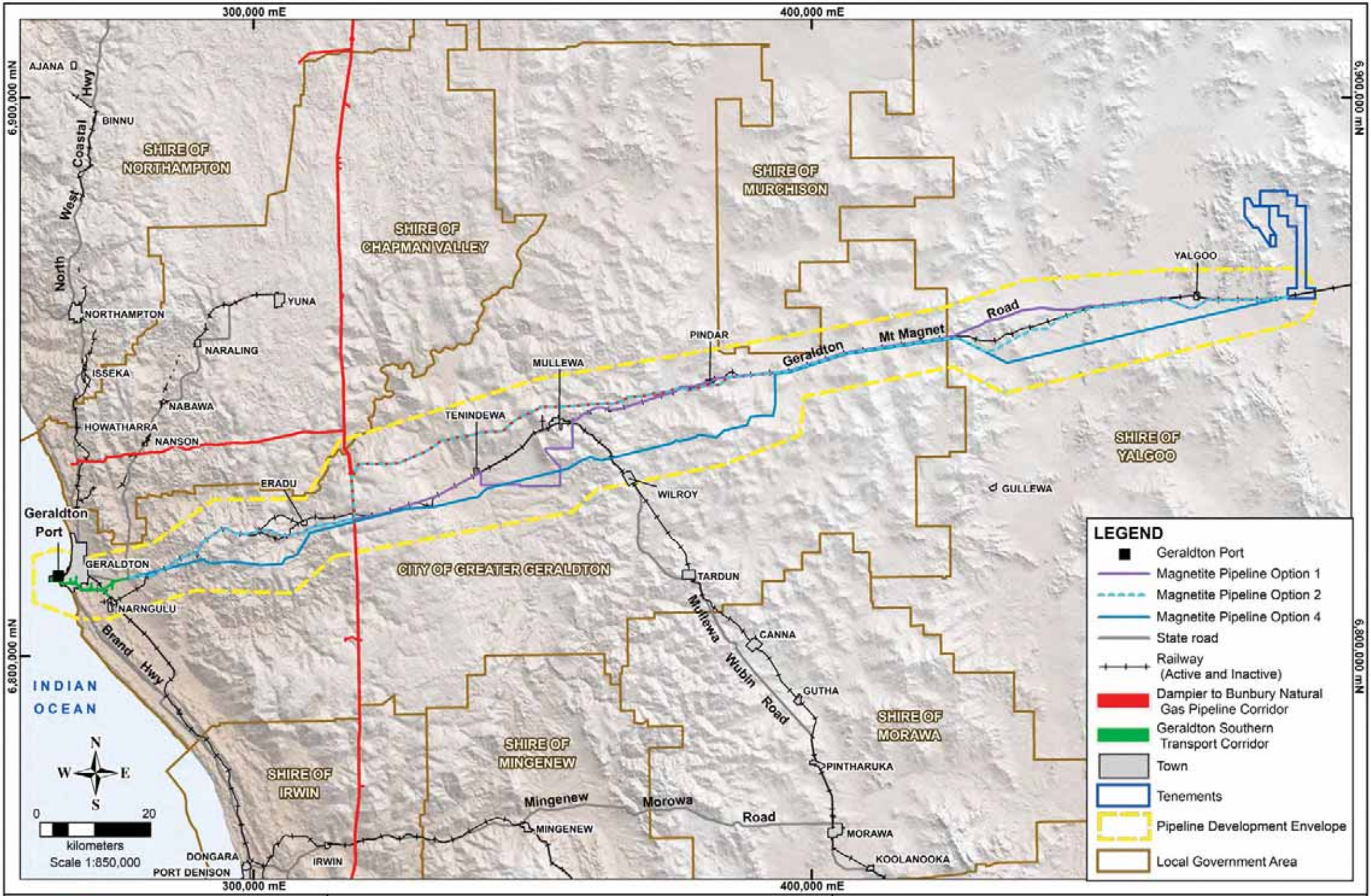
EnviroWorks CONSULTING

Figure 2. Site Layout

Date: 24/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 9A, 15I, 17A, 17C

File Info: F05-J03_SiteLayout_20171024



FIJV

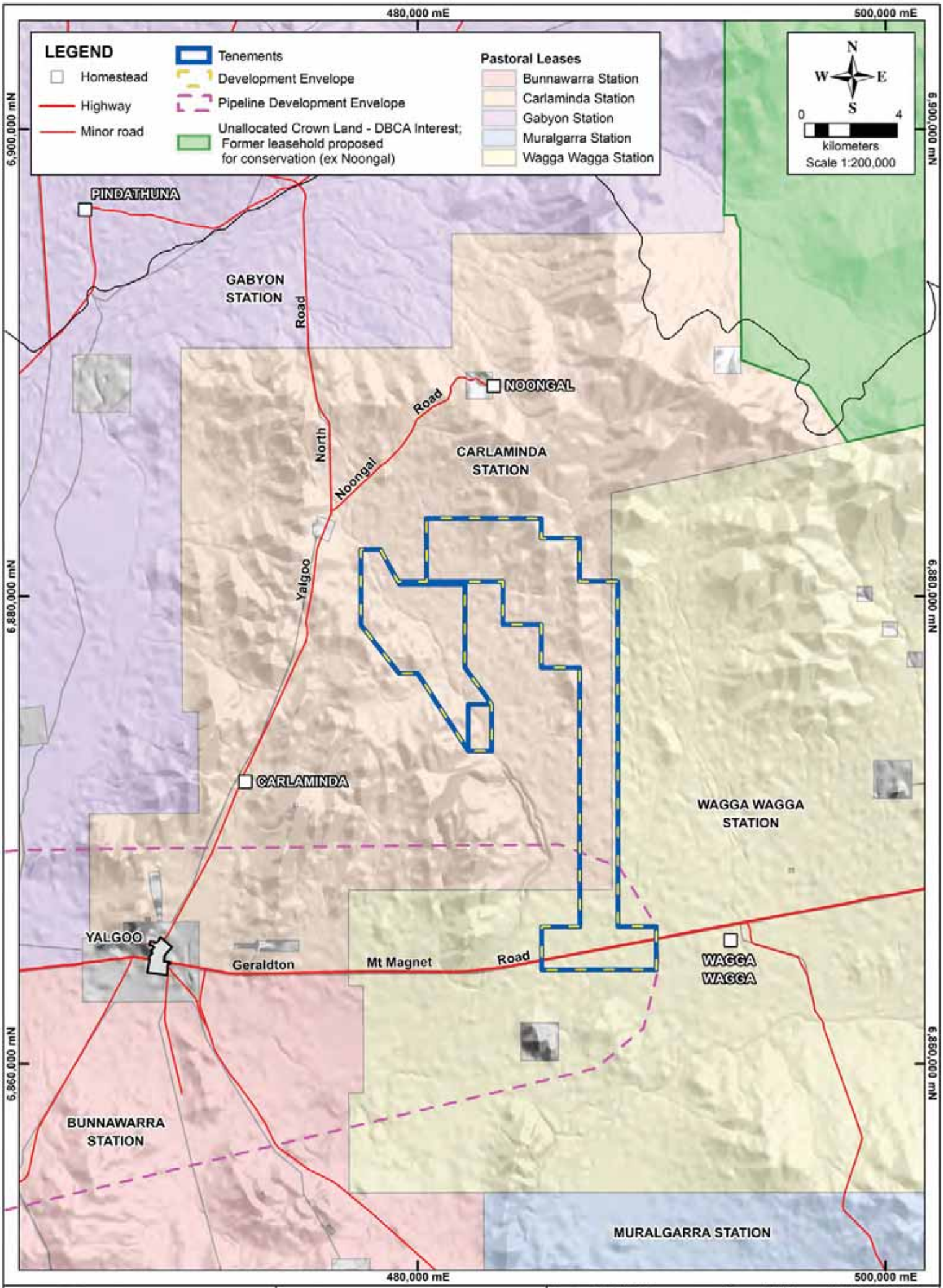
EnviroWorks CONSULTING

Figure 3. Pipeline Development Envelope

Date: 25/10/2017 Paper: A4 L GDA94, MGA50

Data Source: 4A, 4D, 6A, 8A, 9A, 15I, 17A, LGATE-036

File Info: F05-J03_PipelineLayout_20171025



FIJV

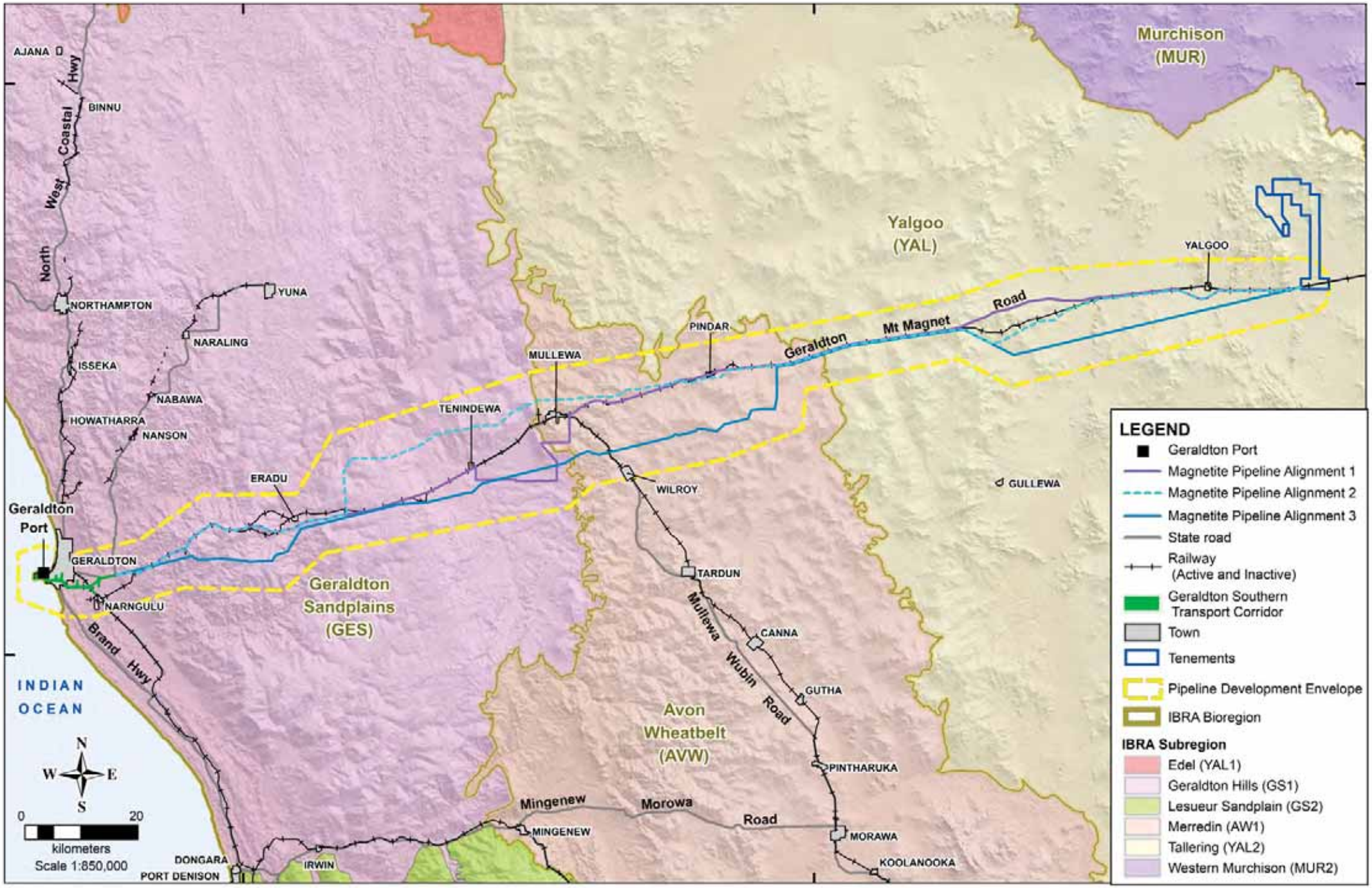
EnviroWorks CONSULTING

Figure 4: Pastoral Leases

Date: 25/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 9A, 10F, 14C, 15I, 17A, 17C

File Info: F05-J03_Pastoral_20171025



FIJV

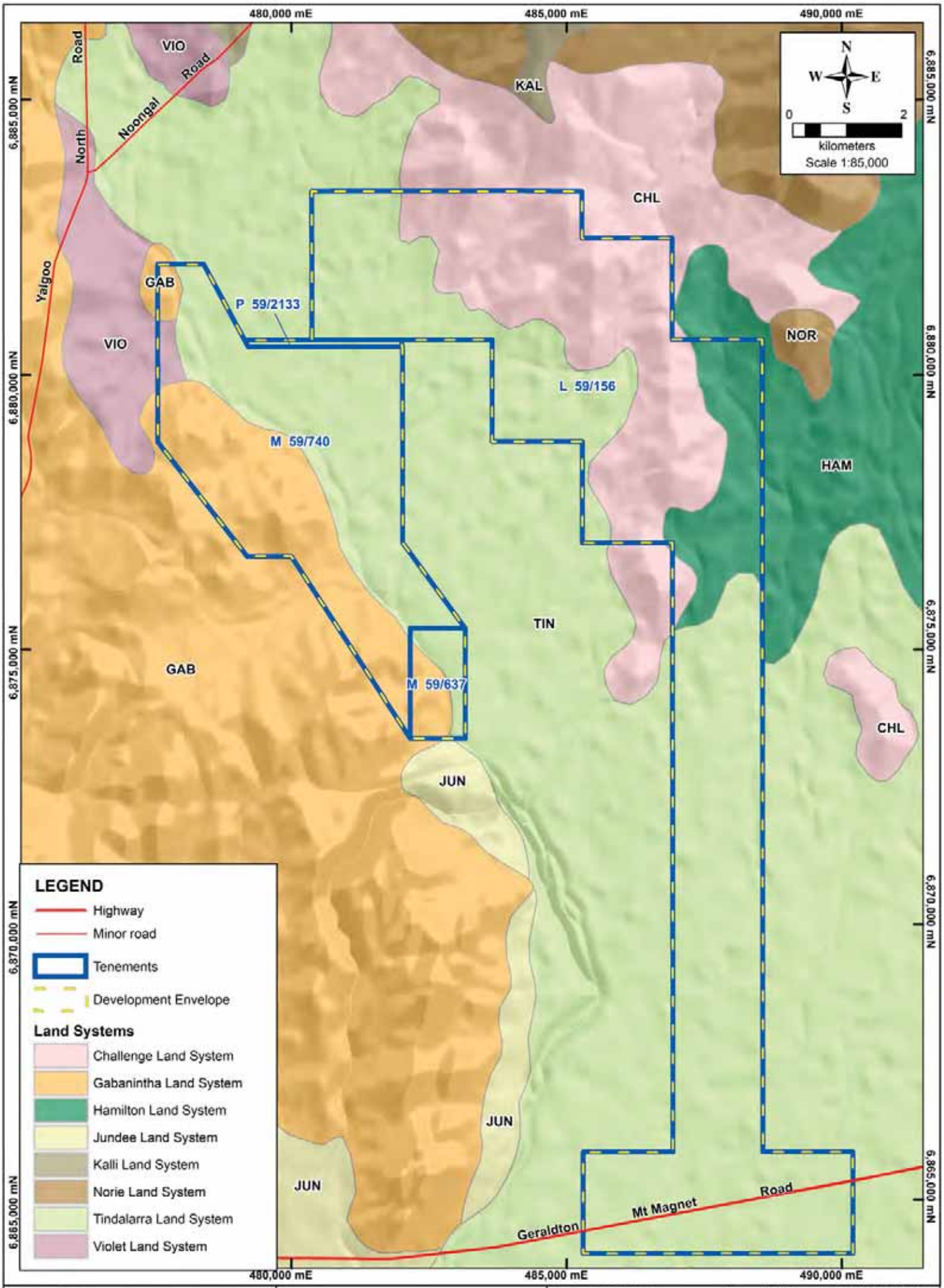
EnviroWorks CONSULTING

Figure 5: IBRA Subregions

Date: 25/10/2017 Paper: A4 L GDA94, MGA50

Data Source: 4A, 4D, 8A, 9A, 15I, 17A, LGATE-036

File Info: F05-J03_IBRA_20171024



FIJV

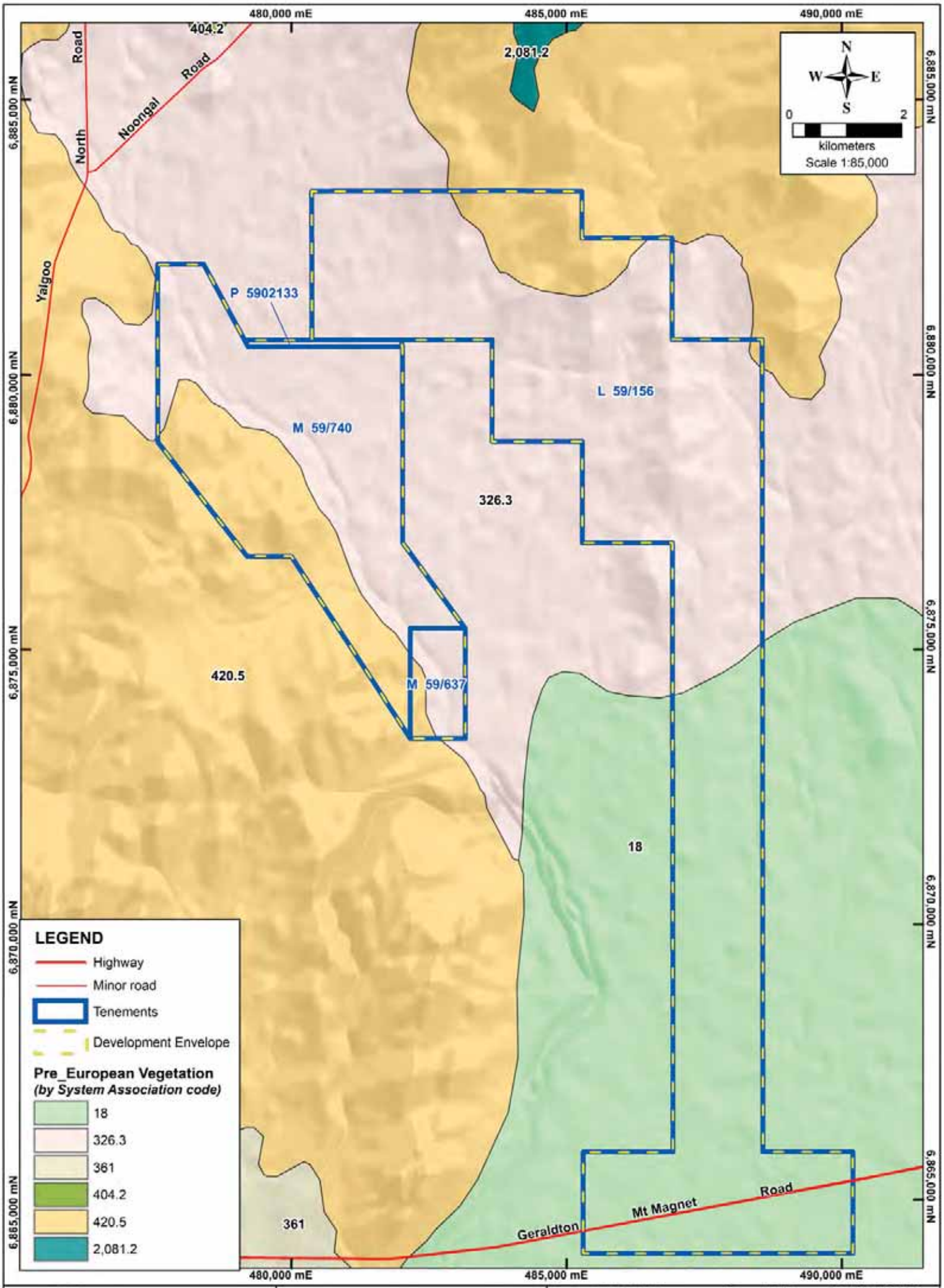
EnviroWorks CONSULTING

Figure 6: Yogi Land Systems

Date: 24/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 9A, 14A, 15I, 17A, 17C

File Info: F05-J03_LandSystems_20171024



FIJV

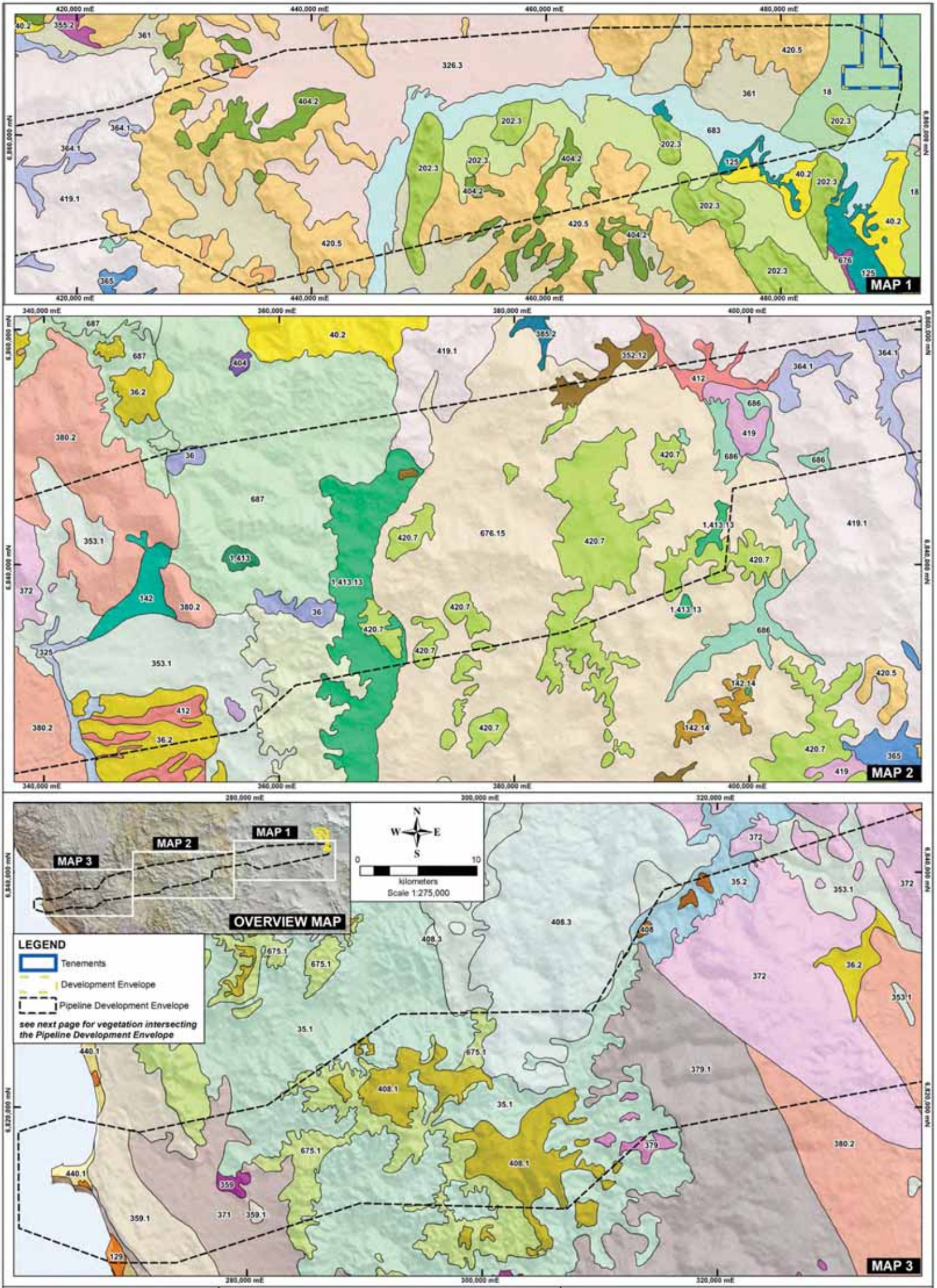
EnviroWorks CONSULTING

Figure 7a: Yogi
Pre-European Vegetation

Date: 24/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 9A, 15I, 17A, 17C, 20C

File Info: F05-J03_PreEuroVeg_20171024



FIJV

EnviroWorks CONSULTING

Figure 7b: Pipeline Development Envelope Pre-European Vegetation

Date: 24/10/2017	Paper: A3 P	GDA94, MGA50
Data Source: 9A, 15l, 17A, 17C, 20C		
File Info: F05-J03_PreEuroVeg_20171024		

LEGEND

Pre-European Vegetation (SA-Code) intersecting Pipeline Development Envelope

10: Eucalyptus open mallee shrubland

18: Acacia woodland

35.1: Eucalyptus isolated trees / Acacia open shrubland / Cephalipterum mixed open forbland

35.2: Eucalyptus mixed isolated trees / Acacia open shrubland

36: Acacia open shrubland / Allocasuarina mixed shrubland

36.2: MOSAIC
- Banksia mixed sparse shrubland / Acacia open shrubland / Acacia mixed heath
- Eucalyptus open mallee shrubland / Triodia open hummock grassland

40.2: Acacia open shrubland / Senna mixed sparse shrubland / Chamaexeros mixed open forbland

