



October 2016

MINING LEASE PROPOSAL AND MANAGEMENT PLANS

Pirie Resources Pty Ltd: Campoonna Graphite Project

Submitted to:

Greg English
Archer Exploration Limited

REPORT



Report Number. 127663057-054-R-Rev5

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SUMMARY INFORMATION

Mine owner	Pirie Resources Pty Ltd, a wholly owned subsidiary of Archer Exploration Limited.
Miner operator	Pirie Resources Pty Ltd
Contact person	Greg English, Executive Chairman
Contact details	genglish@archerexploration.com.au
Existing tenements	EL5804 EL4861 EL5815
Mineral Lease Application	MC 4393: Proposed Campoona Shaft Mineral Lease (ML)
Miscellaneous Purposes Licence Application	T03006: Proposed Sugarloaf processing facility and ancillary infrastructure (MPL Sugarloaf)
Miscellaneous Purposes Licence Application	T03012: Proposed MPL Pindari wellfield and pipeline and potable water infrastructure at Jamieson Tank and pipeline to Sugarloaf (MPL Water)
Name of mining operation	Campoona Graphite Mine
Commodity to be mined	Graphite
MLP and MP date	20 October 2016

WAIVERS

This section details what 'waivers' are required or are in place to implement the full extent of the proposed mining operations outlined in Section 3 of the MLP. A 'waiver' is an agreement with the person who has benefit of land exempt from mining operations under Section 9 of the *Mining Act 1971*. Within the proposed ML and MPLs, the following types of exempt land occur:

- Land within 150m of a building or structure, greater than \$200 in value, and used for an industrial or commercial purpose.
- Cropping land.

The status of waivers and agreements for each affected landowner is provided in the summary table below and suitable waivers of exemption will be in place for each area before any operations can commence in that area.

Name of person entitled to exemption	Proposed ML or MPL	Reason for exemption	Area of exemptions	Waiver/agreement status	Any relevant conditions
Archer (Property owner)	ML	150m to infrastructure (dam)	As identified in Figure 2a.	Agreement to be negotiated	NA
	ML	Cropping land	As identified in Figure 2a.	Agreement to be negotiated	NA
Elson	ML	150m to infrastructure (dam)	As identified in Figure 2a.	Agreement to be negotiated	NA
R&C Nield	ML	150m to infrastructure (dam)	As identified in Figure 2a.	Agreement to be negotiated	NA



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Name of person entitled to exemption	Proposed ML or MPL	Reason for exemption	Area of exemptions	Waiver/agreement status	Any relevant conditions
Archer (Property owner)	MPL (Sugarloaf)	150m to infrastructure (dam)	As identified in Figure 2b.	Agreement to be negotiated	NA
	MPL (Sugarloaf)	Cropping land	As identified in Figure 2b.	Agreement to be negotiated	NA
B.S. Schubert	MPL (Water)	150m to infrastructure (dam)	As identified in Figure 2b.	Agreement to be negotiated	NA
J & K Schubert	MPL (Water)	Cropping land	As identified in Figure 2b.	Agreement to be negotiated	NA
Hilcott Farms Pty Ltd	MPL (Water)	150m to infrastructure (dam)	As identified in Figure 2b.	Agreement being negotiated	NA
SA Water	MPL (Water)	Tank and pump infrastructure	As identified in Figure 2b.	Agreement to be negotiated	NA



DECLARATION OF ACCURACY

This declaration is made pursuant to section 35(1) of the *Mining Act 1971* and Regulation 30(4) of the *Mining Regulations 2011*:

I, Greg English, Executive Chairman of Pirie Resources Pty Ltd (ACN 119 903 301) of Level 1, 28 Greenhill Road Wayville SA 5034, declare pursuant to section 35(1) of the *Mining Act 1971* and Regulation 30(4) of the *Mining Regulations 2011*, that I have taken reasonable steps to review the information in this mining lease proposal and management plans to ensure its accuracy as at the date of submission of the proposal.

Name: Greg English

Position: Executive Chairman, Pirie Resources Pty Ltd

Signature:

Date: 20 October 2016



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1.0 INTRODUCTION

1.1 Project introduction

Pirie Resources Pty Ltd, a wholly-owned subsidiary of Archer Exploration Ltd (Archer) proposes to develop the Campoona Graphite Project (the Project), located in the Campoona region on the Eyre Peninsula of South Australia.