125: Bare areas; salt lakes

129: Bare areas; drift sand

142: Eucalyptus woodland

202.3: Eucalyptus sparse mallee shrubland / Acacia open shrubland / Ptilotus sparse forbland

325: Atriplex open chenopod shrubland

326.3: MOSAIC
- Acacia open shrubland / Senna mixed sparse shrubland / Chamaexeros mixed open forbland
- Acacia open shrubland

352.12: Eucalyptus open mallee shrubland / Acacia mixed sparse shrubland

353.1: Eucalyptus isolated trees / Acacia mixed open shrubland

359: Acacia open shrubland

359.1: Acacia mixed open forest / Acacia mixed open shrubland

361: Acacia isolated trees / Acacia open shrubland

364.1: Eucalyptus mixed isolated mallee shrubs / Acacia open shrubland

371: Eucalyptus isolated trees / Acacia shrubland

372: Allocasuarina mixed shrubland

379: Banksia mixed sparse shrubland / Allocasuarina mixed shrubland

380.2: MOSAIC
- Actinostrobus mixed sparse shrubland / Verticordia mixed heath
- Acacia open shrubland / Baeckea mixed open heath

408.3: Acacia mixed open shrubland / Acacia open shrubland / Acacia mixed heath

412: Melaleuca open shrubland / Halosarcia open samphire shrubland

419: Melaleuca mixed shrubland

419.1: MOSAIC
- Acacia mixed shrubland / Amphipogon mixed sparse tussock grassland
- Allocasuarina mixed shrubland / Amphipogon mixed sparse tussock grassland
- Acacia mixed shrubland / Amphipogon mixed sparse tussock grassland

420.5: Allocasuarina mixed sparse shrubland

420.7: Acacia open shrubland / Dodonaea mixed sparse shrubland / Cephalipterum mixed forbland

379.1: Banksia mixed open woodland / Allocasuarina mixed shrubland / Anigozanthos mixed open forbland

404.2: Acacia open shrubland / Bursaria mixed sparse shrubland / Brachyscome mixed sparse forbland

408: Allocasuarina mixed sparse shrubland / Acacia mixed shrubland

408.1: MOSAIC
- Nuytsia open woodland / Gastrolobium mixed shrubland / Baeckea mixed open heath
- Banksia open shrubland / Allocasuarina mixed shrubland

431.1: MOSAIC
- Spinifex mixed open tussock grassland
- Acacia open shrubland / Acanthocarpus open forbland

440.1: MOSAIC
- Acacia open shrubland
- Spinifex mixed open tussock grassland
- Acacia sparse shrubland / Myoporum mixed open shrubland / Spinifex mixed open tussock grassland

675.1: MOSAIC
- Nuytsia mixed isolated trees / Melaleuca mixed closed shrubland / Melaleuca heath
- Allocasuarina mixed closed shrubland / Hibbertia mixed sparse heath

676.15: MOSAIC
- Halosarcia open samphire shrubland
- Melaleuca sparse shrubland

683: Acacia isolated shrubs / Halosarcia open samphire shrubland

684: MOSAIC
- Eucalyptus isolated trees / Acacia open shrubland
- Allocasuarina shrubland

684.1: MOSAIC
- Allocasuarina mixed sparse shrubland / Verticordia heath
- Acacia shrubland
- Eucalyptus isolated mallee trees / Allocasuarina closed shrubland / Pimelea mixed open heath
- Acacia isolated trees / Acacia shrubland

686: Eucalyptus woodland

687: Eucalyptus mixed isolated trees / Acacia open shrubland

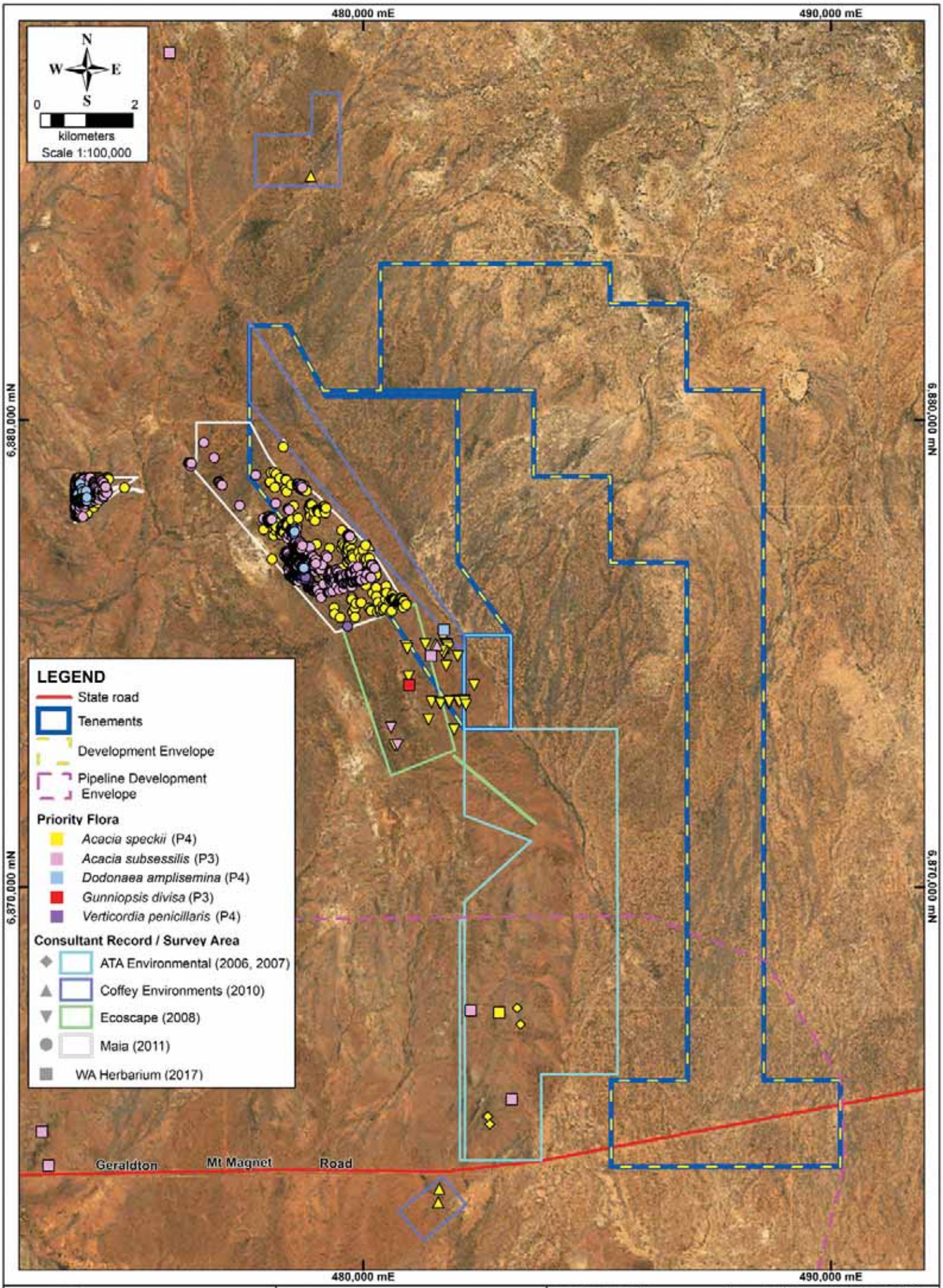
1,413: Acacia mixed shrubland

1,413.13: Eucalyptus isolated trees / Acacia mixed shrubland

Figure 7b: System Association Legend

FIJV

EnviroWorks CONSULTING



FIJV

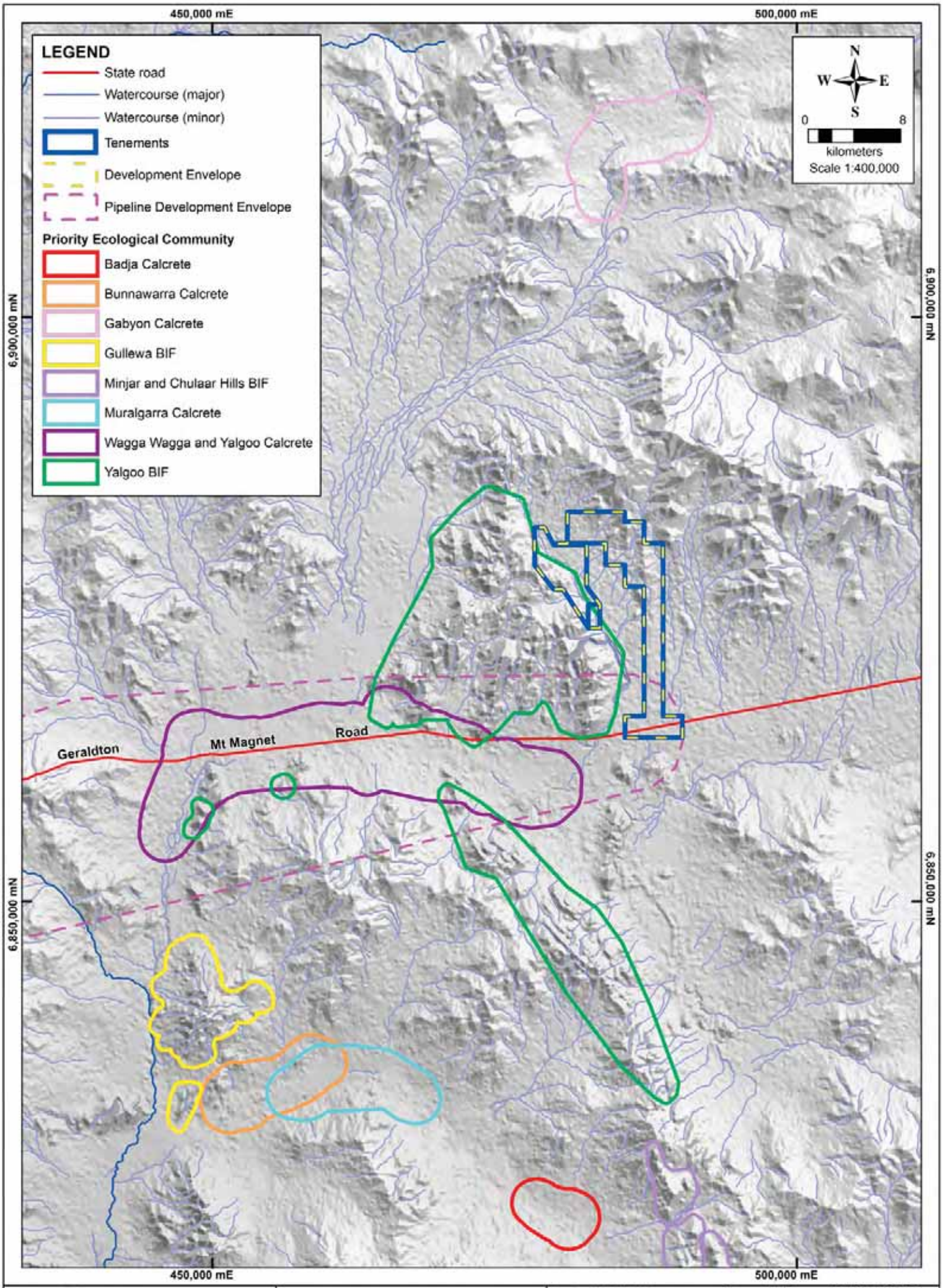
EnviroWorks CONSULTING

Figure 8.
Conservation Flora

Date: 25/102017 Paper: A4 P GDA94, MGA50

Data Source: 4A, 13D, 15I, 17A

File Info: F05-J03_PriorityFlora_20171024



FIJV

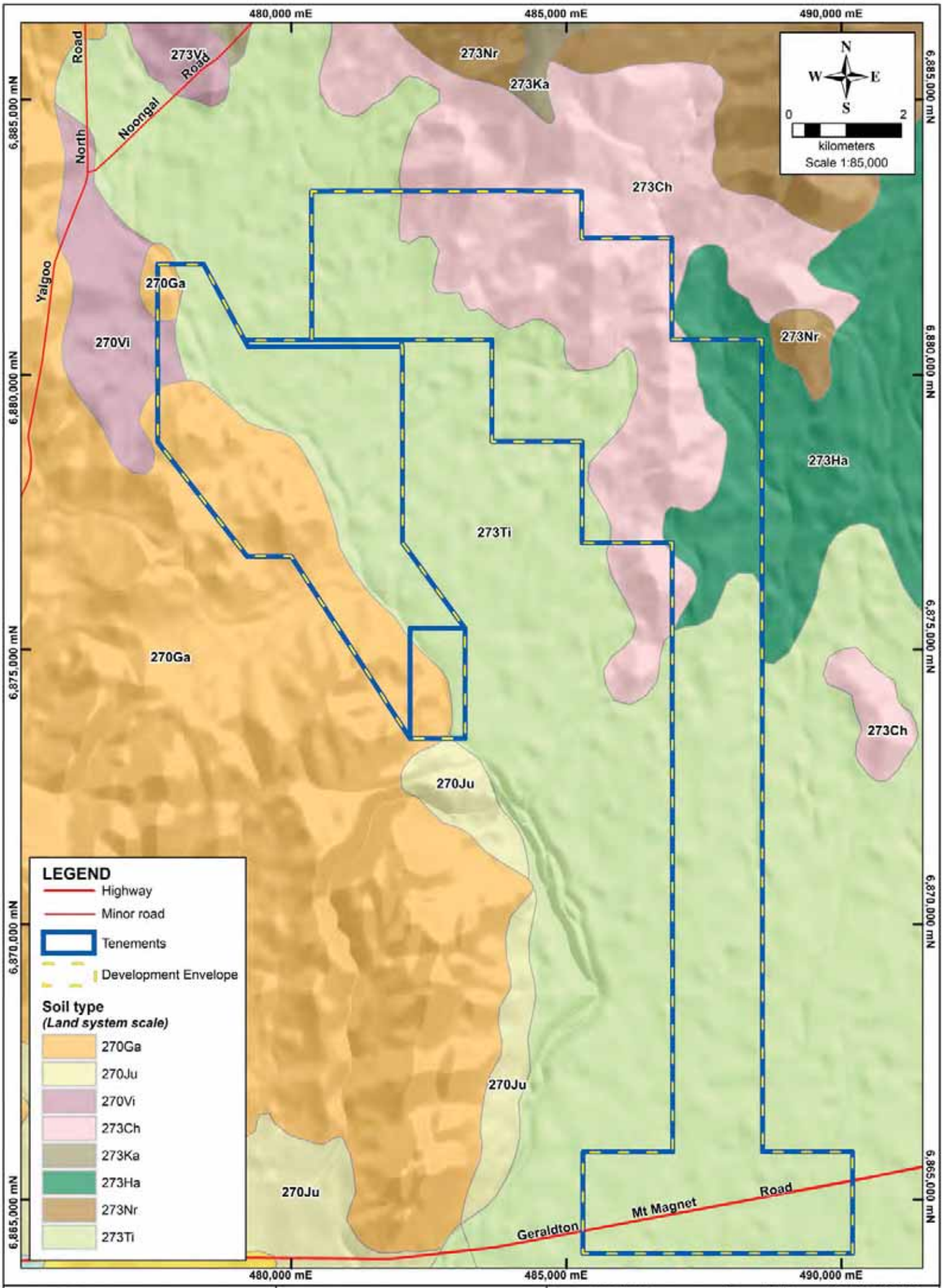
EnviroWorks CONSULTING

Figure 9: Priority Ecological Communities

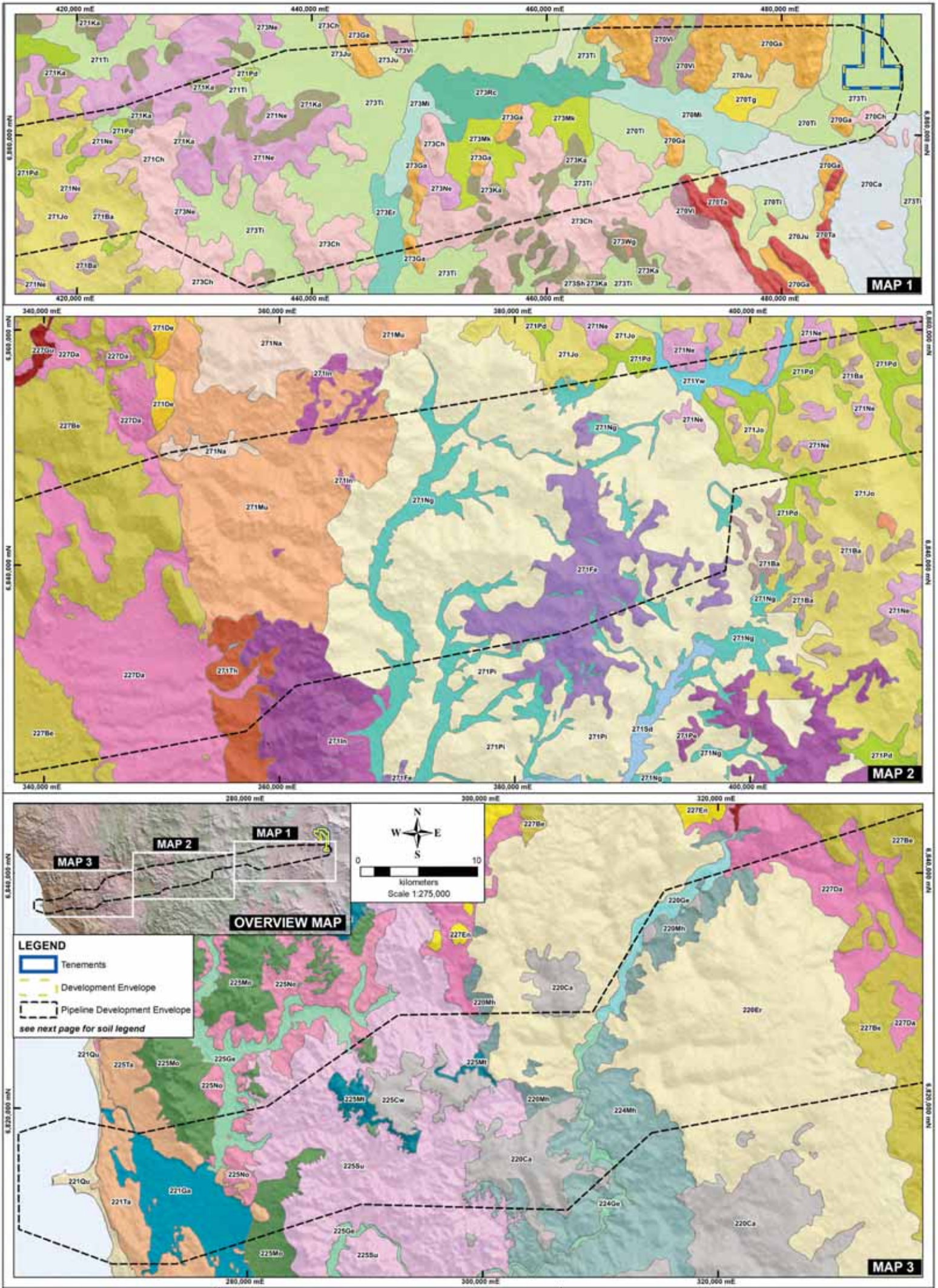
Date: 24/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 4A, 9A, 15I, 17A, DBCA

File Info: F05-J03_PECTEC_20171024



FIJV / EnviroWorks CONSULTING	**Figure 10a: Soils**	Date: 24/10/2017 Paper: A4 P GDA94, MGA50 Data Source: 9A, 15I, 17A, 17C, 18E File Info: F05-J03_Soils_20171024



FIJV

EnviroWorks CONSULTING

Figure 10b: Soils

Date: 24/10/2017	Paper: A3 P	GDA94, MGA50
Data Source: 9A, 15I, 17A, 17C, 18E		
File Info: F05-J03_Soils_20171024		

LEGEND

Soil Descriptions (Land System Scale)

271Na:
Broad valleys draining to Greenough River with undulating to rolling rises and rocky ridges between level and very gently inclined valley flats.

21Qu:
Coastal dune system, including foredunes, beach ridge plains, parabolic dunes, deflation basins and flats. No fixed drainage. Calcareous deep and shallow sands. Coastal heathlands and scrub.

271Pe:
Dissected undulating landscape of narrow valleys divided by stony ridges. Granite outcrops common.

271Mu:
Dissected undulating terrain with rocky hill crests, gentle slopes and numerous drainage lines.

271Ka, 273Ka:
Elevated gently undulating red sandplains edged by stripped surfaces on laterite and granite, supporting acacia tall shrublands with wanderrie grass understoreys.

271Ng:
Extensive level flats to very gently inclined slopes in broad valleys. Associated drainage networks are often saline.

271Yw:
Flat saline floodplains supporting halophytic shrublands dominated by samphire, saltbush, snakewood and spiny snakewood.

225Mo:
Flat topped ranges and isolated mesas.

271In:
Gently inclined to undulating slopes on upland surfaces with low laterite breakaways.

270Vi, 273Vi:
Gritty-surfaced plains and low outcrops of granite with scattered acacia shrublands.

270Ch, 271Ch, 273Ch:
Gently undulating gritty and sandy surfaced plains, occasional granite hills, tors and low breakaways, supporting acacia shrublands and occasional halophytic shrublands.

271Fe:
Gently undulating low rises and hillcrests of broad mature valleys, in upper Irwin River catchment.

271Pi:
Gently undulating sandplain with long gentle slopes.

227Be:
Gently undulating sandplain with numerous dune ridges. Alluvial valley slopes and sandplain remnants underlain by Permian sediments. Yellow deep sand and sandplain soils.

271Th:
Gently undulating terrain with stony rises and gentle slopes. Calcareous rocky soils, gradational red sandy loams and calcareous red and brown clays with gilgai microrelief.

270Ga, 273Ga:
Greenstone ridges, hills and footslopes supporting sparse acacia and other mainly non-halophytic shrublands.

271Ba:
Gently undulating gravelly plains on greenstone, laterite and hardpan, with low stony rises and minor saline plains; supporting groved mulga and bowgada shrublands and occasionally chenopod shrublands.

270Yl:
Hardpan plains and drainage tracts carrying concentrated flow, supporting mulga, curara and other acacia shrublands.

273Rn:
Hardpan plains and prominent broad drainage tracts supporting dense mulga tall shrublands.

273Mk:
Hardpan plains with occasional sandy banks supporting mulga tall shrublands and wanderrie grasses.

270Ju, 273Ju:
Hardpan plains with variable gravelly mantles and minor sandy banks supporting weakly groved mulga shrublands.

225Mt:
Lateritic breakaways and long gentle slopes broken by low gravel ridges and broad open depressions

220Mh:
Lateritic breakaways and long gentle slopes broken by low gravel ridges and broad open depressions (undulating low hills) on sand and laterite over Permian and Mesozoic sediments. Pale and yellow deep sands with sandy gravel and sand over gravel.

224Mh:
Lateritic breakaways with spillway sands. Long gentle slopes broken by low gravel ridges and broad open depressions.

221Ga:
Level alluvial plain with areas of minor terracing

220Er:
Level to gently undulating sandplain. Drainage lines absent with a few soaks. Permian and Mesozoic sediments mainly formed insitu. Yellow deep sand and sandy earth.

220Ca, 225Cw:
Level to gently undulating sandplain; Yellow deep sand and sand over gravel, some pale deep sands, yellow sandy earths and sandy gravels

271Pd:
Loamy plains surrounded by sandplain supporting York gum woodlands and acacia shrublands.

271Sd:
Narrow drainage lines to broad level salt plains in broad mature valleys.

225No:
Narrow valleys with gently undulating to rolling rises and low hills with an integrated drainage system.

Near level hardpan wash plains, narrow drainage lines and moderately saline drainage floors; supporting tall mixed acacia shrublands with wanderrie grasses, also minor saltbush/bluebush low shrublands.

273Rc:
Partly calcreted alluvial plains with dense acacia shrublands and bluebush and saltbush low shrublands.

270Ta:
Prominent ridges and hills of banded ironstone, dolerite and sedimentary rocks supporting bowgada and other acacia shrublands.

221Ta, 225Ta:
Rises and low hills with relict dunes and some limestone outcrop on coastal limestone north of Jurien Bay. Yellow deep sands common, with yellow/brown shallow sands and calcareous shallow and deep sands. Banksia woodlands and heathlands

220Ge:
River beds, terraces and alluvial flats, includes dissected margins of relic alluvial plains (level plain) on alluvium. Shallow sandy duplex, and red loamy and sandy earths. York gum woodland, Acacia-Hakea scrub, river red gum woodland.

224Ge, 225Ge:
River beds, terraces and alluvial flats, includes dissected margins of relic alluvial plains.

270Mi, 273Mi:
Saline and non-saline calcreted river plains with flood plains and calcrete platforms supporting variable tall shrublands, mixed halophytic shrublands and shrubby grasslands.

270Tg:
Saline hardpan plains with ironstone gravel mantles supporting mulga tall shrublands with halophytic and non-halophytic understorey shrubs.

270Ca:
Salt lakes with fringing saline alluvial plains, kopi dunes and sandy banks, supporting halophytic shrublands and acacia tall shrublands.

273Er:
Tributary floodplains with shallow, erodible duplex soils on red-brown hardpan, more or less saline and supporting acacia shrublands with halophytic and non-halophytic undershrubs.