The Project is approximately 20 kilometres (km) north of Cleve and 540 km via road North-West of Adelaide, South Australia (Figure 1-1a). Pirie Resources plans to mine graphite ore from an open pit at the Campoona Shaft site then truck the ore to a processing facility at the Sugarloaf site, approximately 15 km to the west. Both mining and processing will be staged to allow product accreditation and market penetration (Figure 1-1b).

Unlike many commodities, graphite markets trade in a market where price is negotiated based notionally on a posted market price. Buying and selling of graphite is based on rigorous customer-based testing. Firstly on small samples (~1 kg), followed by larger samples (> 1 tonne), which give the buyer the ability to conduct meaningful production runs using the new graphite source material. If this second larger-scale testing demonstrates that the graphite meets the customer's needs, then the buyer and seller will enter into negotiations regarding supply. To enable this, customers need a volume of material that can only be efficiently produced in a small-scale processing facility. Accordingly, Pirie Resources proposes to stage the Project to allow identification of a customer base, which may take three years, however, the project may operate at full scale in the first year if a suitable customer base can be identified at the initial stage of the project prior to commencing a scaled processing rate, which will expand up to about 140,000 tonnes per annum (tpa). Over the >16-year life the Project will process some 1.6 million tonnes of graphitic ore.

With graphene emerging as an important and higher-value product, Pirie Resources will, subject to market demand, process some graphite concentrate to produce graphene. Graphene is single atom thick graphite. Should the graphene market uptake be significant, Pirie Resources could preferentially produce graphene.

These Mining Lease Proposal (MLP) and Management Plans are submitted to the Department of State Development (DSD) on behalf of Pirie Resources. This MLP forms part of the regulatory requirements for a mining lease application being submitted pursuant to Section 35(1) of the *Mining Act 1971*. It has been developed having regard to the Ministerial Determination 006:

Minimum information required to be provided in a mining proposal or management plan for a mineral lease (ML) and any associated miscellaneous purposes licence (MPL) applications for metallic and industrial minerals (excluding extractive minerals, coal and uranium);

as gazetted in accordance with *Mining Regulations 2011*, regulations 30(3) and 49(3) (SA Government Gazette 50: 3064-3077, 12 July 2012).

This MLP provides the necessary project and environmental information; including risk and impact assessment, and management plans for consideration by the DSD as follows:

- A Mineral Lease (ML) for the site known as Campoona Shaft, pursuant to Regulation 30(3) of the *Mining Regulations 2011* (ML Campoona Shaft) (Figure 1-2),

The facilities within the proposed ML may be staged based on requirements, but include:

- An initial trenching phase to strip a 50 m × 25 m of topsoil and excavate a 10 m × 5 m trench to provide sample for product accreditation and then small-scale production over approximately 3 years.
- After approximately three years the pit will be expanded to an open cut mine over an additional 13 years. At full scale mining, the site will include the following infrastructure:
 - Waste rock storage facilities and topsoil and subsoil stockpile areas
 - Ore stockpile areas



- Site office and warehouse facility
- Mine workshop
- Fuel storage
- Magazine.

■ Two Miscellaneous Purposes Licences (MPL) pursuant to Division 2, Regulation 49(3) of the *Mining Regulations 2011*.

These MPLs will accommodate a mineral processing facility known as Sugarloaf (MPL Sugarloaf) and water supply infrastructure called MLP Water, refer (Figure 1-3).

Infrastructure associated with the MPL Sugarloaf may be staged to provide the necessary infrastructure depending on small scale or full scale production. Small scale production will include:

- A small, modular processing facility (skid mounted or containerised) capable of processing up to about 10,000 tonnes of ore per year to produce approximately 1,000 tonnes of high purity graphite concentrate. Depending on identifying a market for commercial quantities of graphene, up to 100 tonnes of graphene could be produced by exfoliating graphite concentrates to produce 2-3 layer graphene.
- Water tanks and lined pond to store processing water needs.
- Power requirements will be provided by the existing 3-phase supply augmented with supply from a diesel generator.
- A 'mini' tailings storage facility built within the same footprint as the life-of-mine tailings storage facility.

Full scale production of about 10,000 tpa of graphite concentrate will include:

- Ore stockpile areas
- Tailings storage facility
- Processing plant
- Administration building
- Diesel storage and refuelling tank
- Water supply within the MPL boundary
- Workshops and storage sheds.