227Da:
Undulating plain with crests, slopes, dunes and drainage lines. Weathered Permean sediments. Red-brown hardpan shallow loam and red earths, loams, sands and duplexes.

271Ne, 273Ne:
Undulating plains of sandy-surfaced laterite and weathered granite with low remnant plateaux, breakaways and rises supporting acacia shrublands.

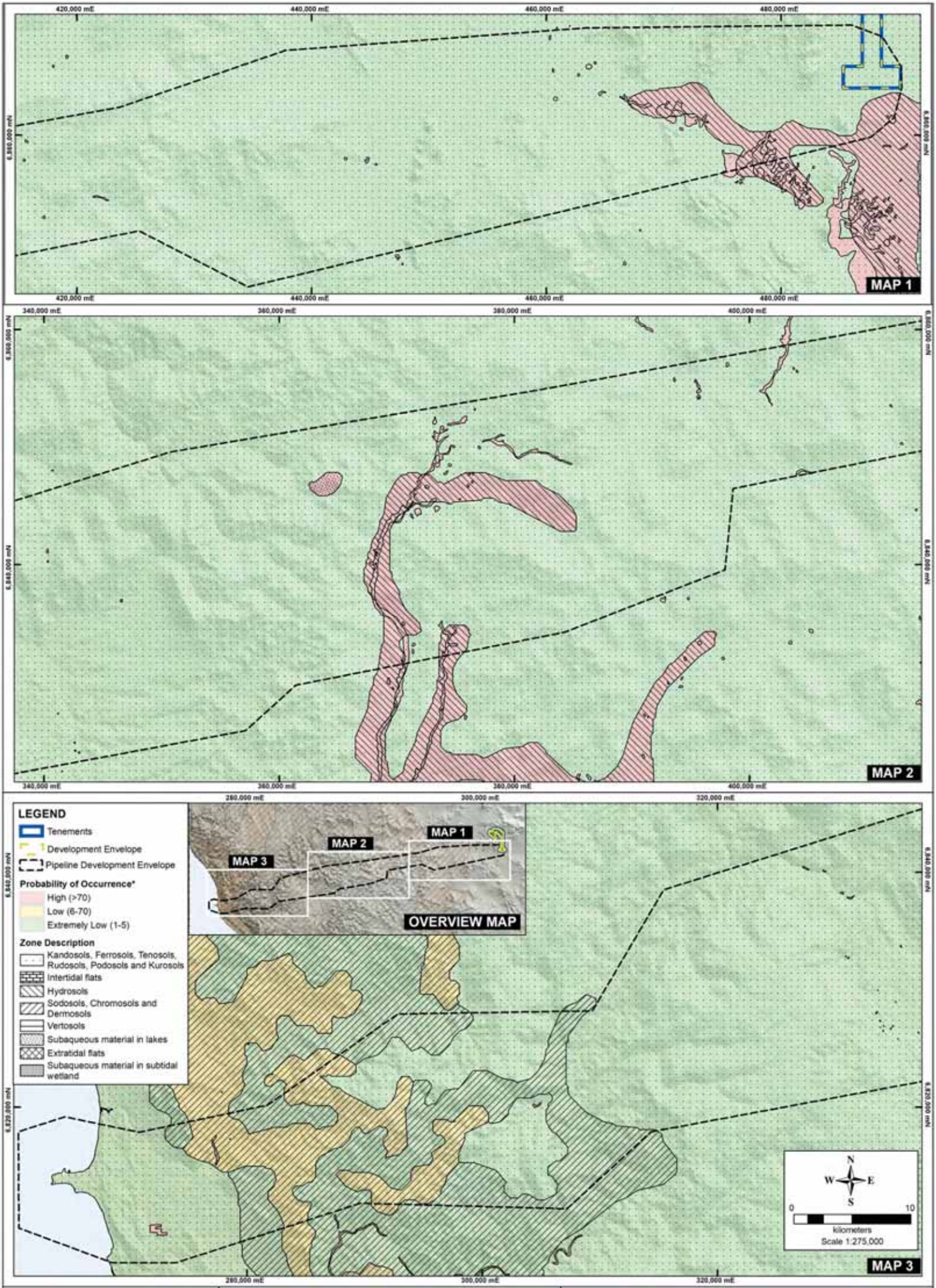
225Su:
Undulating to rolling rises with narrow valleys and an integrated drainage pattern.

271Jo:
Undulating yellow sandplain supporting dense mixed acacia, melaleuca and casuarina shrublands with patchy mallees.

Figure 10b: Soil Legend

FIJV

EnviroWorks CONSULTING

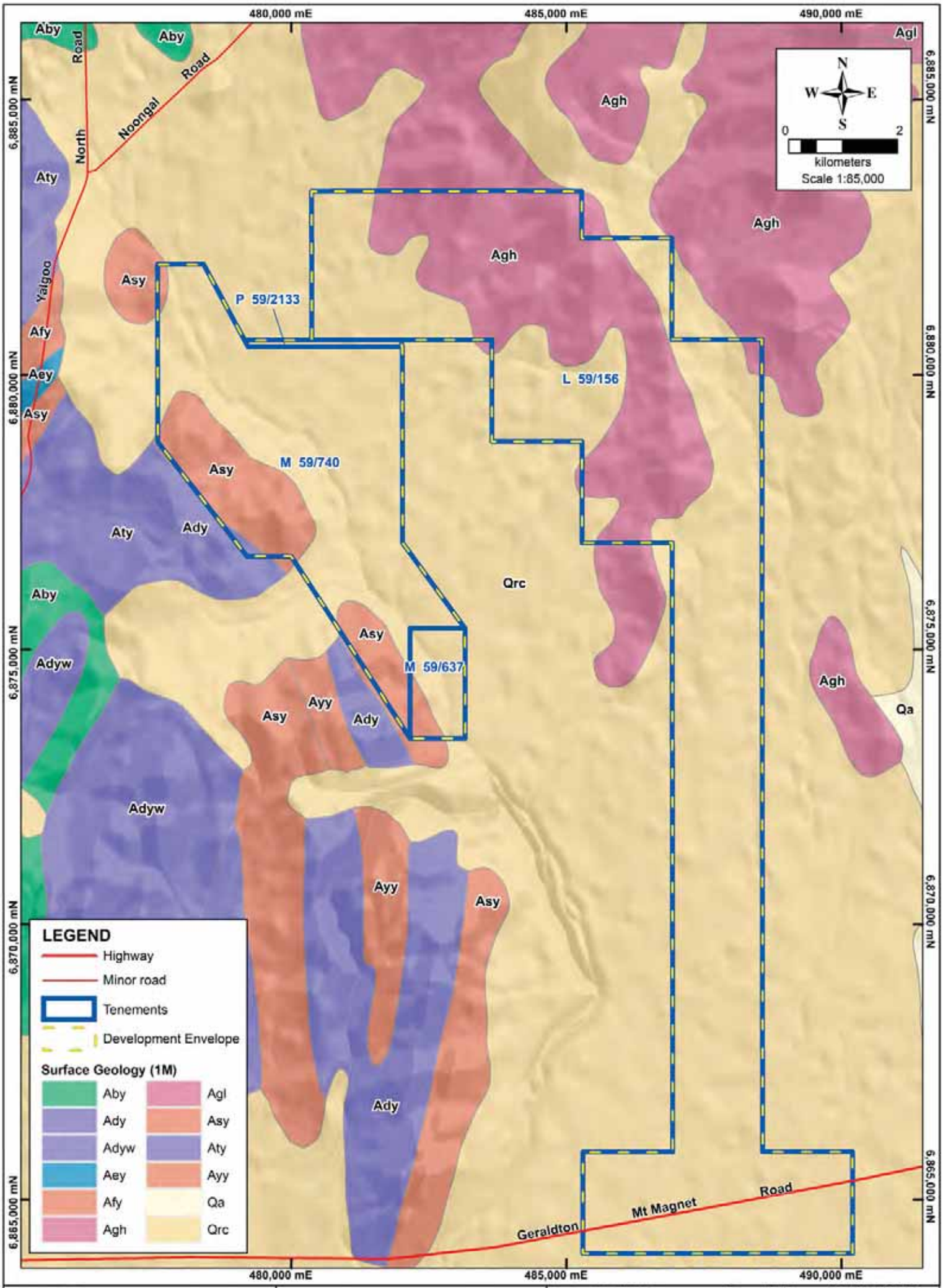


FIJV

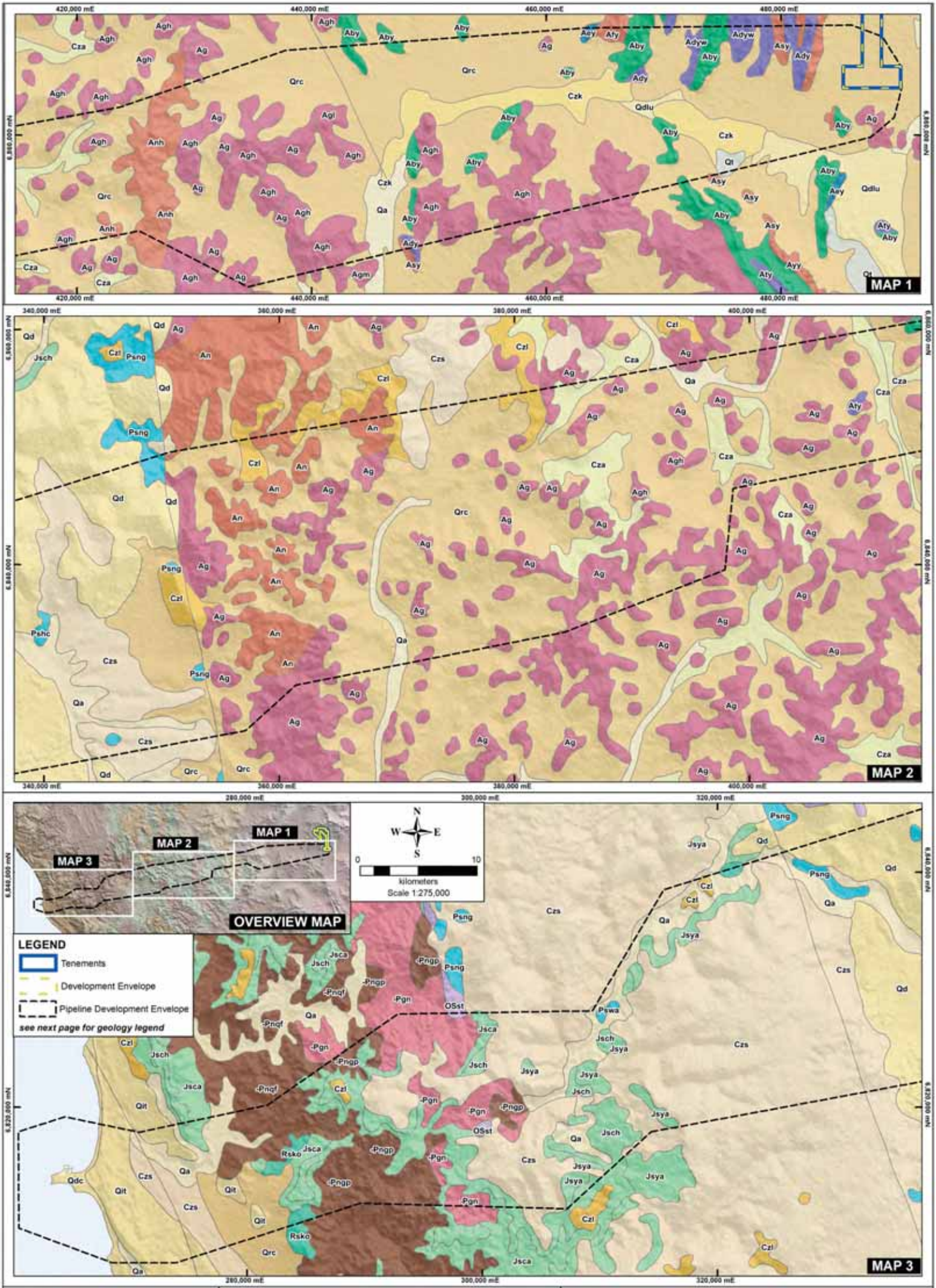
EnviroWorks CONSULTING

Figure 11: Acid Sulphate Soil Probability

Date: 24/10/2017	Paper: A3 P	GDA94, MGA50
Data Source: 9A, 15I, 17A, 17C, 18G		
File Info: F05-J03_AcidSulphateSoils_20171024		



FIJV / EnviroWorks CONSULTING	**Figure 12a: Surface Geology**
Date: 24/10/2017	Paper: A4 P GDA94, MGA50
Data Source: 9A, 11O, 15I, 17A, 17C	
File Info: F05-J03_Geology_20171024	



FIJV

EnviroWorks CONSULTING

Figure 12b: Surface Geology (1M)

Date: 24/10/2017	Paper: A3 P	GDA94, MGA50
Data Source: 9A, 11O, 15I, 17A, 17C		
File Info: F05-J03_Geology_20171024		

LEGEND

Surface Geology (1M) intersecting Pipeline Development Envelope

-Pgn: Porphyritic granite - includes contaminated facies (largely marginal)

-Pngp: Garnet paragneiss; Northhampton Block, Pinjarra Orogen

-Pnqf: Quartzofeldspathic gneiss; Northhampton Block, Pinjarra Orogen

Aby: Metabasalt, high-Mg basalt, tholeiitic basalt, carbonated basalt, agglomerate, mafic schist, dolerite, amphibolite; porphyritic basalt and dolerite; komatiitic basalt; mafic pyroclastics; minor mafic schist with granite intercalations

Ady: Mafic intrusive rocks, medium to coarse-grained; layered mafic to ultramafic intrusions; metadolerite; medium to coarse-grained metagabbro, dolerite and granophyre, local ultramafic bases

Adyw: Layered intrusion - some original minerals preserved

Aey: Metamorphosed komatiite, pyroxenite, chlorite-tremolite schist, talc-chlorite schist, anthophyllite-tremolite-talc rock; olivine-cummingtonite schist; talc-carbonate-tremolite-chlorite rock, serpentinite; amphibole schist after pyroxenite

Afy: Felsic volcanic and volcaniclastic rocks, locally amygdaloidal or fragmental; dacite, quartz-feldspar porphyry, tuff, agglomerate, andesitic lava, quartz-muscovite schist, felsic schist, felsic gneiss

Ag: Undifferentiated felsic intrusive rocks, including monzogranite, granodiorite, granite, tonalite, quartz monzonite, syenogranite, diorite, monzodiorite, pegmatite. Locally metamorphosed, foliated, gneissic. Local abundant mafic inclusions

Agh: Monzogranite, granodiorite, tonalite, quartz monzonite; in places recrystallised and foliated; some mixed granite and country rock assemblages; high-Ca granite

Agl: Syenogranite, alkali-feldspar granite, monzogranite; in places recrystallised; some mixed granite and country rock assemblages; low-Ca granite

Agm: Granite; mafic granite

An: Banded granitic gneiss (monzogranitic to granodioritic), quartzofeldspathic gneiss with mafic bands, migmatite, granofels, mafic and felsic granulites, hypersthene-plagioclase-quartz granulite; schist, pelitic or mafic granofels

Anh: Banded to agmatitic felsic and/or granitic gneiss, migmatite; high-Ca group.

Asy: Conglomerate, chert, small amounts felsic volcaniclastic rocks, sandstone, quartzite, siltstone, phyllite, schist, pelite, shale. Includes the former Hatfield Formation.

Aty: Amphibolite, mafic schist, mafic rock intercalated with granite, para-amphibolite; metabasalt, metagabbro, metapyroxenite and metadolerite; Youanmi Terrane

Ayy: Metasandstone, metashale, metasiltstone, metaconglomerate and meta-volcaniclastics, pelitic schists, phyllite, fuchsitic quartzite with clasts quartzite and felsic volcanic rock; quartzite; pelitic and psammitic gneiss

Cza: Reworked or incised alluvium in older stream channels; alluvial terraces above younger alluvium; alluvial and colluvial outwash deposits not in defined channel systems; lateritised alluvium; sand, silt, gravel, clay, evaporites

Czk: Calcrete, travertine; calcareous cementing of bedrock and transported materials; pisolitic to nodular or massive; as low mounds, in playa lakes, valley calcrete, or in subsurface; may contain intercalated chalcedony; locally dissected and karstified

Czl: Ferruginous duricrust, laterite; pisolitic, nodular, vuggy; may include massive to pisolitic ferruginous subsoil, mottled clays, magnesite, reworked products of ferruginous and siliceous duricrusts, calcrete, gossan; residual ferruginous saprolite

Czs: Sand or gravel plains; may include some residual alluvium; quartz sand sheets commonly with ferruginous pisoliths or pebbles; local clay, calcrete, laterite, silcrete, silt, colluvium

Jsca: Poorly sorted sandstone to conglomerate; ?fluviatile.

Jsch: Ferruginous sandstone, fossiliferous limestone, grey to black shale

Jsya: Fine to coarse-grained, poorly sorted feldspathic sandstone, thin beds of shale, siltstone; minor conglomerate and coal present.

OSst: Red-bed sequence; sandstone, siltstone, minor conglomerate; fluviatile, and marginal marine.

Pshc: Coarse-grained quartzofeldspathic sandstone, minor siltstone, claystone and carbonaceous shale.

Psho: Green to grey shale and siltstone with thin limestone beds, sporadic glacial erratics and cannonball concretions; marine.

Psng: Tillite, shale, tillitic sandstone, conglomerate; continental to marine.

Pswa: Fine- to medium-grained clayey quartz sandstone; minor conglomerate, shale, siltstone and coal.

Qa: Channel and flood plain alluvium; gravel, sand, silt, clay; may be locally calcreted

Qd: Dunes, sandplain with dunes and swales; may include numerous interdune claypans; may be locally gypsiferous

Qdc: Coastal sand dunes, beach sand, barrier beaches, foredune, beach ridges; calcareous and siliceous, locally shelly and/or cemented (beach rock); locally reworked

Qdlu: Quartz and gypsum dunes and mounds (kopi); may include minor silt, sand, gravel, and clay flats adjacent to playas; locally includes some playa sediments

Qit: Unconsolidated to strongly lithified calcarenite with calcrete/ kankar soils; aeolian. Locally quartzose, feldspathic, or heavy-mineral-bearing.

Qrc: Colluvium and/or residual deposits, sheetwash, talus, scree; boulder, gravel, sand; may include minor alluvial or sand plain deposits, local calcrete and reworked laterite

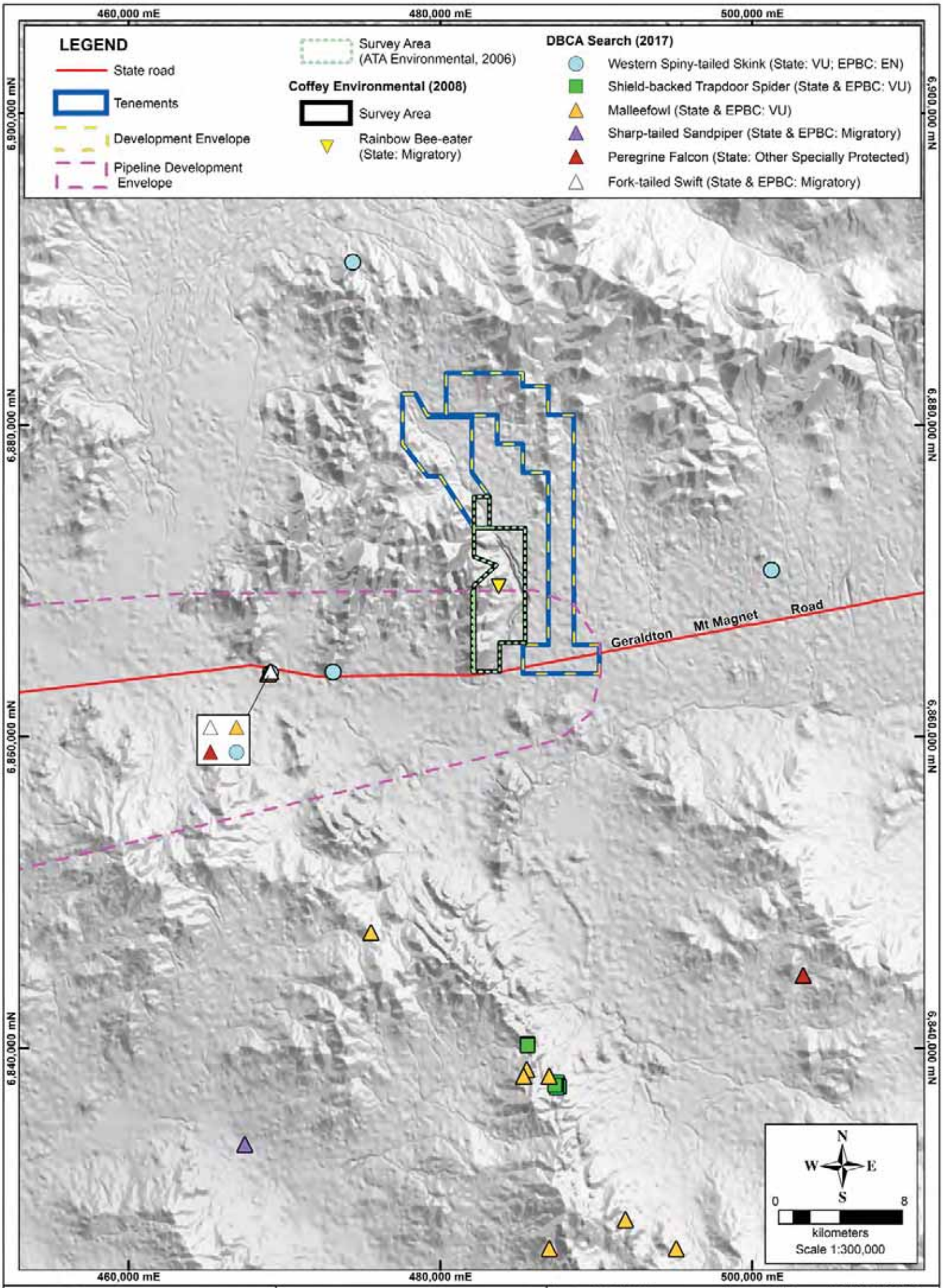
Qt: Lake and swamp deposits; mud, silt, evaporites, limestone; minor sand, peat

Rsko: Yellow and white shale and siltstone with purple ferruginous bands.

Figure 12b: Surface Geology Legend

FIJV

EnviroWorks CONSULTING



FIJV

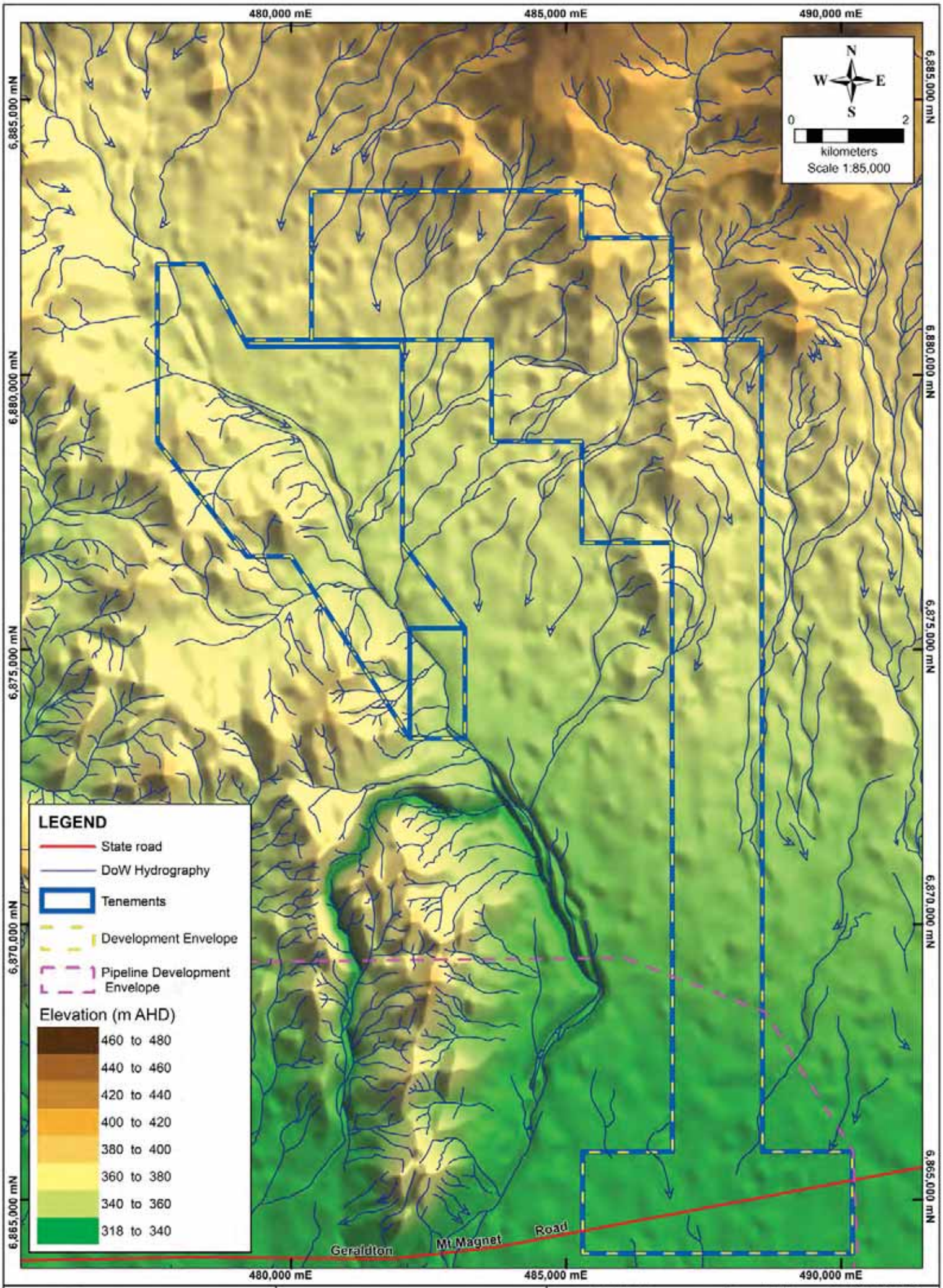
EnviroWorks CONSULTING

Figure 13.
Conservation Fauna

Date: 25/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 9E, 15I, 17A, DBCA

File Info: F05-J03_PriorityFauna_20171024



FIJV

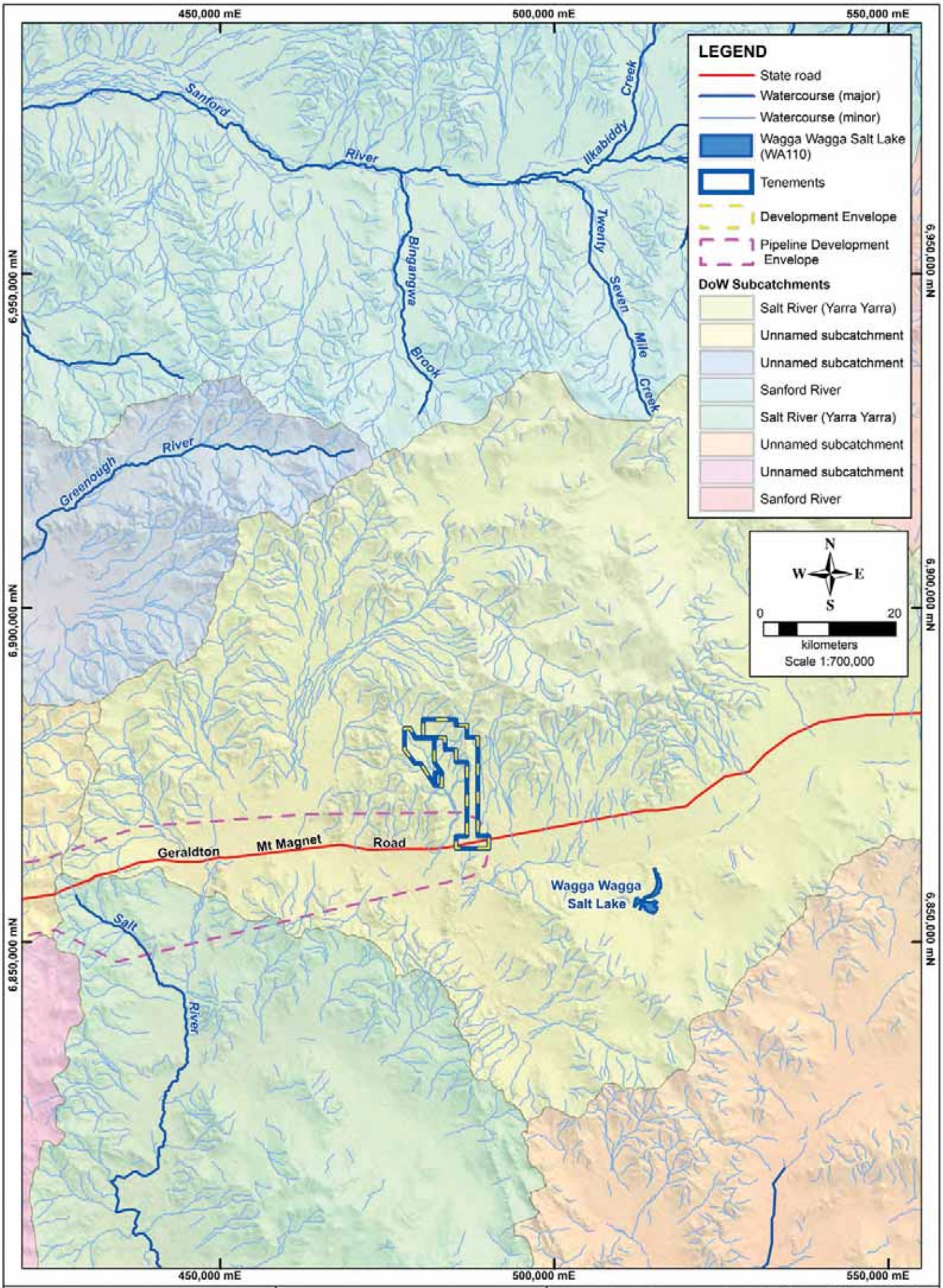
EnviroWorks CONSULTING

Figure 14: Topography

Date: 24/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 4A, 9A, 15I, 17A, DBCA

File Info: F05-J03_PECTEC_20171024



FIJV

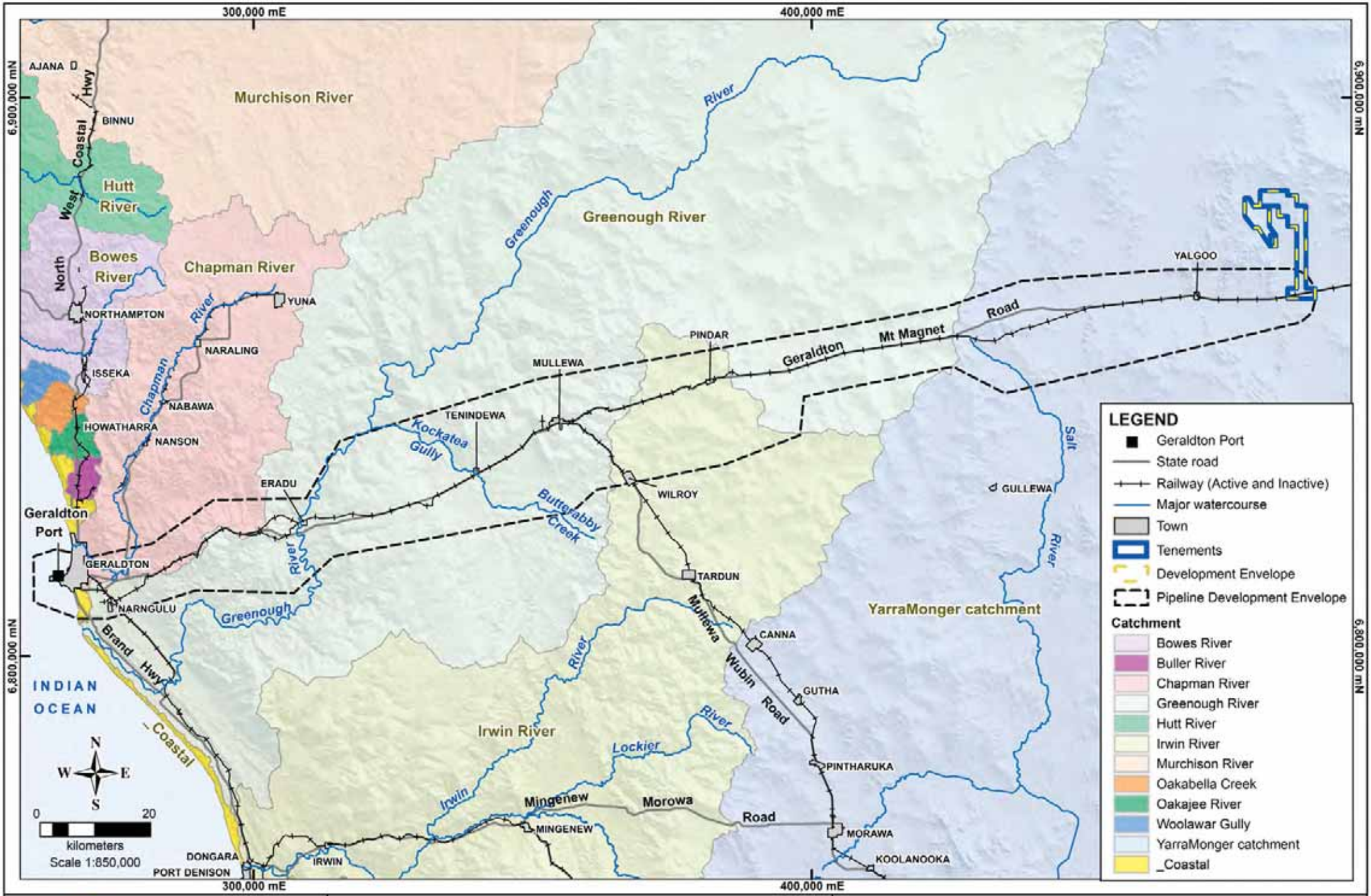
EnviroWorks CONSULTING

Figure 15a.
Surface Water Catchments

Date: 24/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 4A, 9A, 15I, 17A, 21U

File Info: F05-J03_Catchments_20171024



FIJV

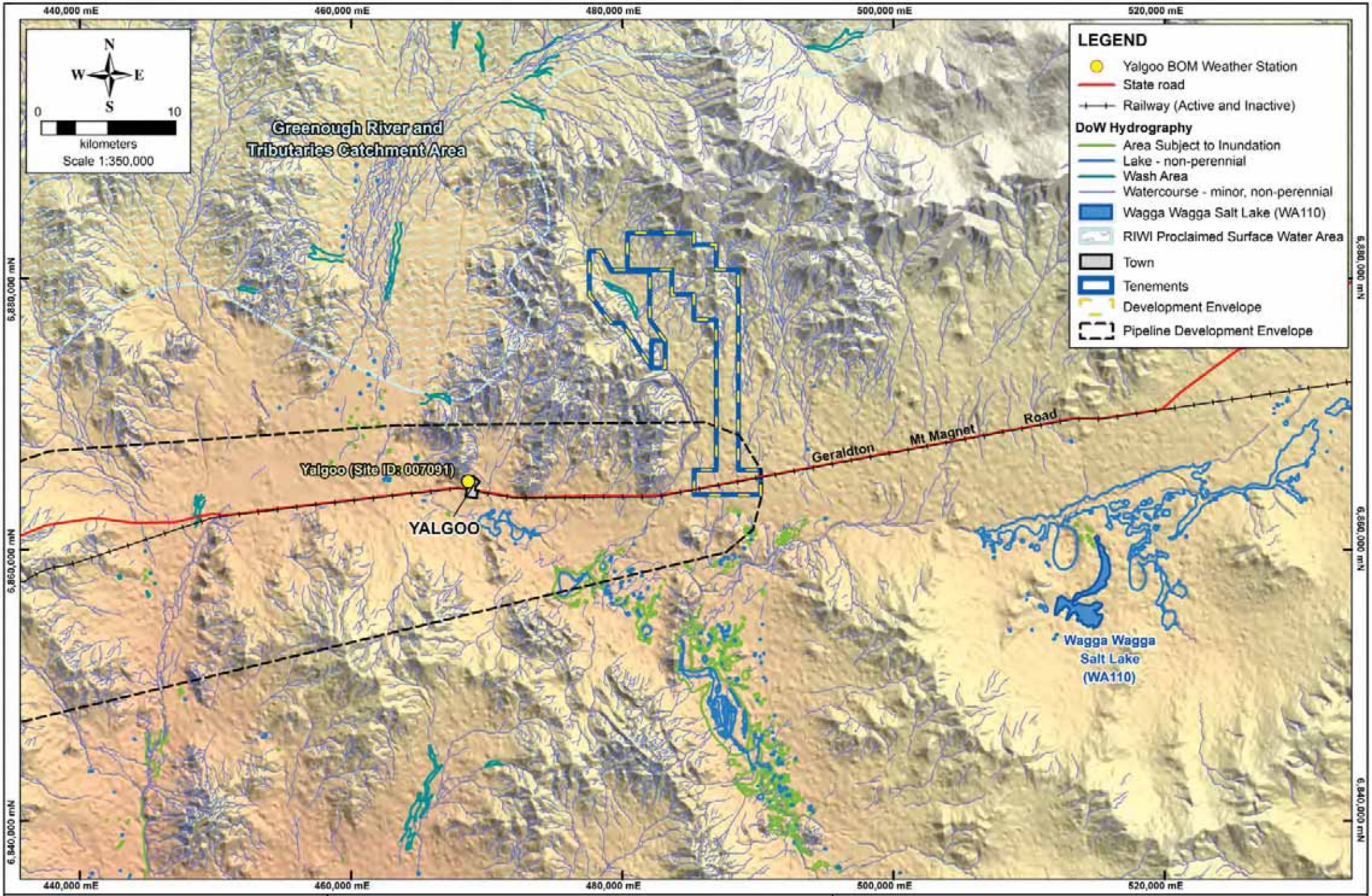
EnviroWorks CONSULTING

Figure 15b: Pipeline Development Envelope Catchments

Date: 25/10/2017 Paper: A4 L GDA94, MGA50

Data Source: 4A, 4D, 9A, 15I, 17A, 21S, LGATE-036

File Info: F05-J03_Catchments_20171024

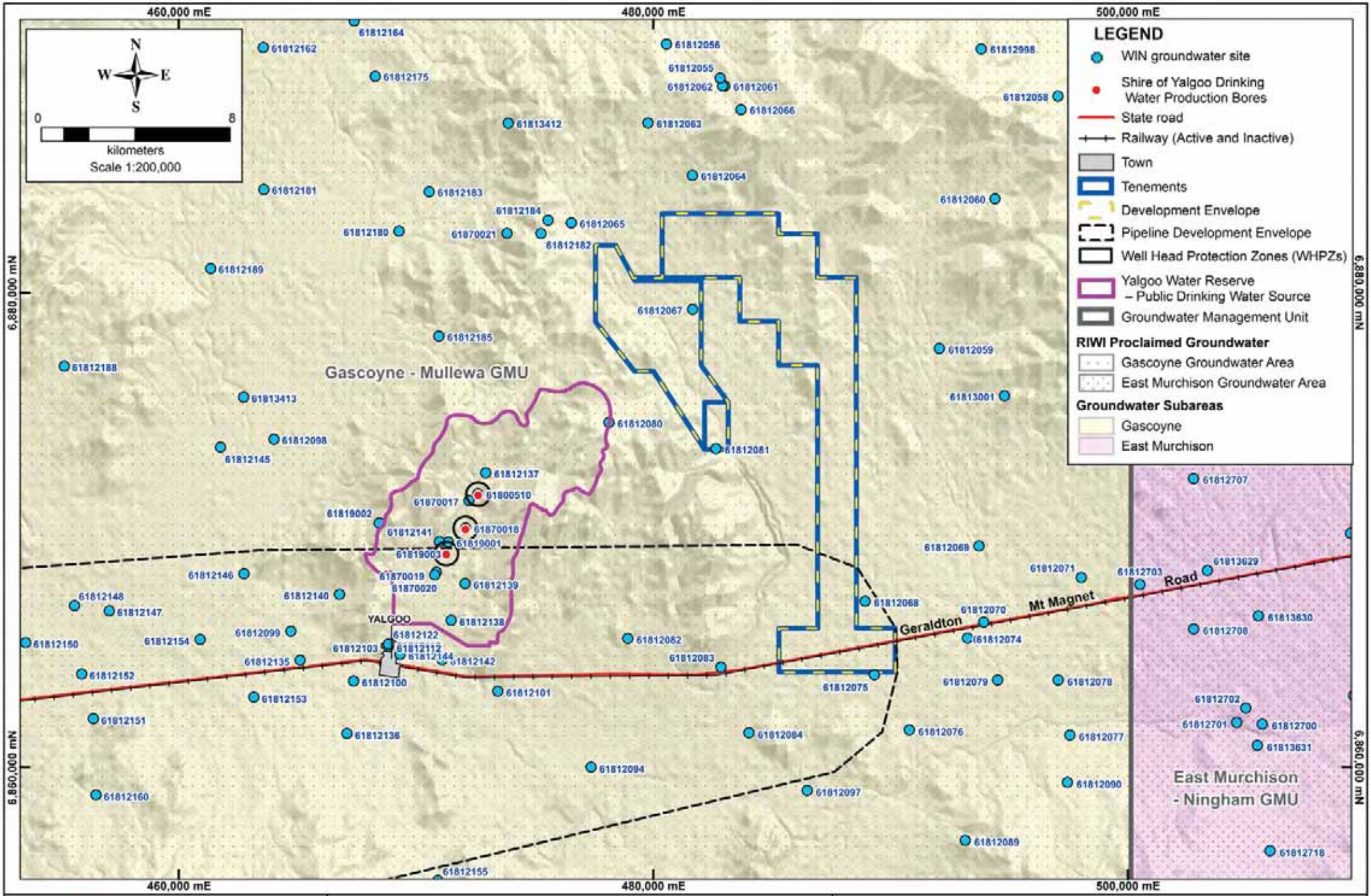


FIJV

EnviroWorks CONSULTING

Figure 16:Surface Water

Date: 25/10/2017	Paper: A4 L	GDA94, MGA50
Data Source: 4A, 4D, 9A, 15I, 17A, 21D, 21AC, 21AF, LGATE-036		
File Info: F05-J03_SurfaceWater_20171025		

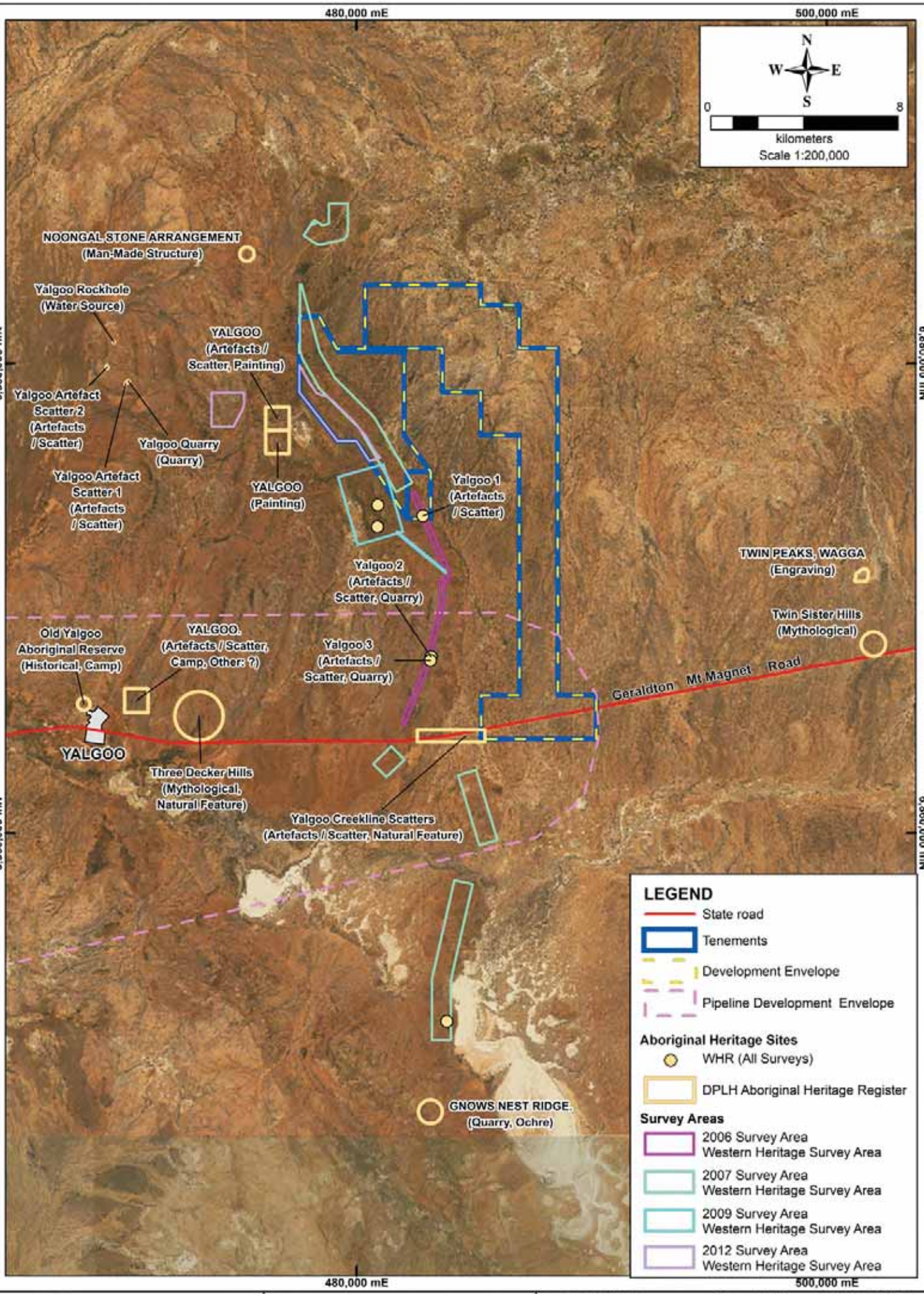


FIJV

EnviroWorks CONSULTING

Figure 17: Groundwater

Date: 25/10/2017	Paper: A4 L	GDA94, MGA50
Data Source: 4A, 4D, 9A, 15I, 17A, 21A, 21B, 21G, 21M, 21O, LGATE-036		
File Info: F05-J03_Groundwater_20171025		



FIJV

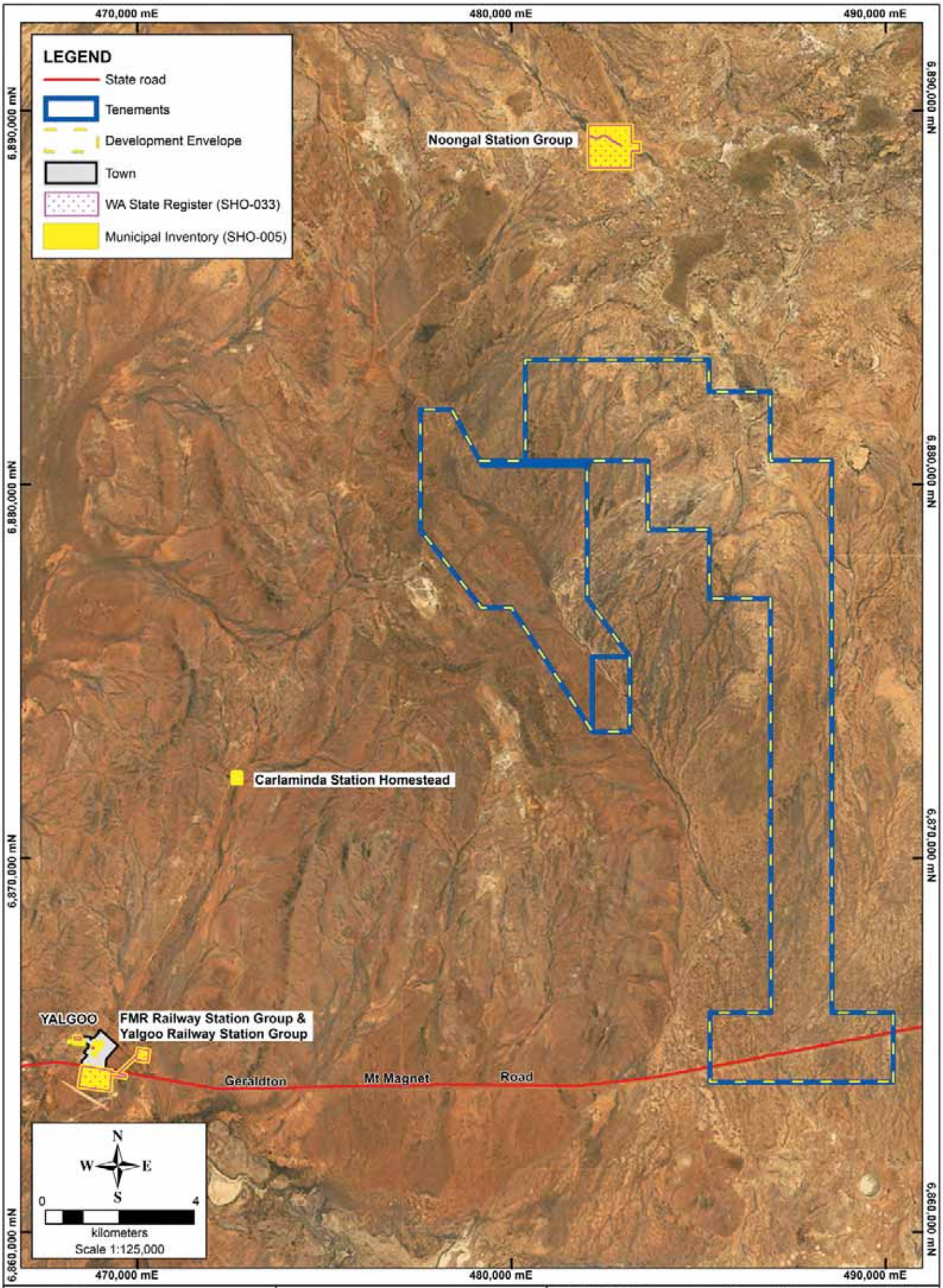
EnviroWorks CONSULTING

Figure 18: Aboriginal Heritage

Date: 25/10/2017 Paper: A4 P GDA94, MGA50

Data Source: 2H, 4A, 9A, 13D, 15I, 17A

File Info: F05-J03_Heritage_20171024



FIJV

EnviroWorks CONSULTING

Figure 19.
European Heritage

Date: 25/102017 Paper: A4 P GDA94, MGA50

Data Source: 12E, 12I. 13D, 15I, 17A

File Info: F05-J03_EuropeanHeritage_20171025

APPENDIX A. EPBC PROTECTED MATTERS SEARCH

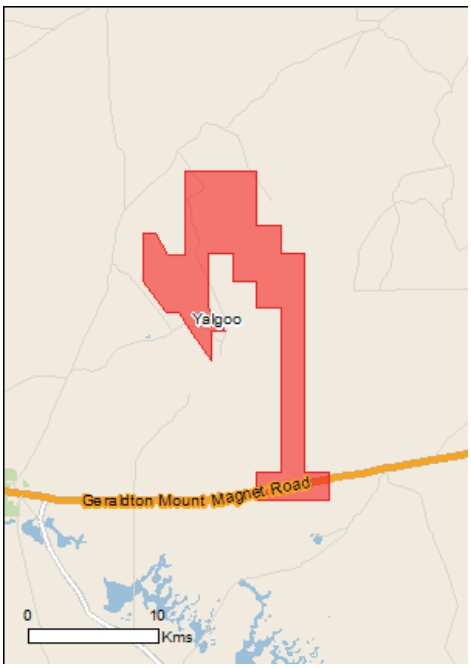
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