MPL Water will accommodate the Pindari Wellfield, associated Pindari pipeline to the Sugarloaf processing facility and potable water supply from Jamieson Tank to supply water for processing and other site needs (MPL Water) (Figure 1-3). Infrastructure associated with the MPL Water will include:

- Initially at Pindari, one of the two existing water bores will be developed and a submersible pump installed to abstract process water, first into either a tank or a lined water pond, with the process water then trucked to Sugarloaf as needed. On full production a bunded pipeline will deliver process water to Sugarloaf per annum.
- During the small-scale start-up phase (Years 1 – 3) water pumping facilities will be installed at Jamieson Tank and potable water trucked to Sugarloaf to augment supply captured off the existing shed. On full production a 7.5 km pipeline will be installed from Jamieson Tank to the processing facility at Sugarloaf to provide potable water to the plant.



This document identifies the existing conditions at all project sites, and provides an assessment of the impacts and mitigation measures.

Should approval for the proposed ML and MPLs be granted, Pirie Resources will develop and submit a 'program for environment protection and rehabilitation' (PEPR) for approval prior to commencement of mining. The PEPR will provide the project design and management plans based on the concept design and mitigation and monitoring measures proposed within this MLP.

1.2 The Mining Lease Proposal

Pirie Resources has prepared documentation to support the Lease and Licence applications as part of the South Australian mining approvals process. Under Section 35 of the Mining Act, applications for a proposed ML and MPL must be accompanied by a mining lease proposal (MLP) and management plans to cover all of the proposed activities associated with the Campoona Graphite Project.

This MLP has been prepared as the accompanying document to support the proposed ML, and MPL applications, in accordance with the:

- *Mining Act 1971 (SA).*
- *Mining Regulations 2011 (SA).*
- Minerals Regulatory Guidelines MG2 – *Guidelines for Miners: Preparation of a Mining Lease Proposal.*
- Mining and Rehabilitation Program (MARP) in South Australia, Version 4.11 January 2011.
- Ministerial Determination 006 – *Minimum information required to be provided in a mining proposal or management plan for a mineral lease (ML) and any associated miscellaneous purposes licence (MPL) applications for metallic and industrial minerals (excluding extractive minerals, coal and uranium) (DMITRE 2012).*

The MLP details the following information for the Campoona Graphite Project:

- A detailed description of the existing environment for the proposed mining operation on the ML and MPLs.
- An evaluation of the social and economic setting, benefits and impacts from the proposed operations.
- The methodology and results of the landholder and community consultation undertaken to date in connection with the proposed mining operations.
- An assessment of the potential social and environmental impacts from the proposed mining operations.
- An outline of the measures and procedures that Pirie Resources proposes to take to avoid, manage or remedy those potential impacts.
- A statement of proposed social and environmental outcomes expected to be met through the life of mine, including closure.
- A draft statement of the criteria to be adopted to measure the proposed environmental outcomes.

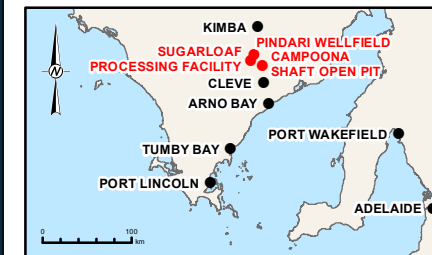
This MLP is the principal document used by Department for State Development (DSD) to facilitate consultation across a wide stakeholder base and to present the social and environmental risks and proposed outcomes that are aimed to be acceptable to all stakeholders.



CAMPOONA PROJECT MINING LEASE PROPOSAL

PROJECT LOCATION

LOCATION MAP



LEGEND

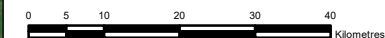
- Project Site
- Township

NOTES

1. Township data sourced from MapInfo StreetPro.

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1. World Imagery - Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Aerial Imagery Copyright ESRI.