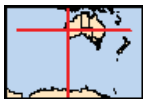
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 18/08/17 15:09:19



Coordinates
Buffer: 50.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	8
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	4
Regional Forest Agreements:	None
Invasive Species:	9
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area
Plants		
Eremophila viscida Varnish Bush [2394]	Endangered	Species or species habitat may occur within area
Ricinocarpos brevis [82879]	Endangered	Species or species habitat may occur within area
Reptiles		
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Barnong Pastoral Lease	WA
Dalgaranga and Noongal Pastoral Leases	WA
Narloo, part Yuin & part Twin Peaks Pastoral Leases	WA
Thundelarra	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		

Name	Status	Type of Presence
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Wagga Wagga Salt Lake	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-28.35 116.9,-28.333333 116.9,-28.333333 116.883333,-28.316667 116.883333,-28.3 116.883333,-28.283333 116.883333,-28.266667 116.883333,-28.25 116.883333,-28.233333 116.883333,-28.216667 116.883333,-28.2 116.883333,-28.2 116.866667,-28.183333 116.866667,-28.183333 116.85,-28.166667 116.85,-28.15 116.85,-28.15 116.833333,-28.15 116.816667,-28.15 116.8,-28.166667 116.8,-28.174 116.8,-28.2 116.8,-28.201087 116.799977,-28.201078 116.788154,-28.187527 116.779959,-28.187529 116.771428,-28.203708 116.771424,-28.21669 116.771421,-28.23546 116.787908,-28.235477 116.7961,-28.248699 116.805814,-28.265405 116.818092,-28.247358 116.818092,-28.247358 116.828281,-28.233302 116.816747,-28.214621 116.816748,-28.201099 116.816749,-28.2 116.816729,-28.2 116.833333,-28.216667 116.833333,-28.216667 116.85,-28.233333 116.85,-28.233333 116.866667,-28.25 116.866667,-28.266667 116.866667,-28.283333 116.866667,-28.3 116.866667,-28.316667 116.866667,-28.333333 116.866667,-28.333333 116.85,-28.35 116.85,-28.35 116.866667,-28.35 116.883333,-28.35 116.9

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

APPENDIX B. MONTHLY WINDROSES – 9AM AND 3PM

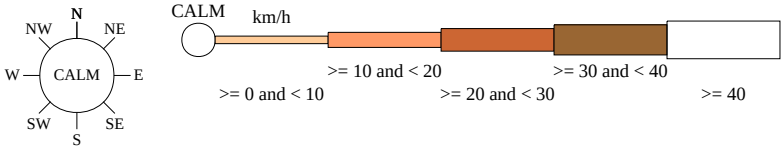
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

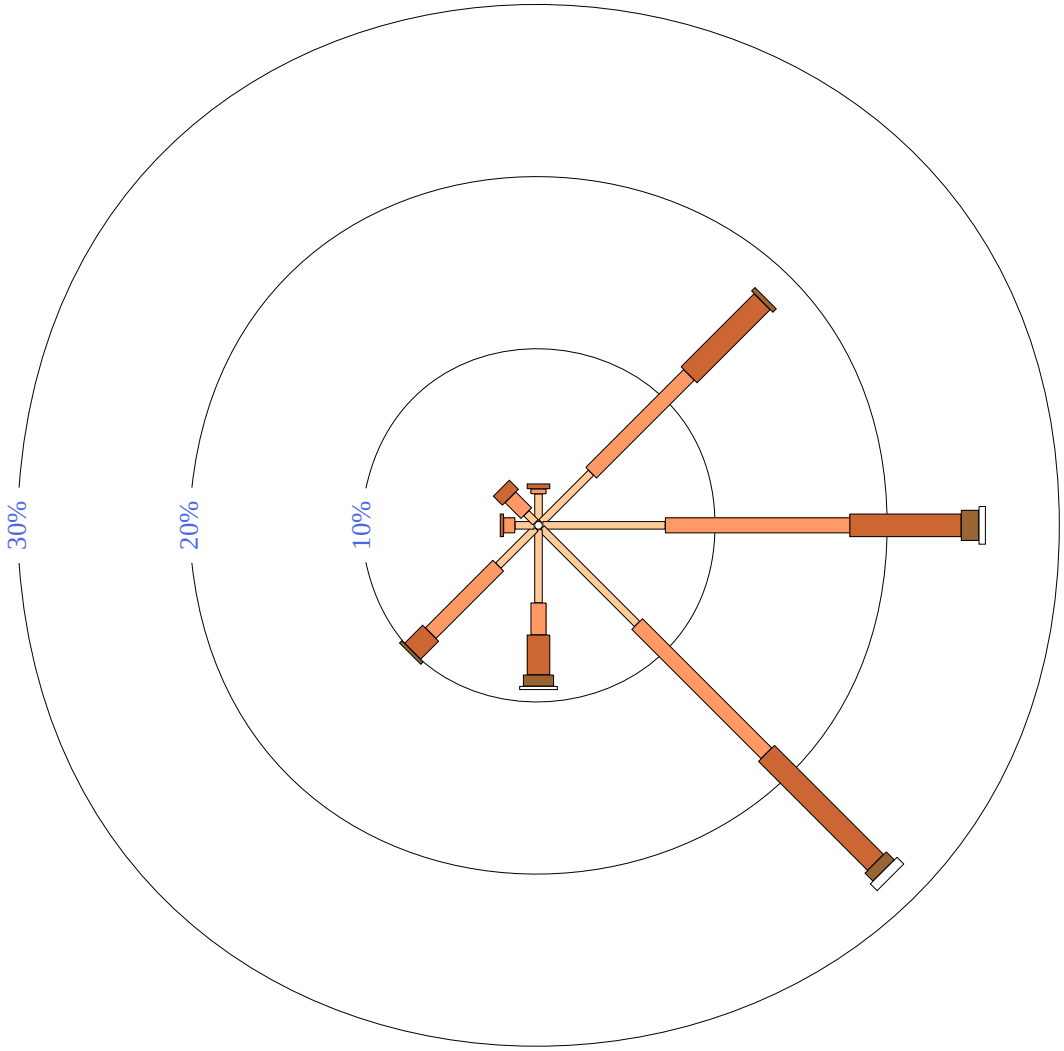
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Jan
542 Total Observations

Calm 1%



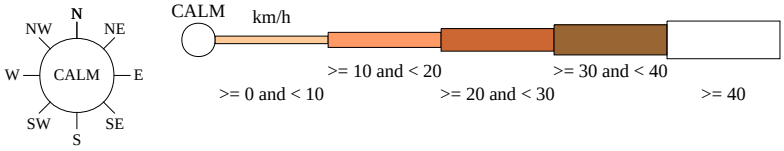
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

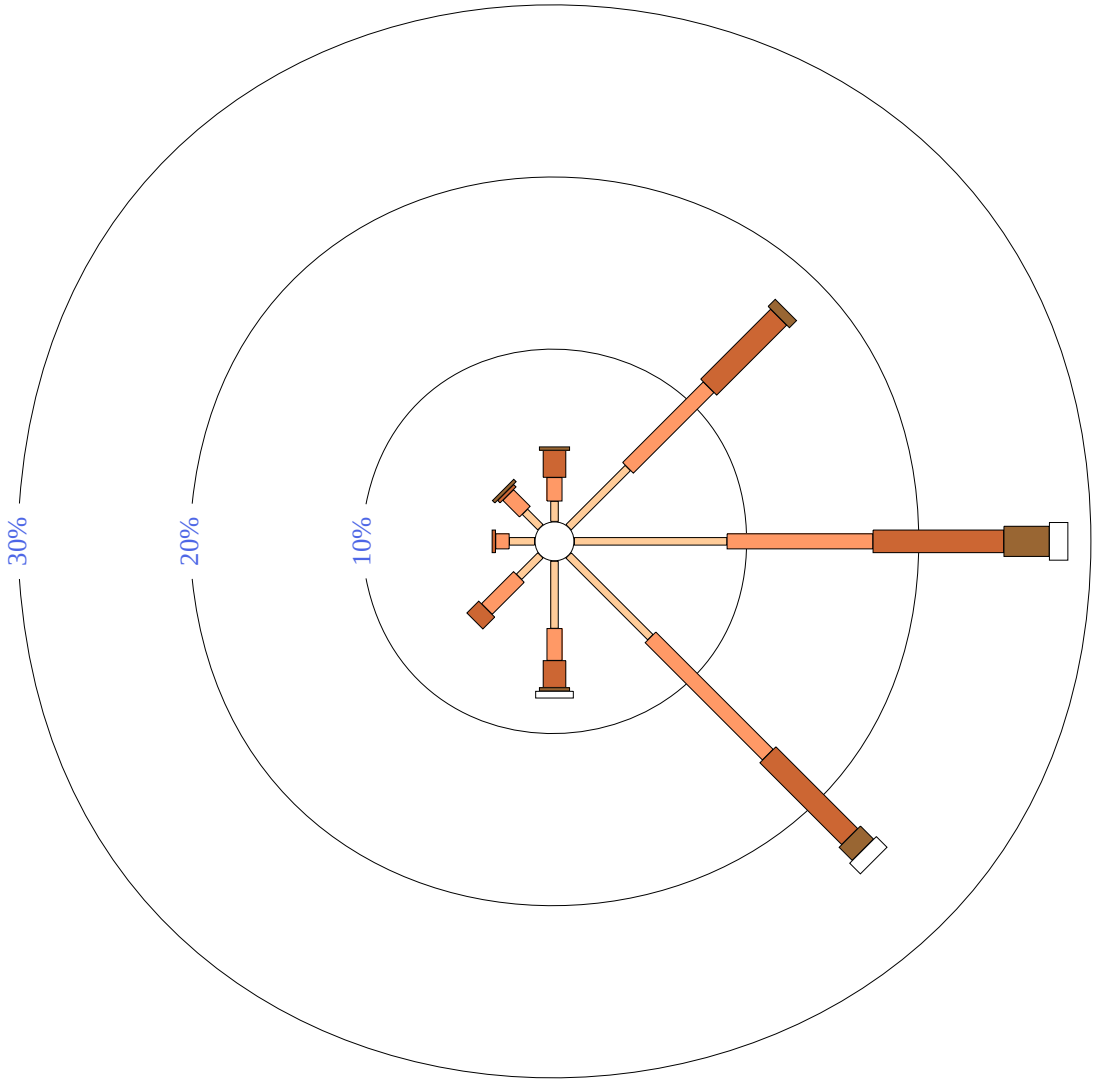
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Feb
514 Total Observations

Calm 6%



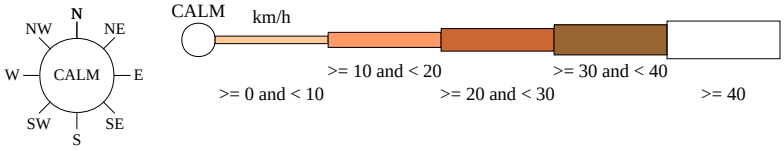
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

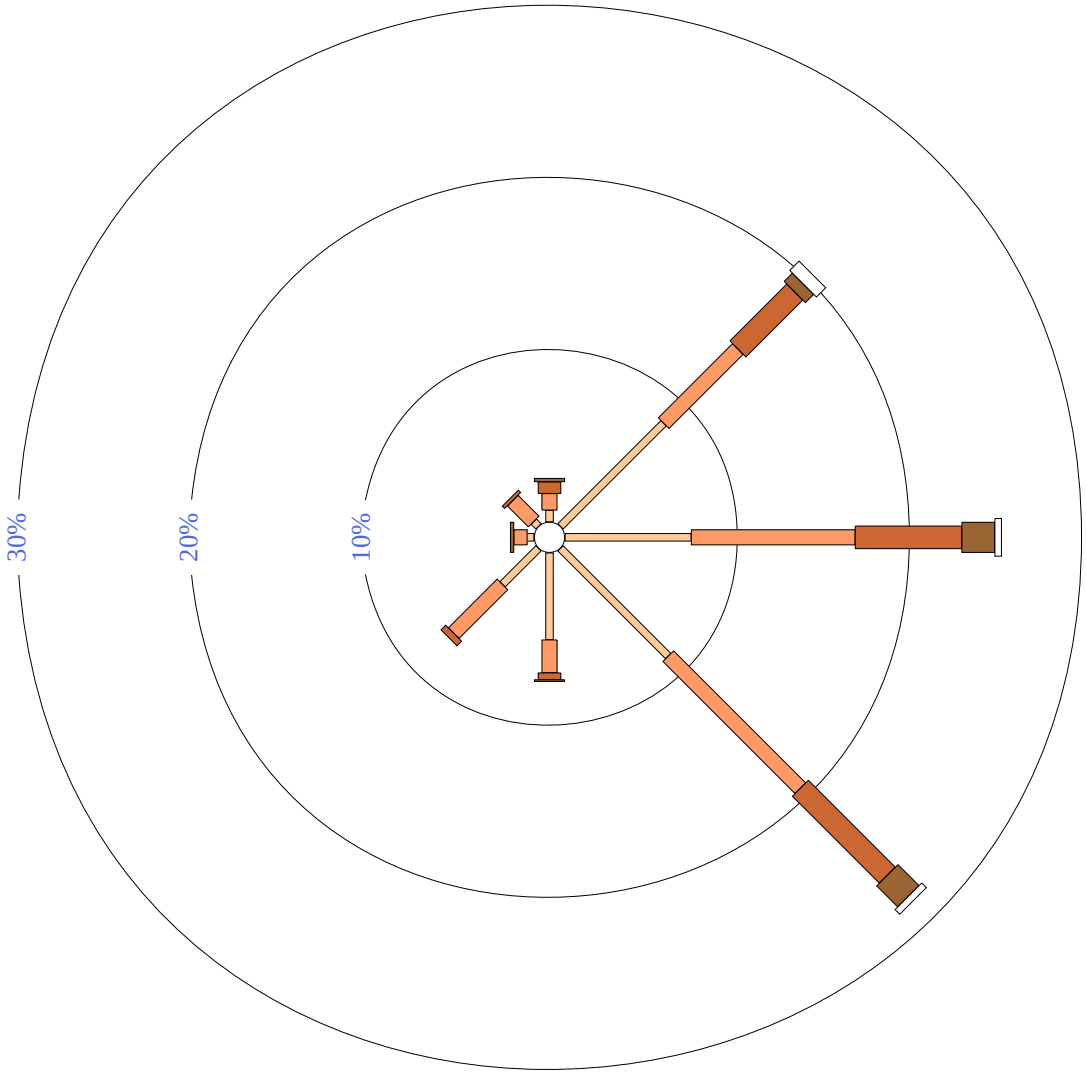
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Mar
526 Total Observations

Calm 4%



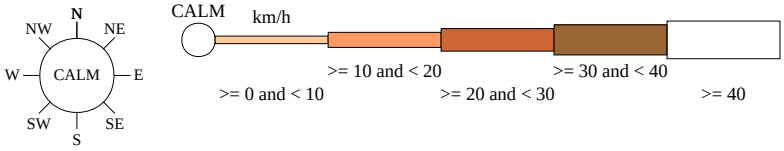
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

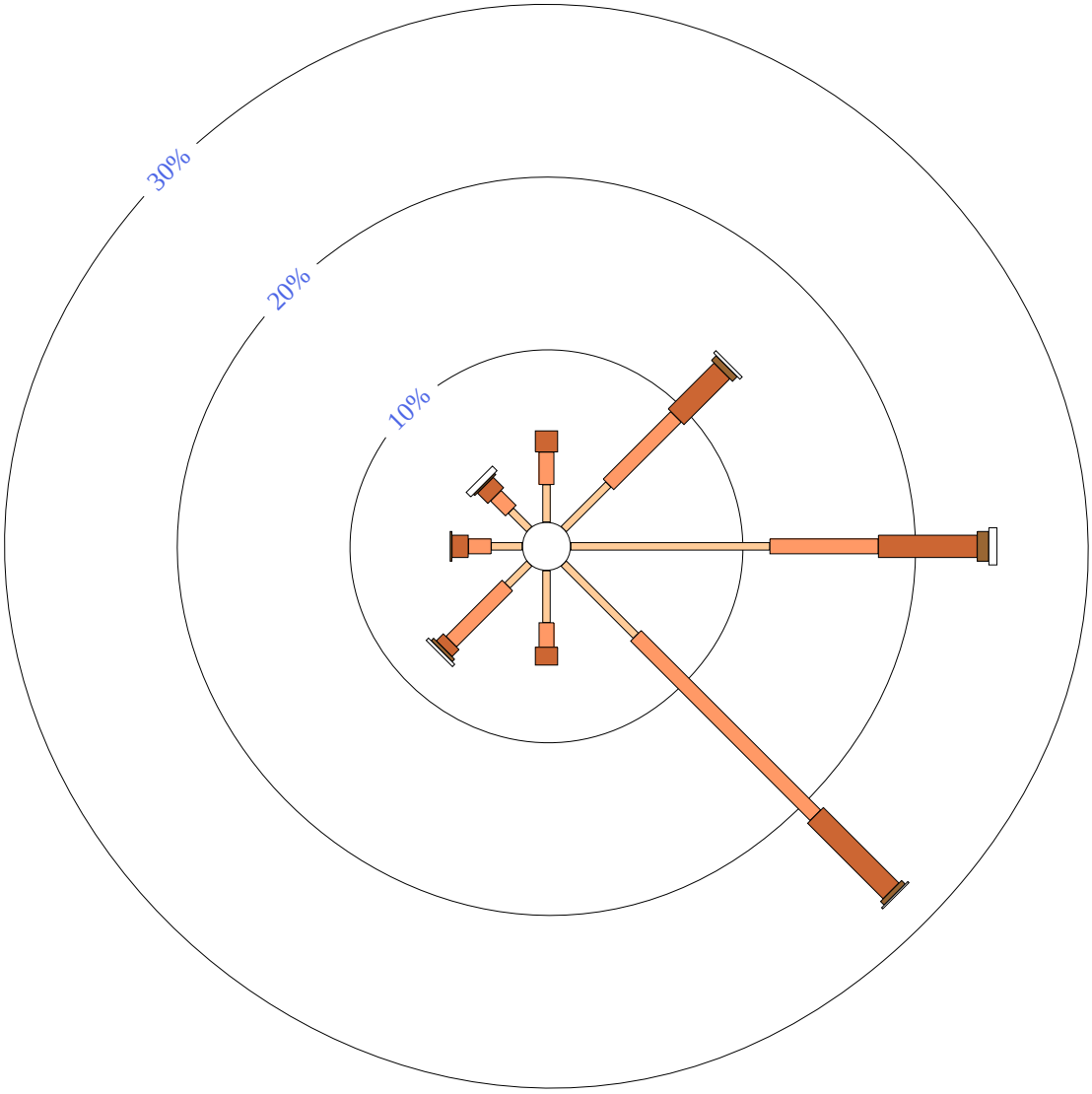
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Apr
525 Total Observations

Calm 7%



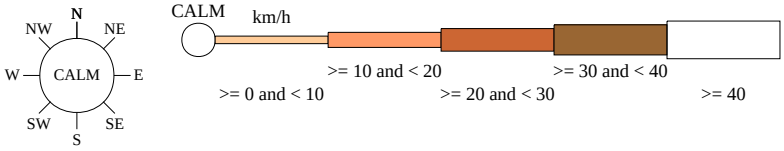
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

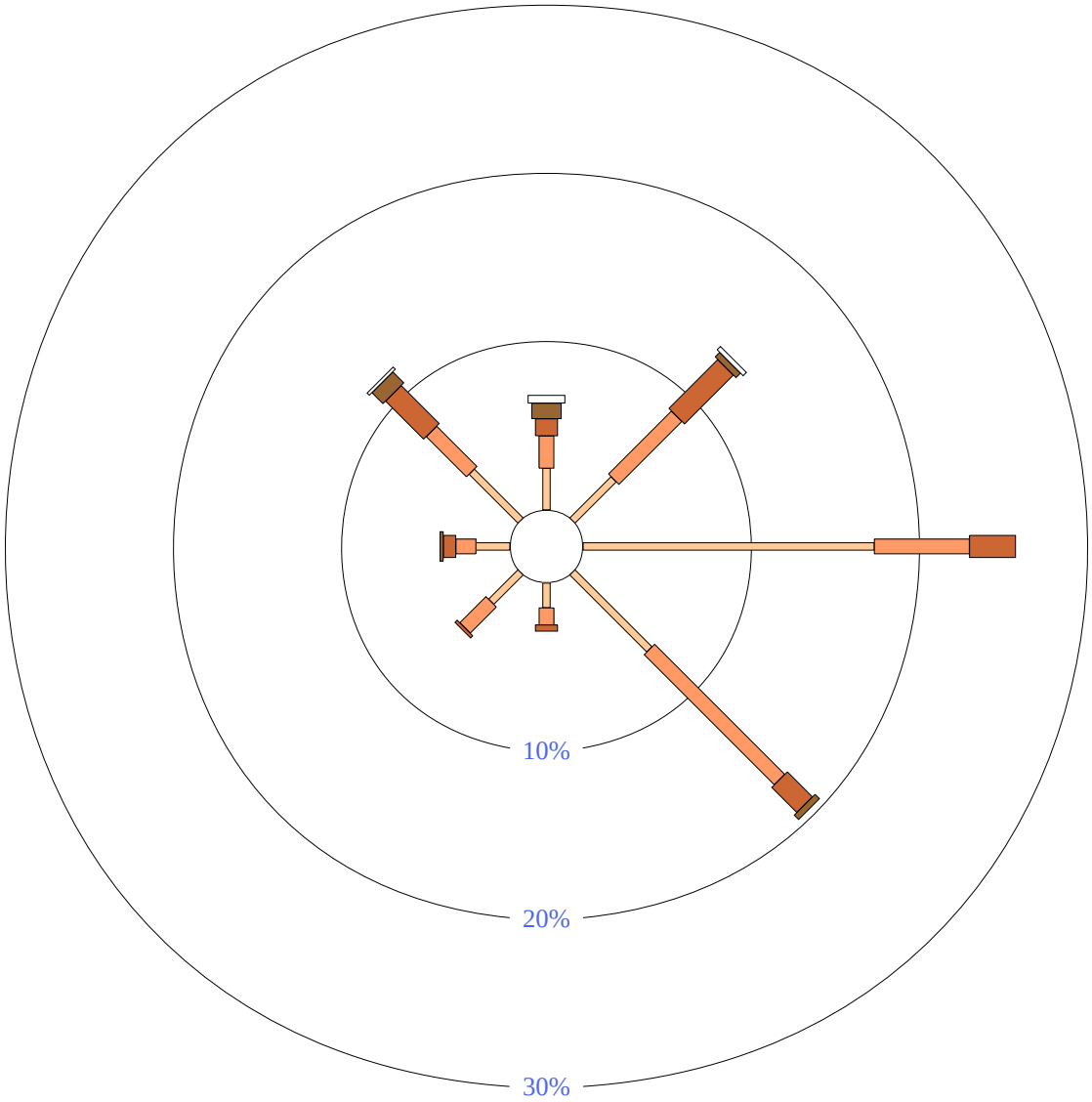
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am May
549 Total Observations

Calm 11%



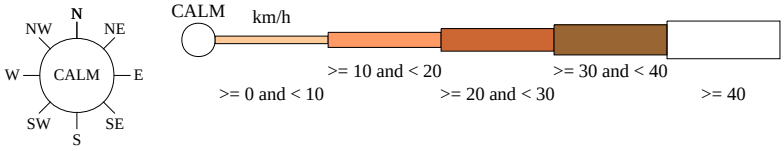
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

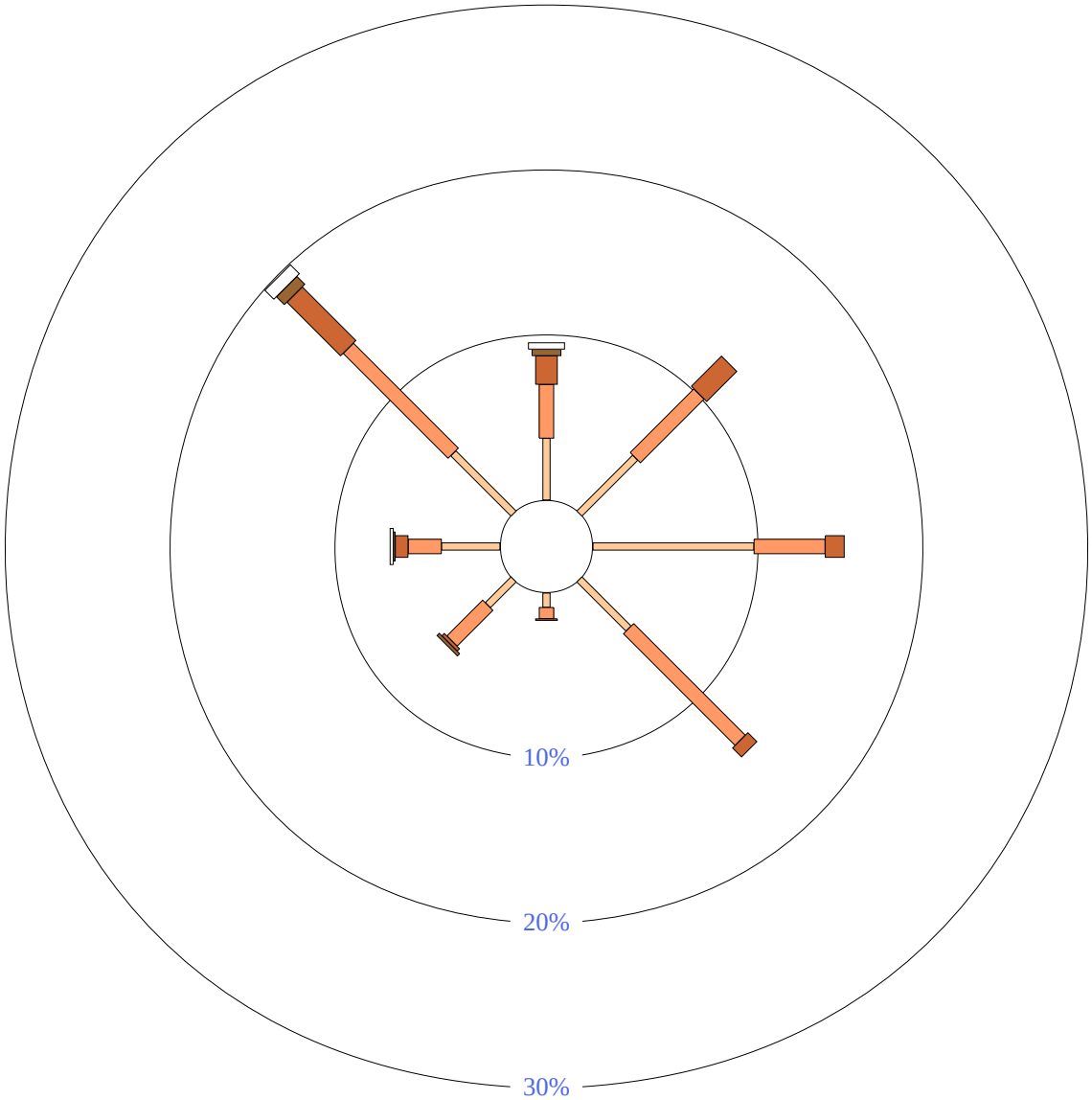
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Jun
523 Total Observations

Calm 14%



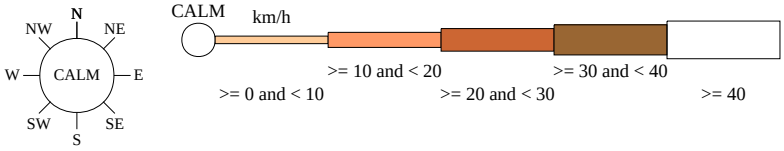
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

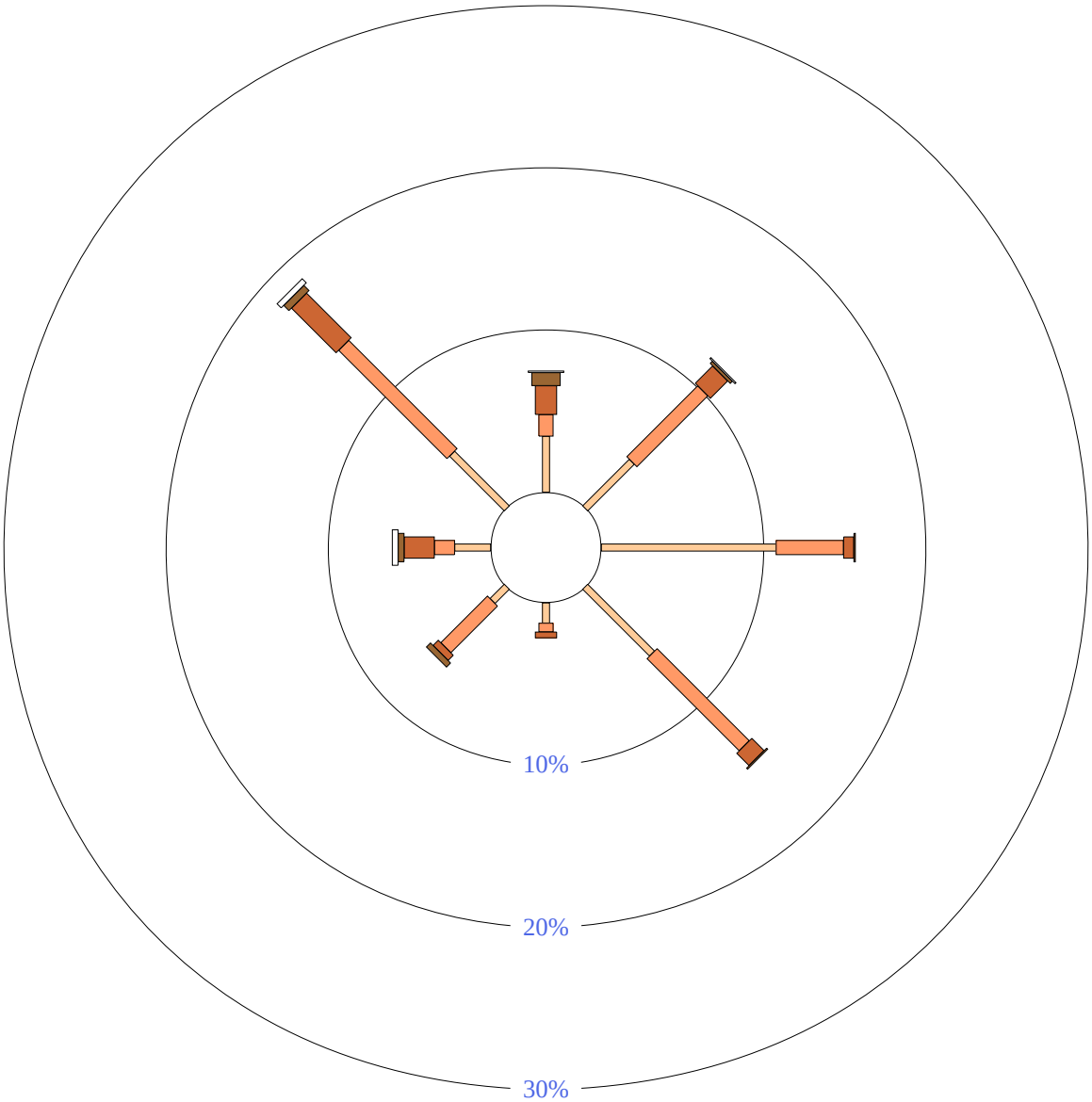
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Jul
567 Total Observations

Calm 17%



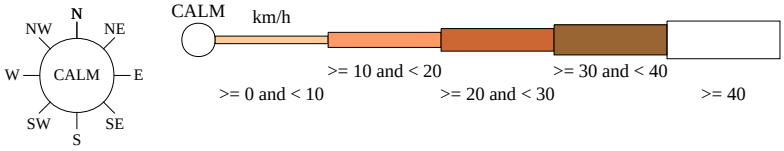
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

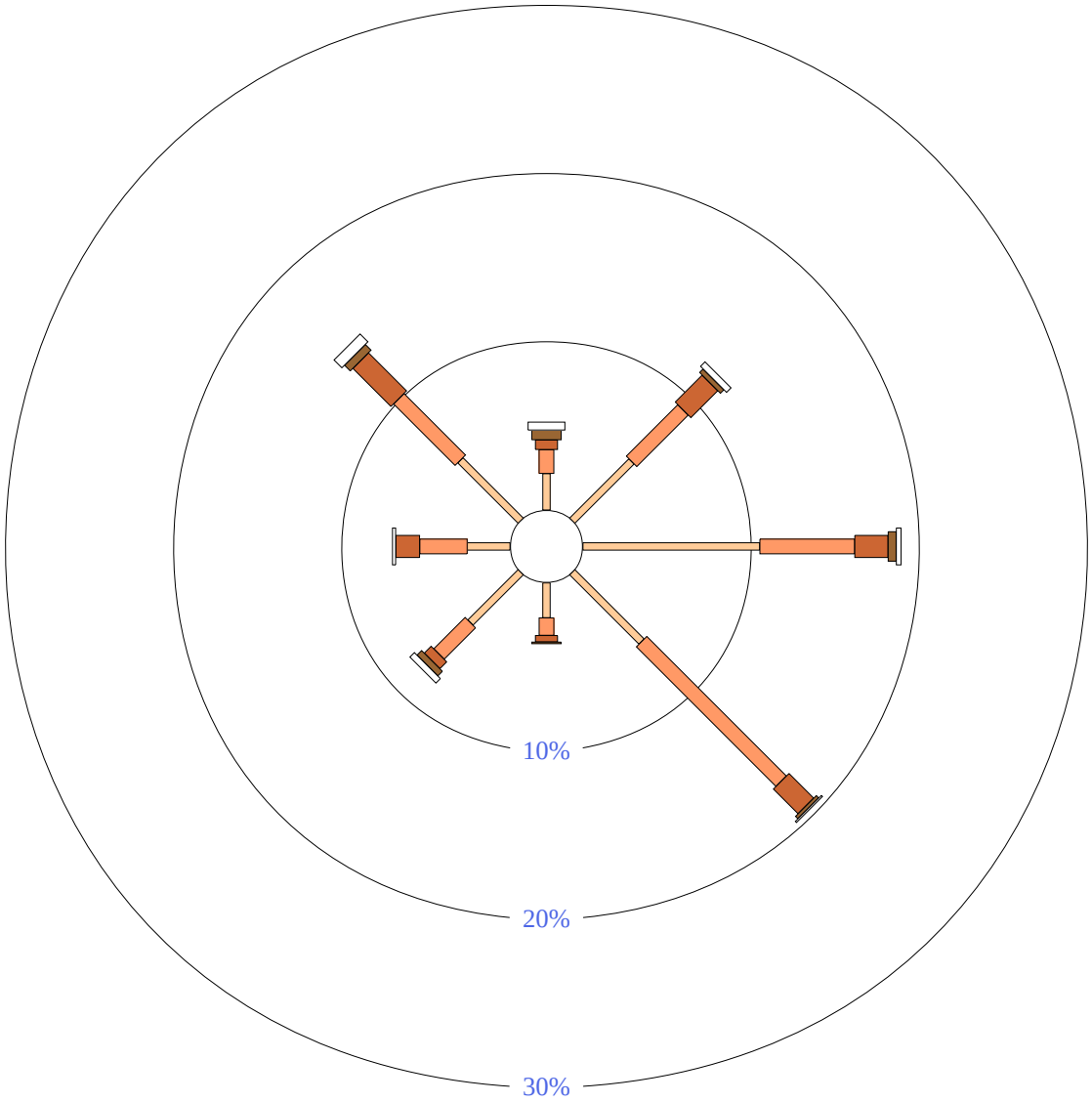
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Aug
533 Total Observations

Calm 11%



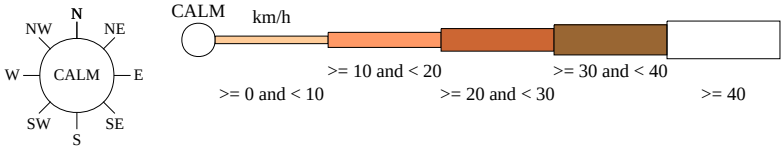
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

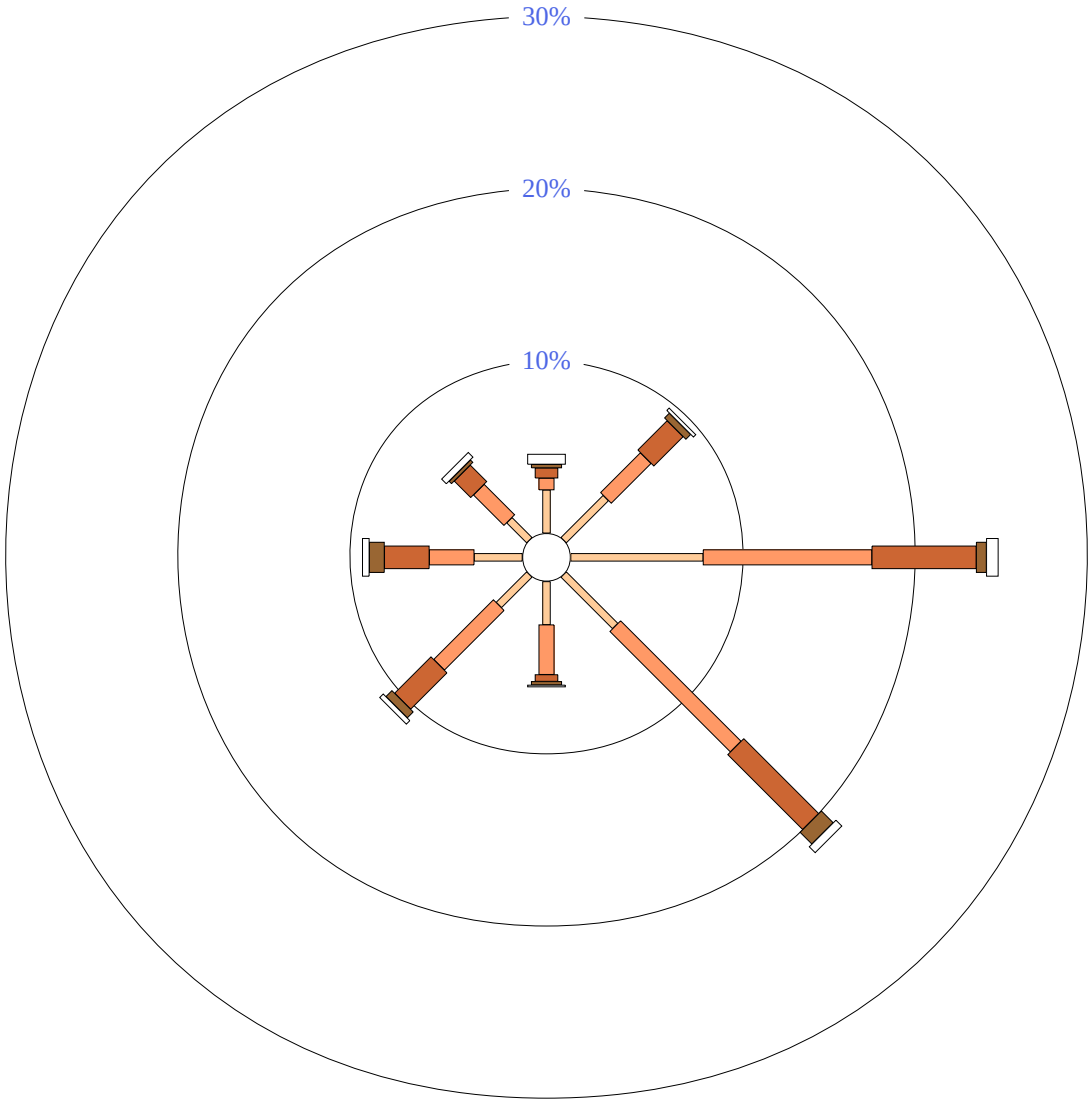
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Sep
521 Total Observations

Calm 7%



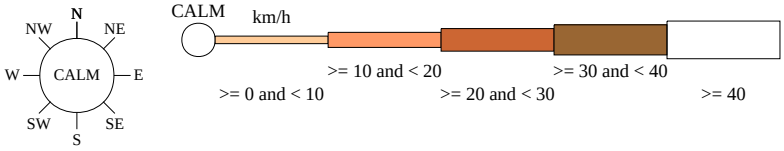
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

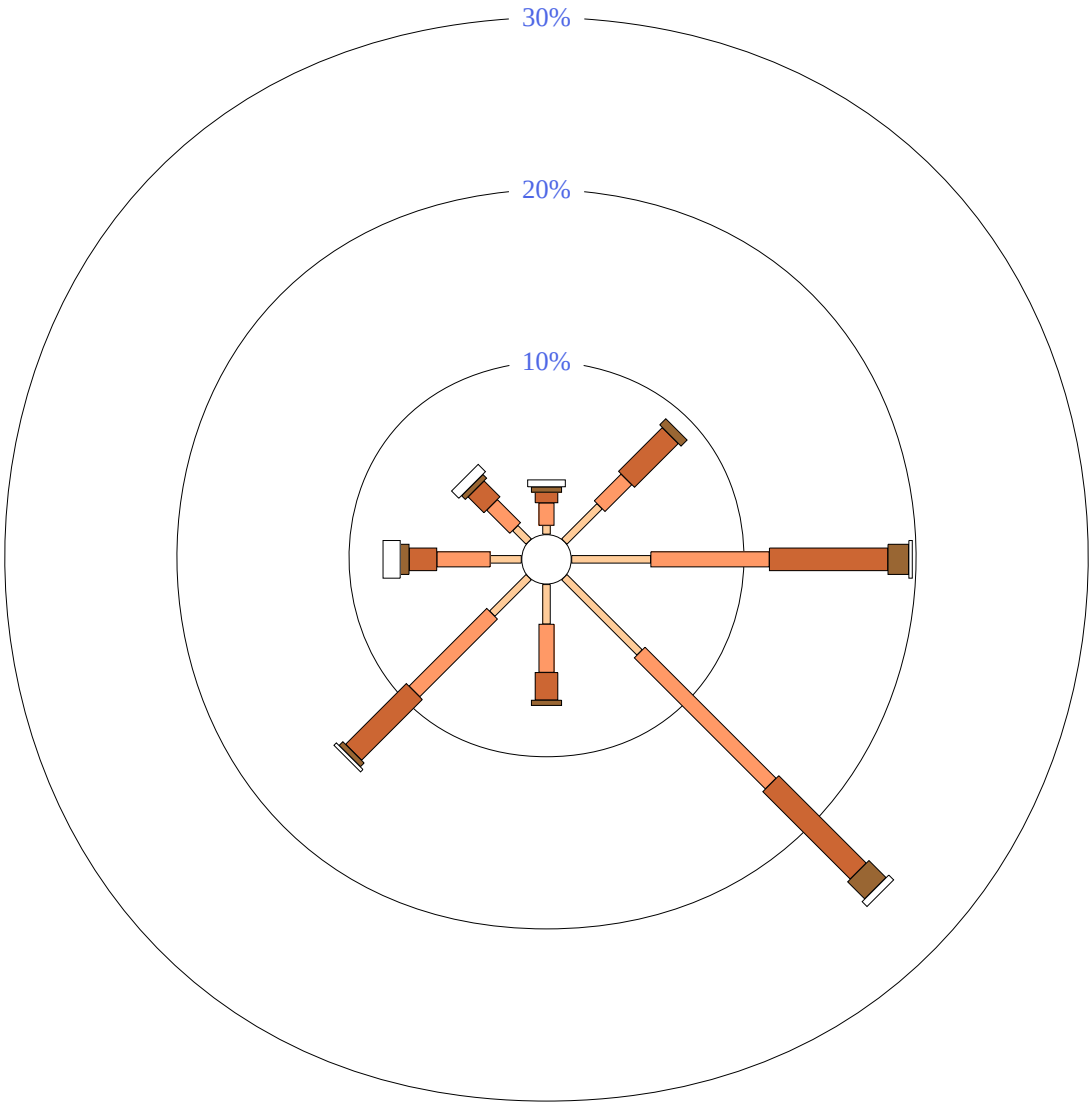
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Oct
502 Total Observations

Calm 7%



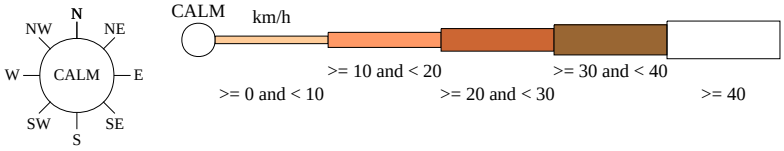
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

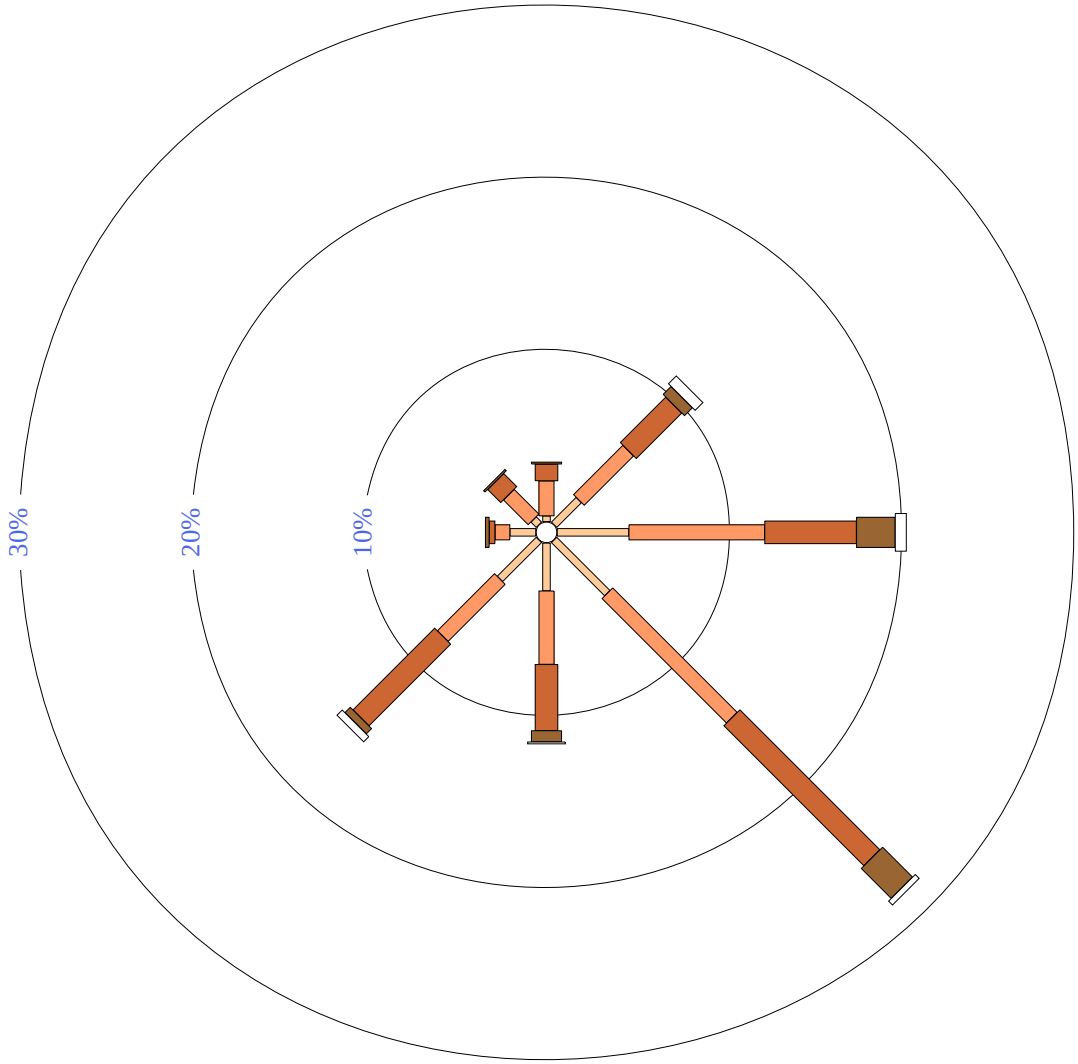
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Nov
470 Total Observations

Calm 3%



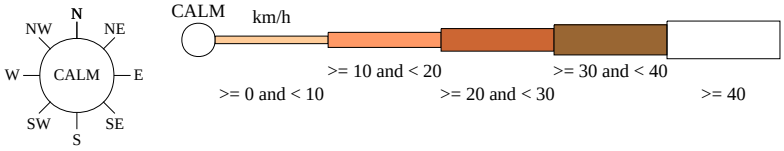
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

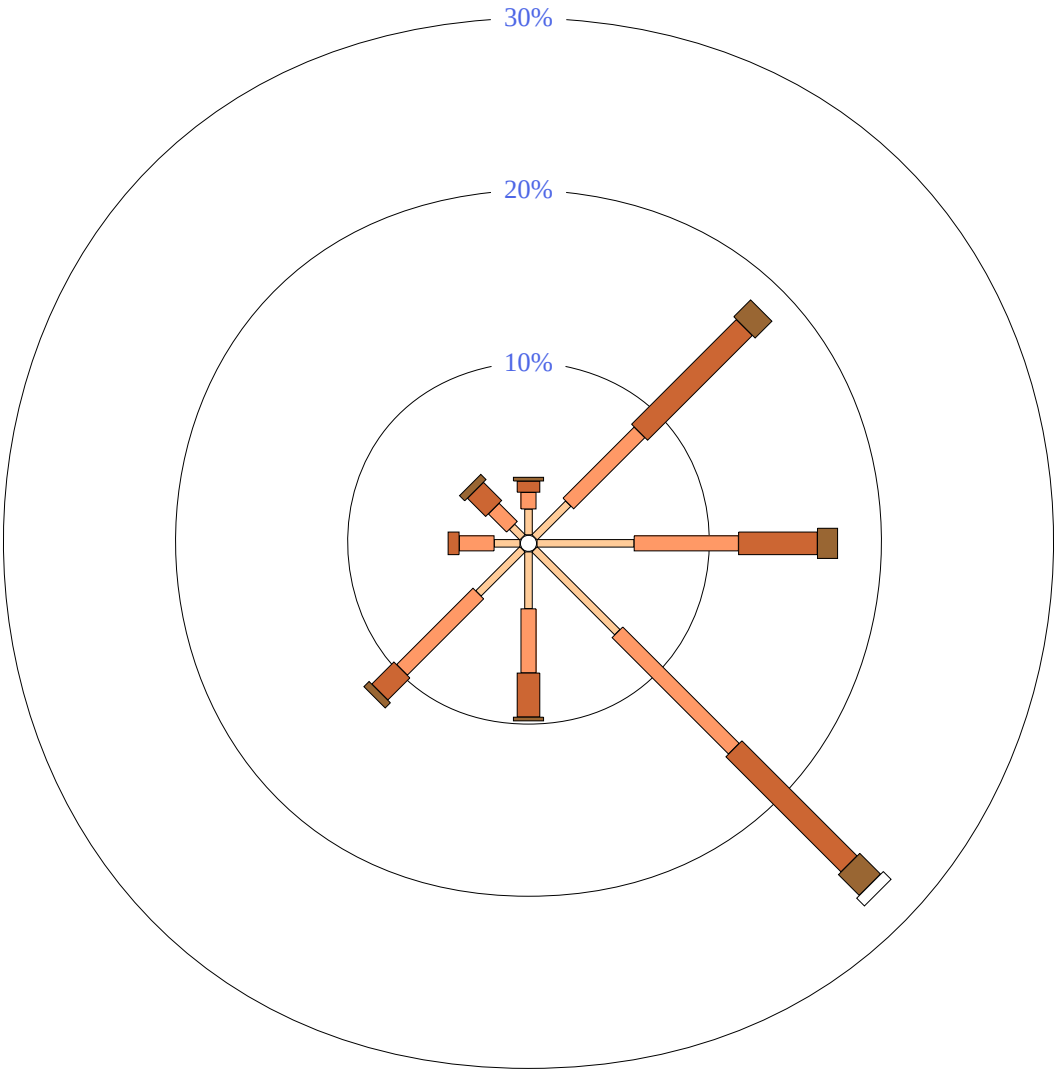
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Dec
471 Total Observations

Calm 2%



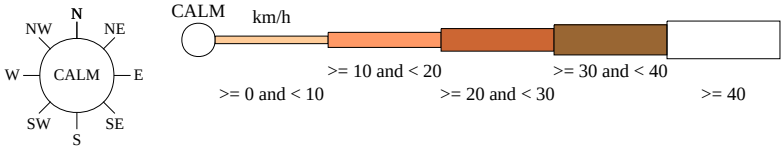
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

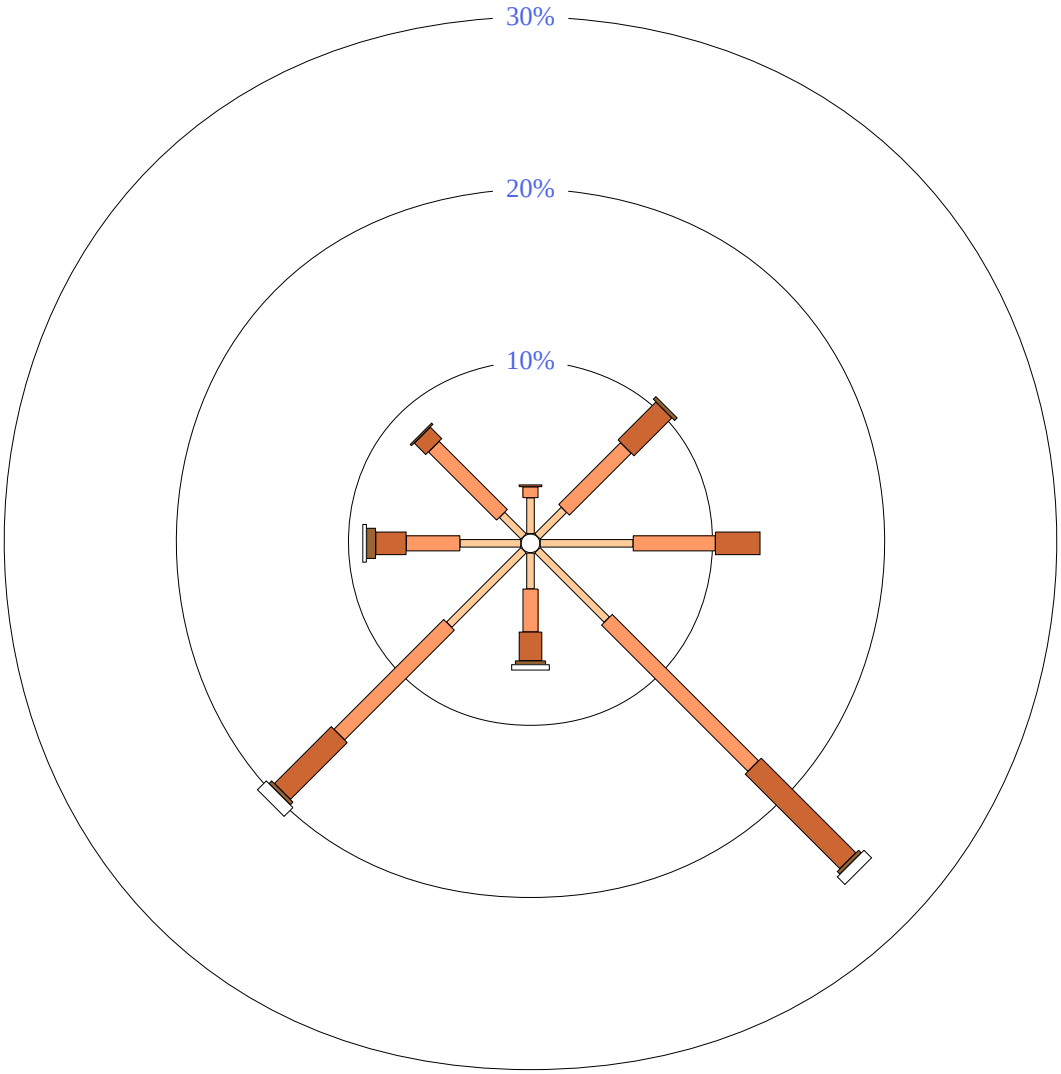
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Jan
483 Total Observations

Calm 3%



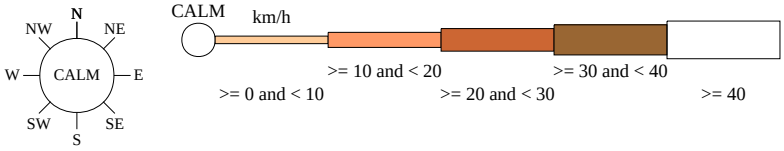
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

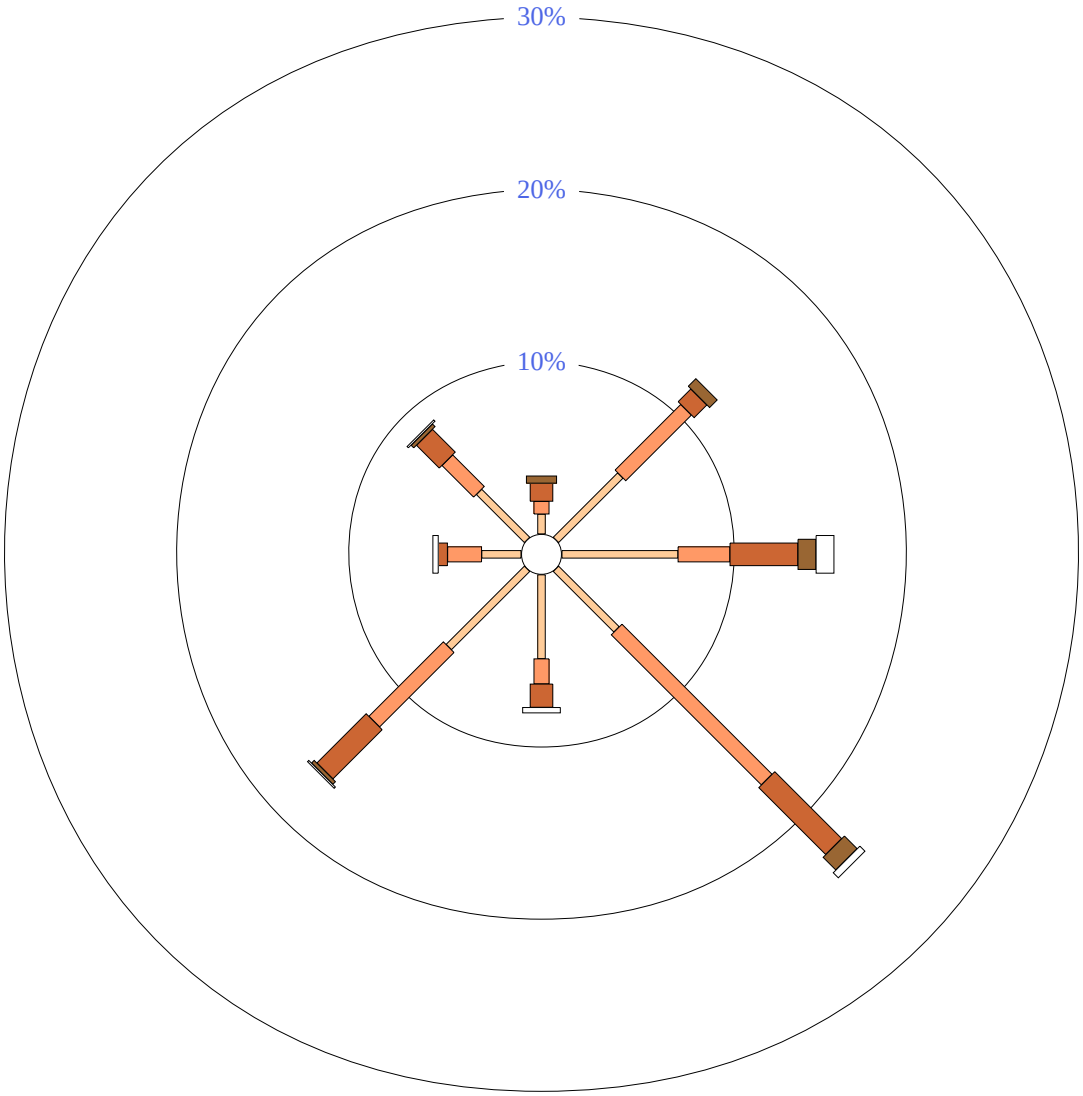
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Feb
483 Total Observations

Calm 6%



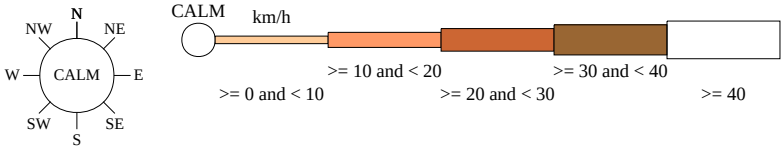
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

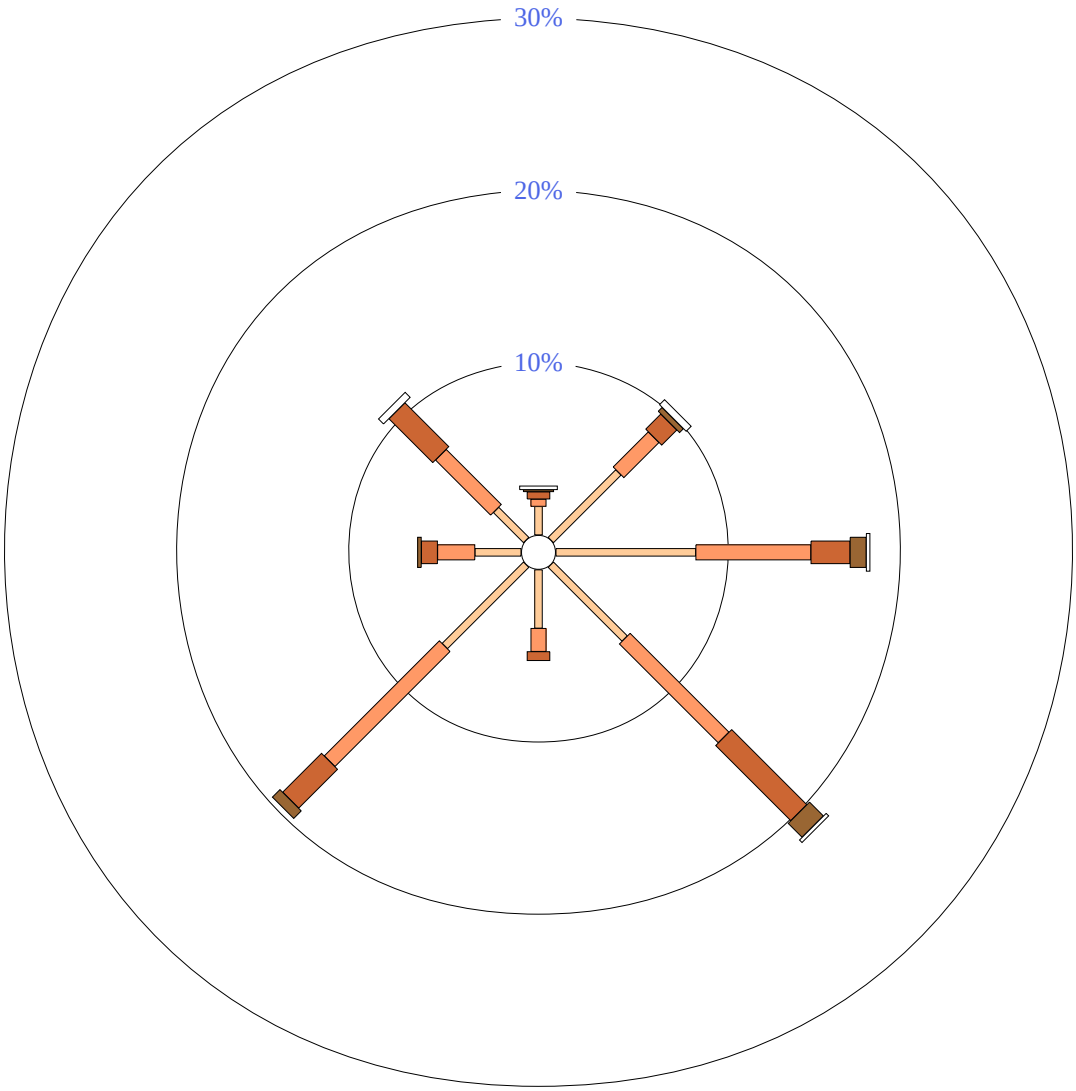
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Mar
487 Total Observations

Calm 5%



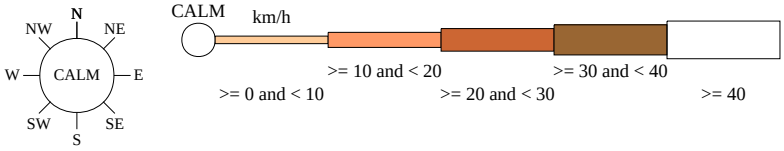
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

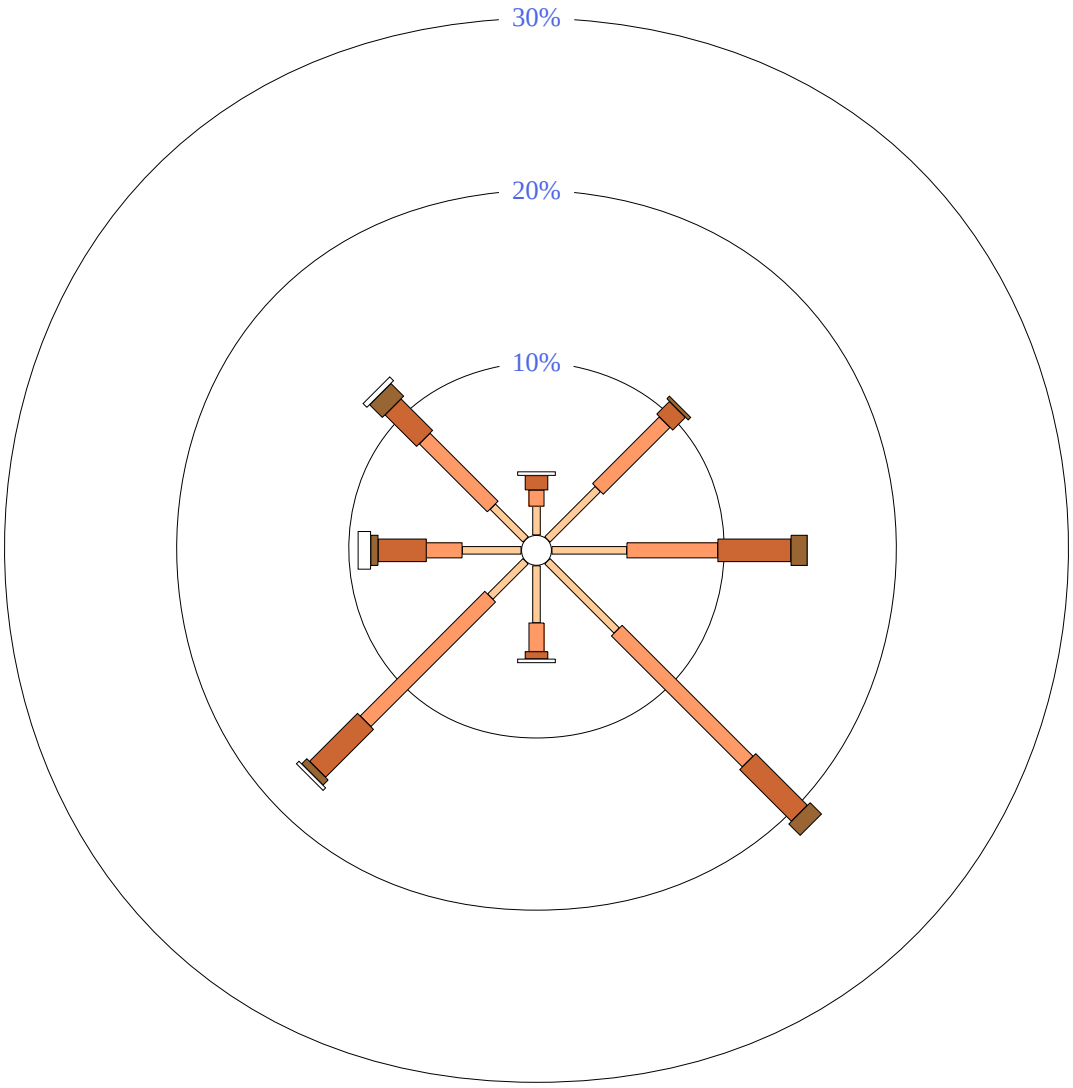
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Apr
484 Total Observations

Calm 4%



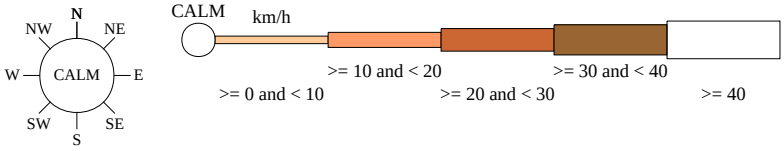
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

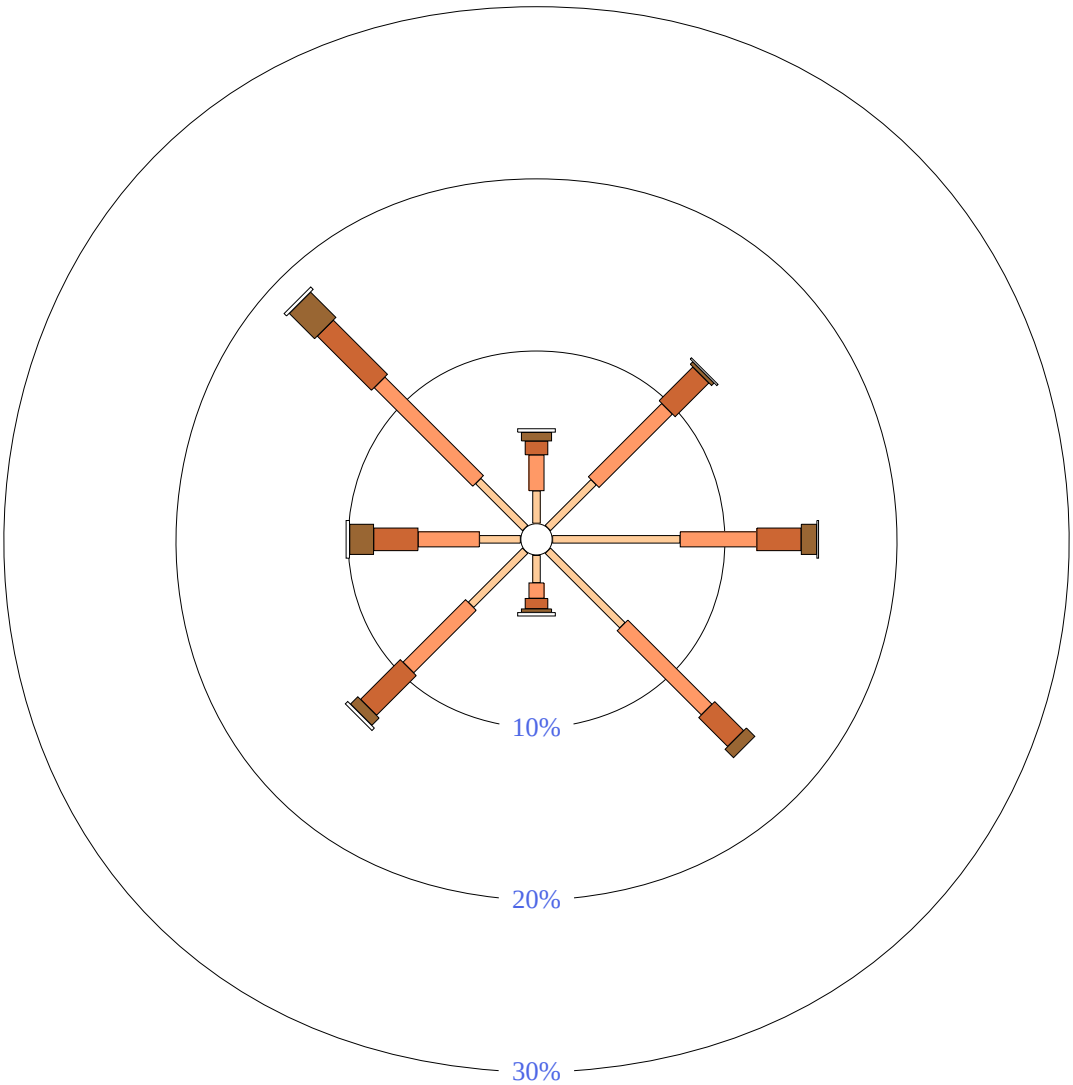
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm May
507 Total Observations

Calm 5%



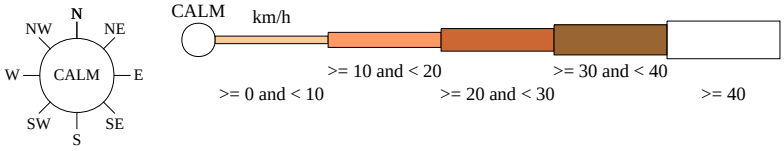
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

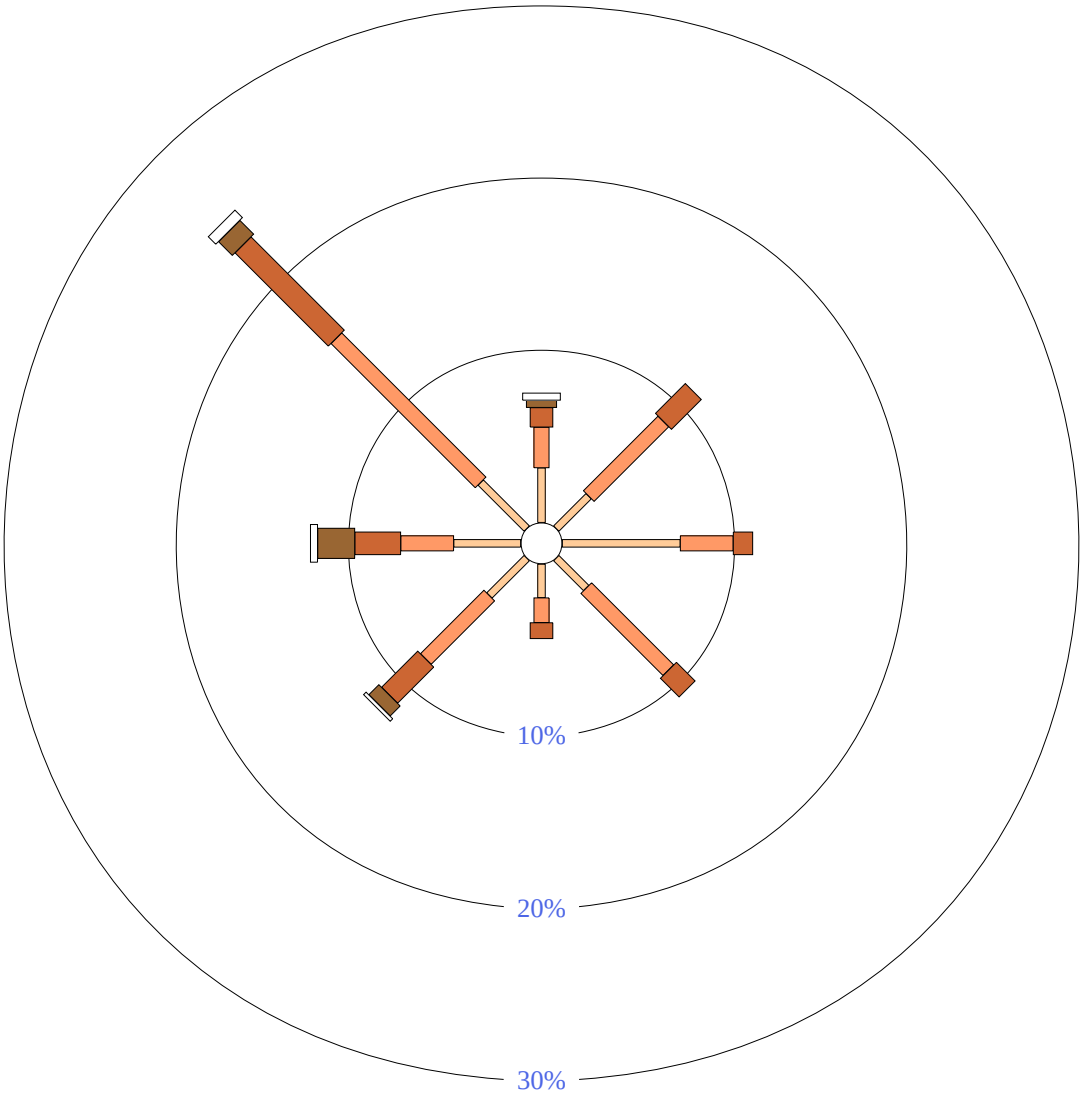
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Jun
490 Total Observations

Calm 6%



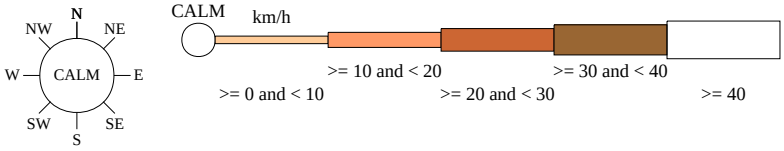
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

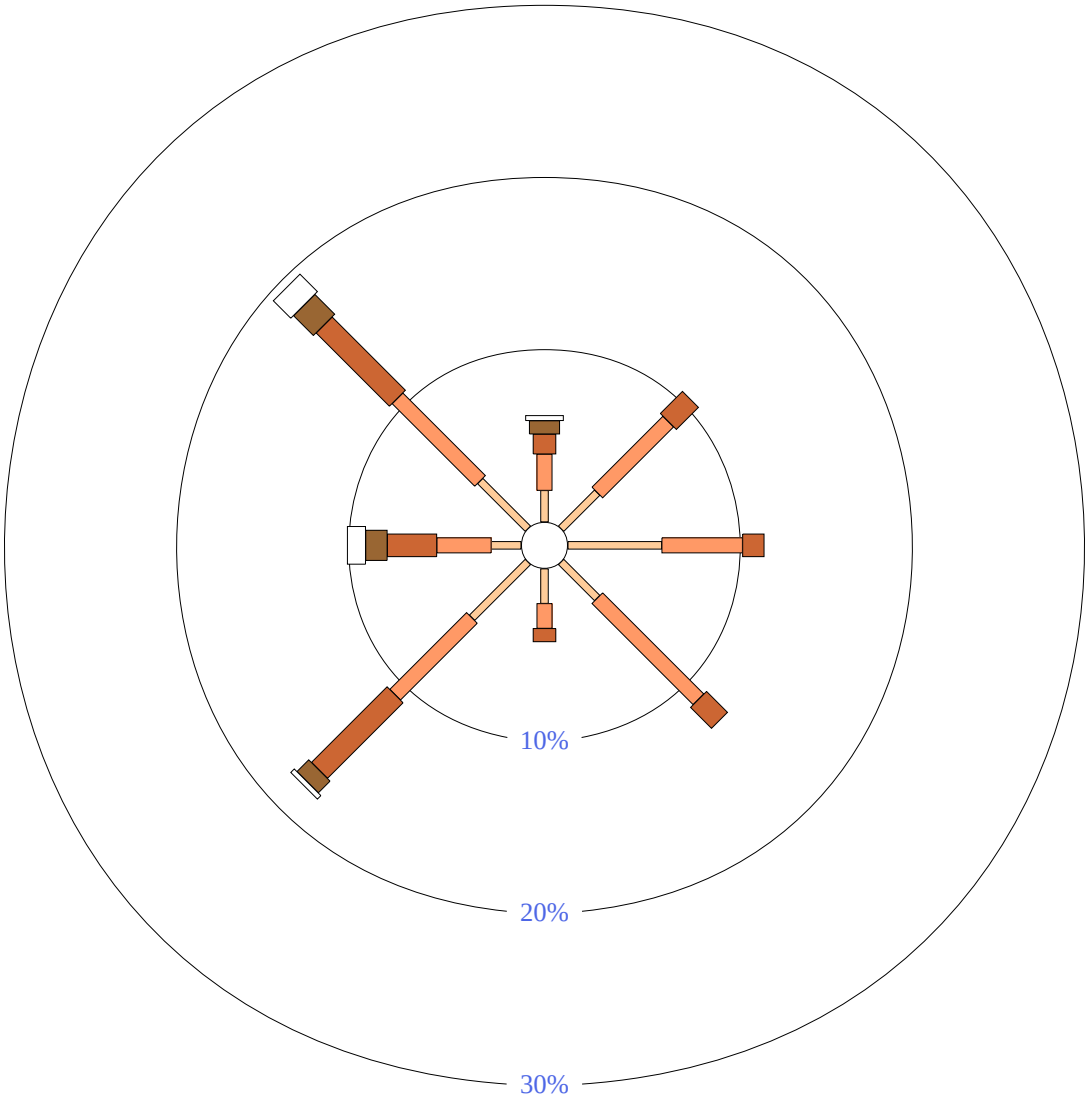
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Jul
524 Total Observations

Calm 7%



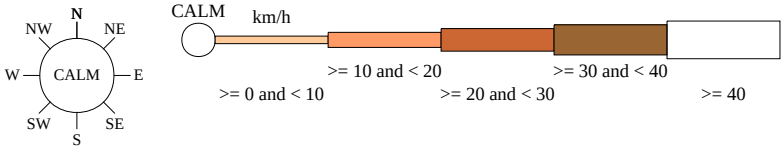
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

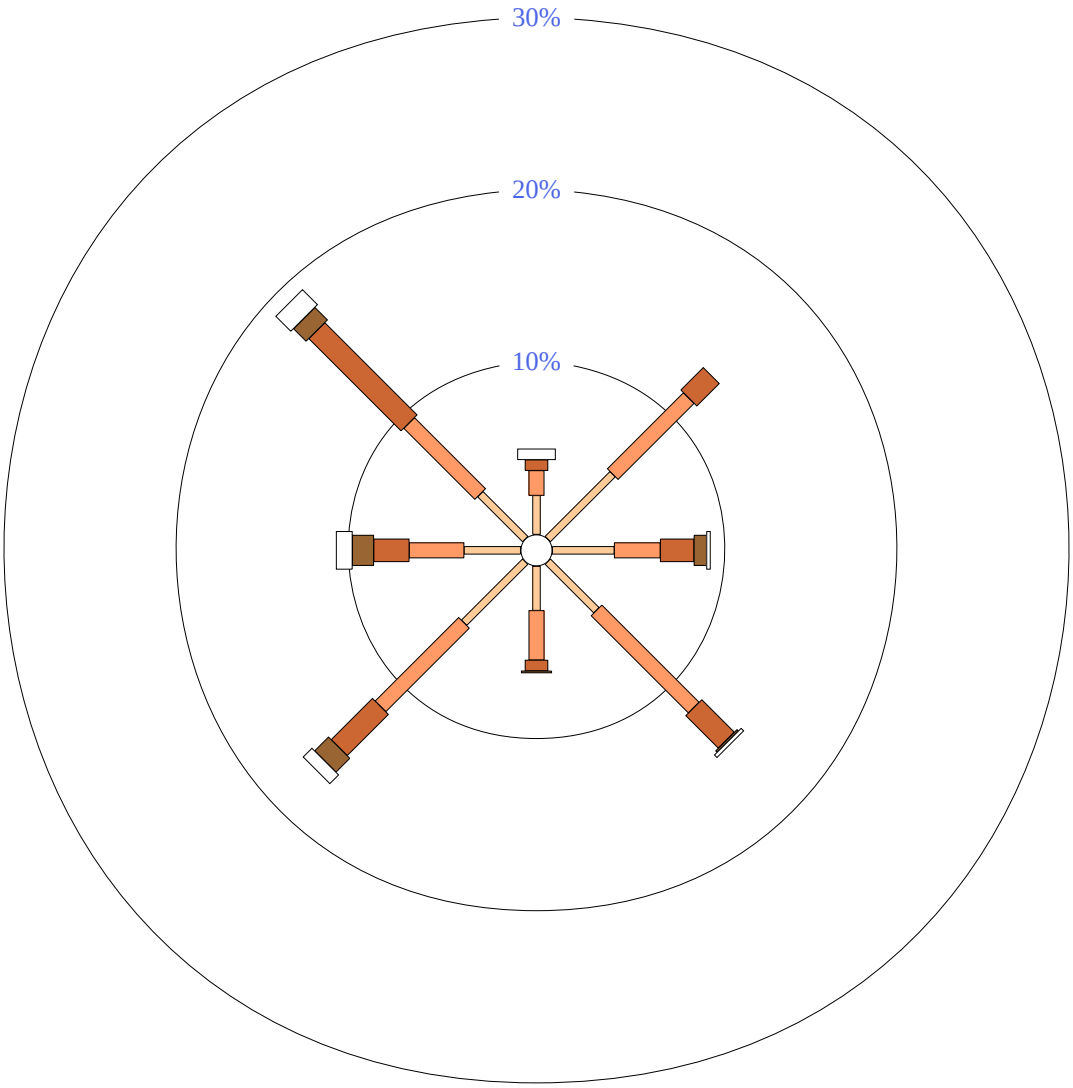
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Aug
489 Total Observations

Calm 4%



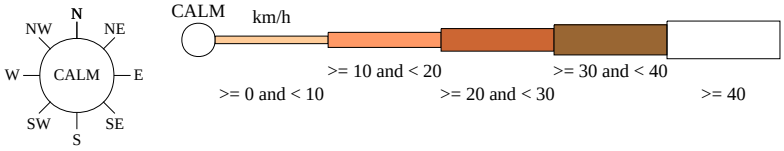
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

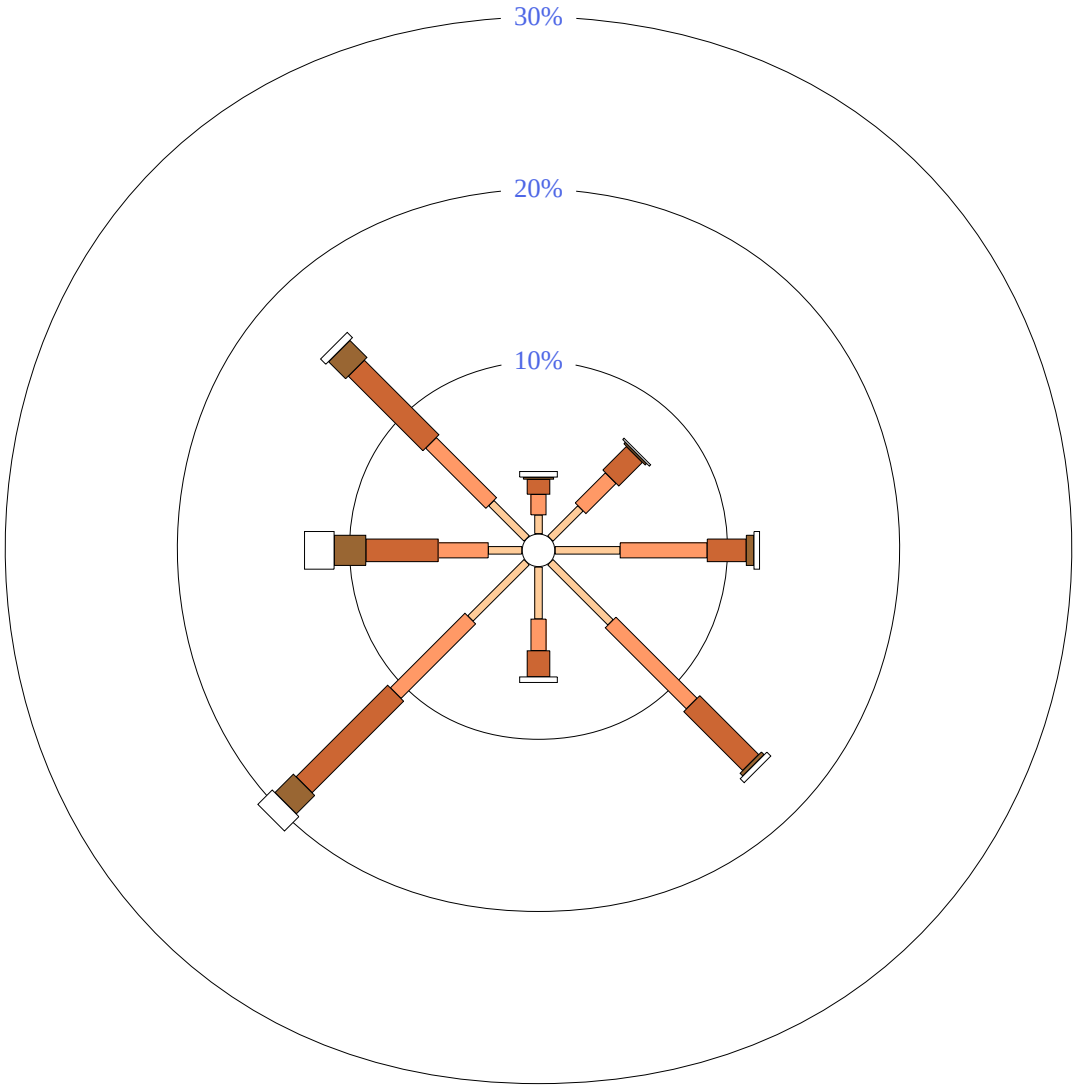
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Sep
466 Total Observations

Calm 5%



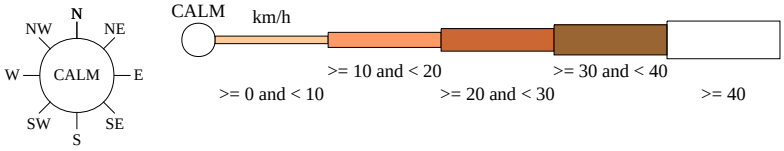
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

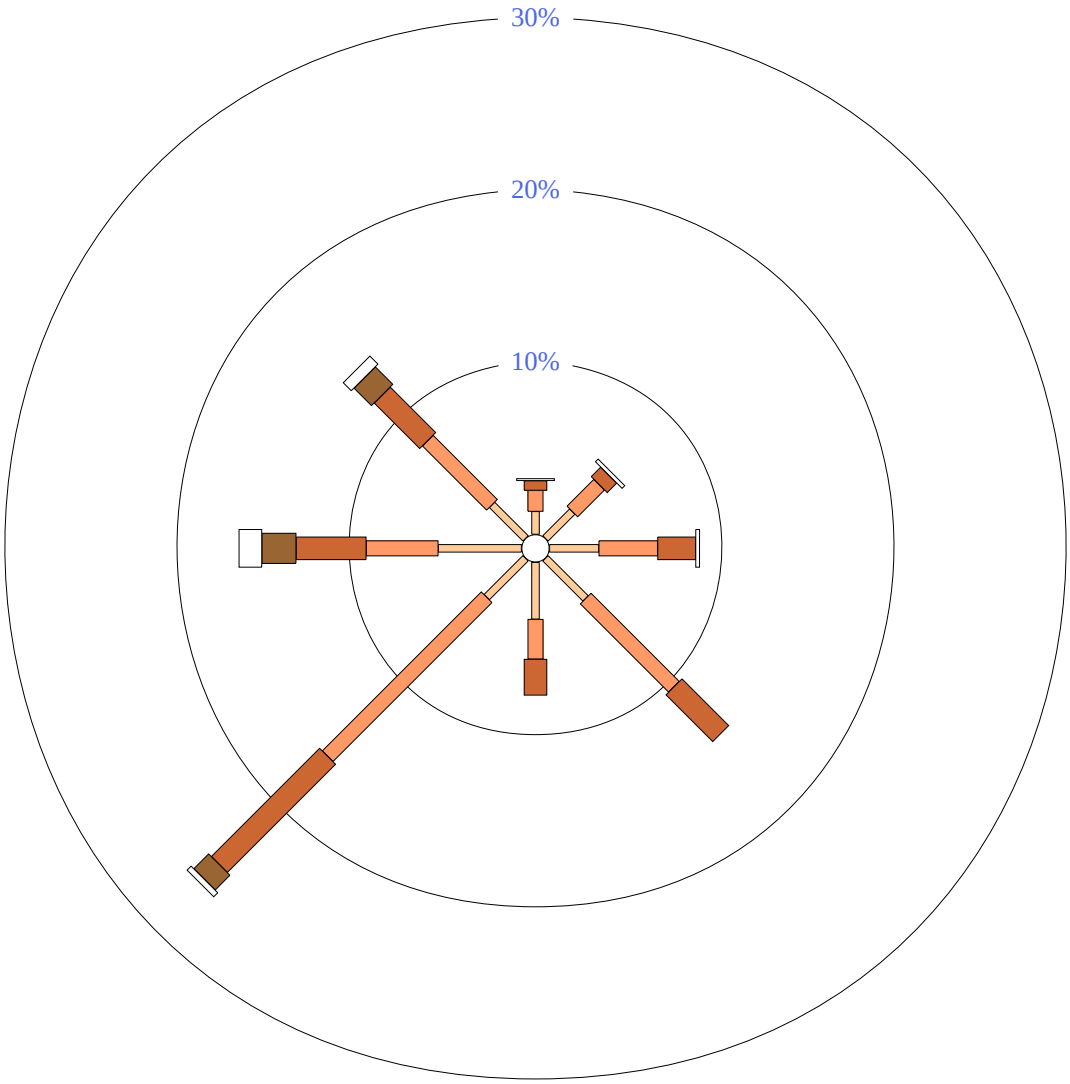
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Oct
456 Total Observations

Calm 4%



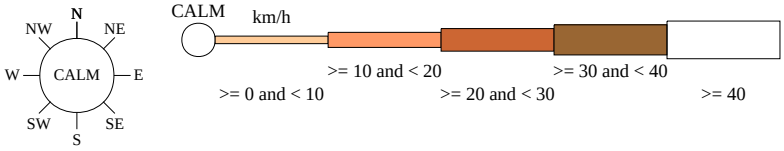
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

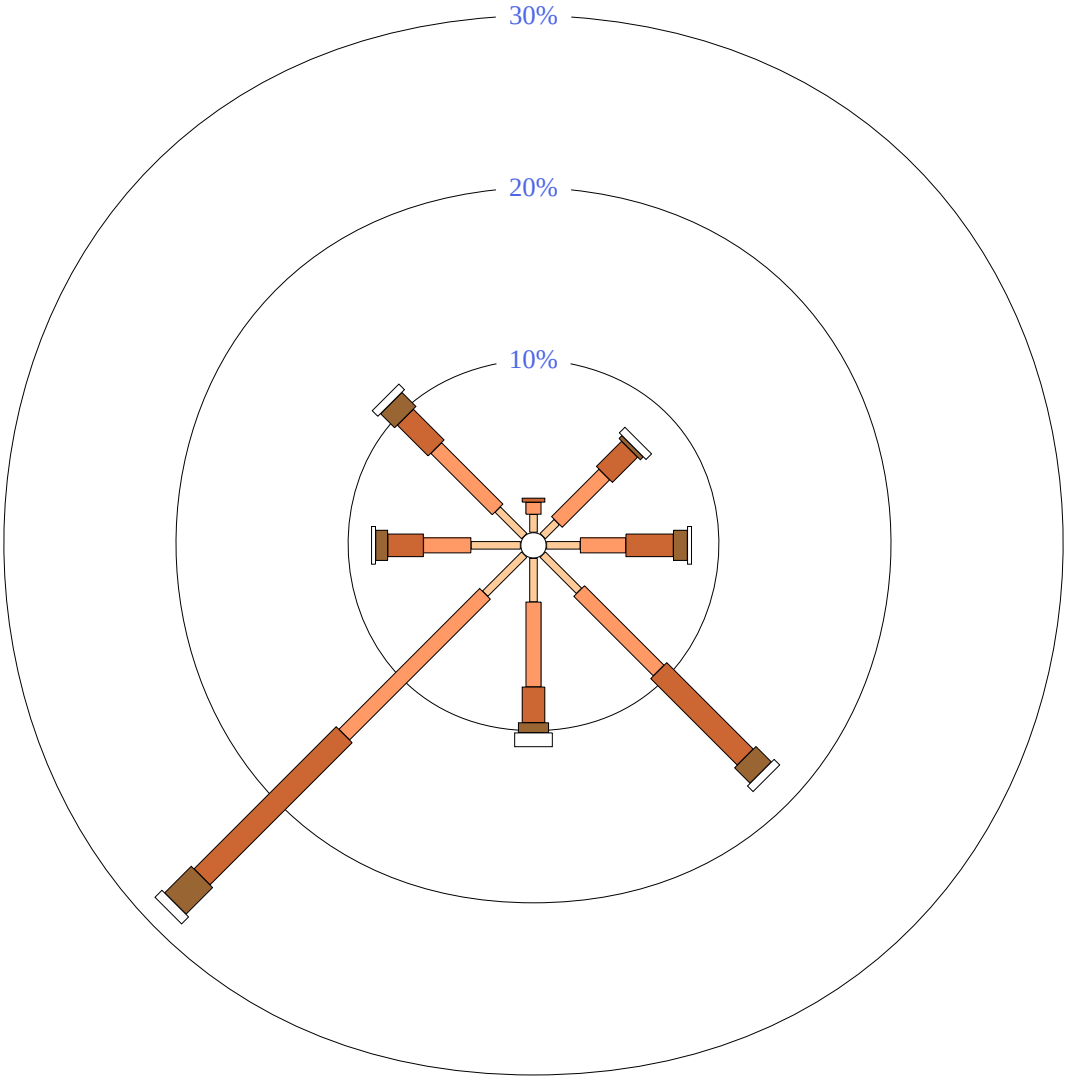
Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Nov
437 Total Observations

Calm 4%



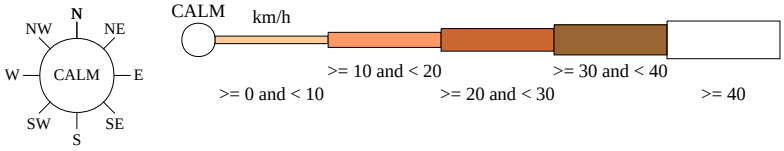
Rose of Wind direction versus Wind speed in km/h (01 Jan 1957 to 28 Nov 1975)

Custom times selected, refer to attached note for details

YALGOO

Site No: 007091 • Opened Jan 1896 • Still Open • Latitude: -28.3386° • Longitude: 116.6825° • Elevation 318m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm Dec
425 Total Observations

Calm 3%