REFERENCE SCALE: 1:1,000,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

**FIGURE
1.1**





GRAPHITE PROJECT MLP AND MPS

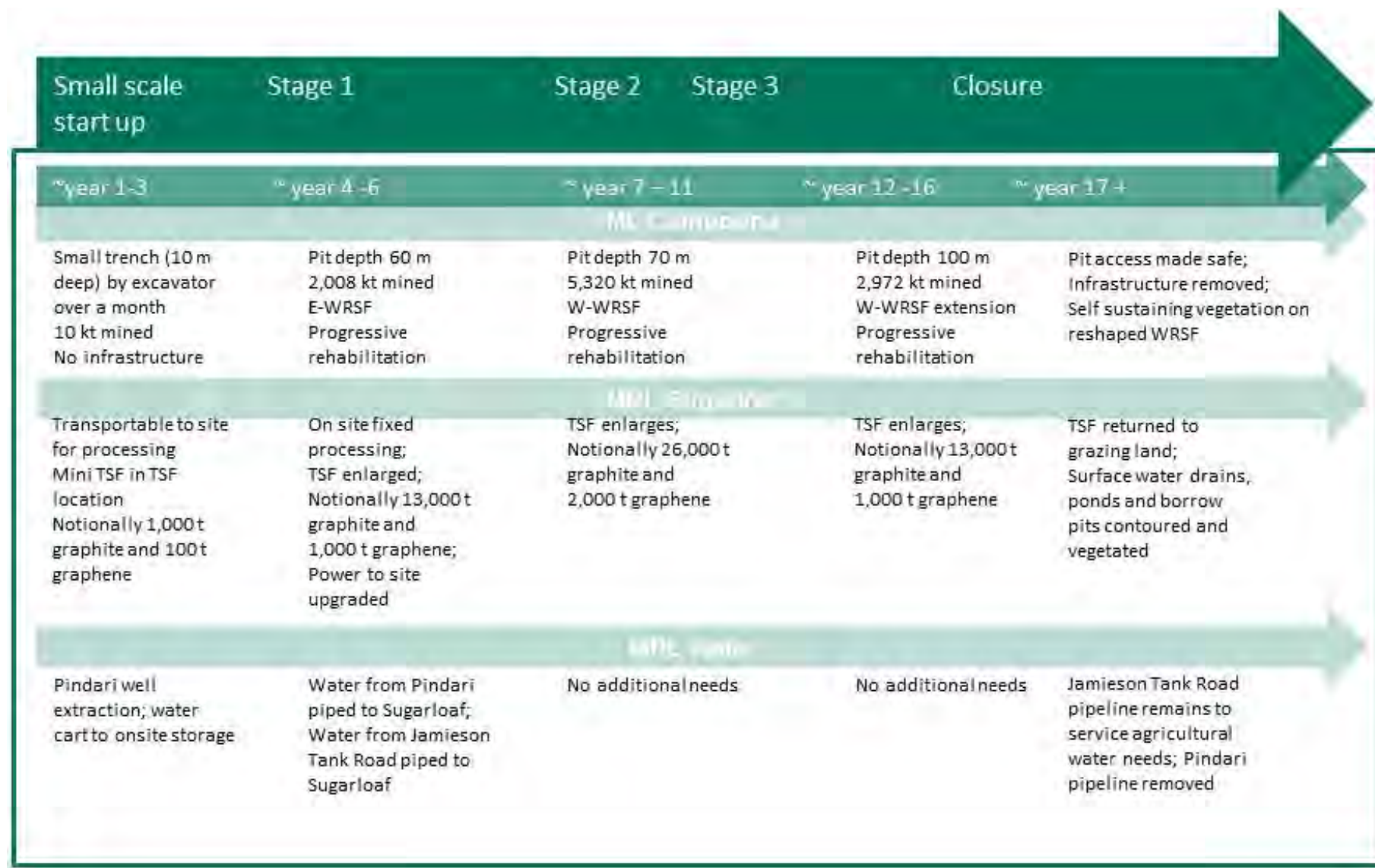


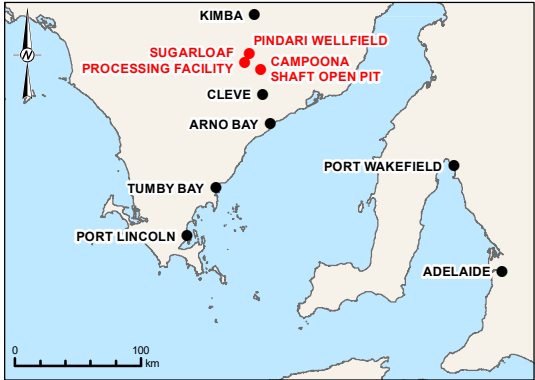
Figure 1-1: (b) A summary of project stages



CAMPOONA PROJECT
MINING LEASE PROPOSAL

**PROPOSED ML (CAMPOONA
SHAFT)**

LOCATION MAP



LEGEND

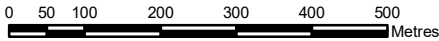
Mineral Claim Boundary

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.

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1. Aerial image sourced from Mapland, Department of Environment, Water and Natural Resources, South Australian Government.

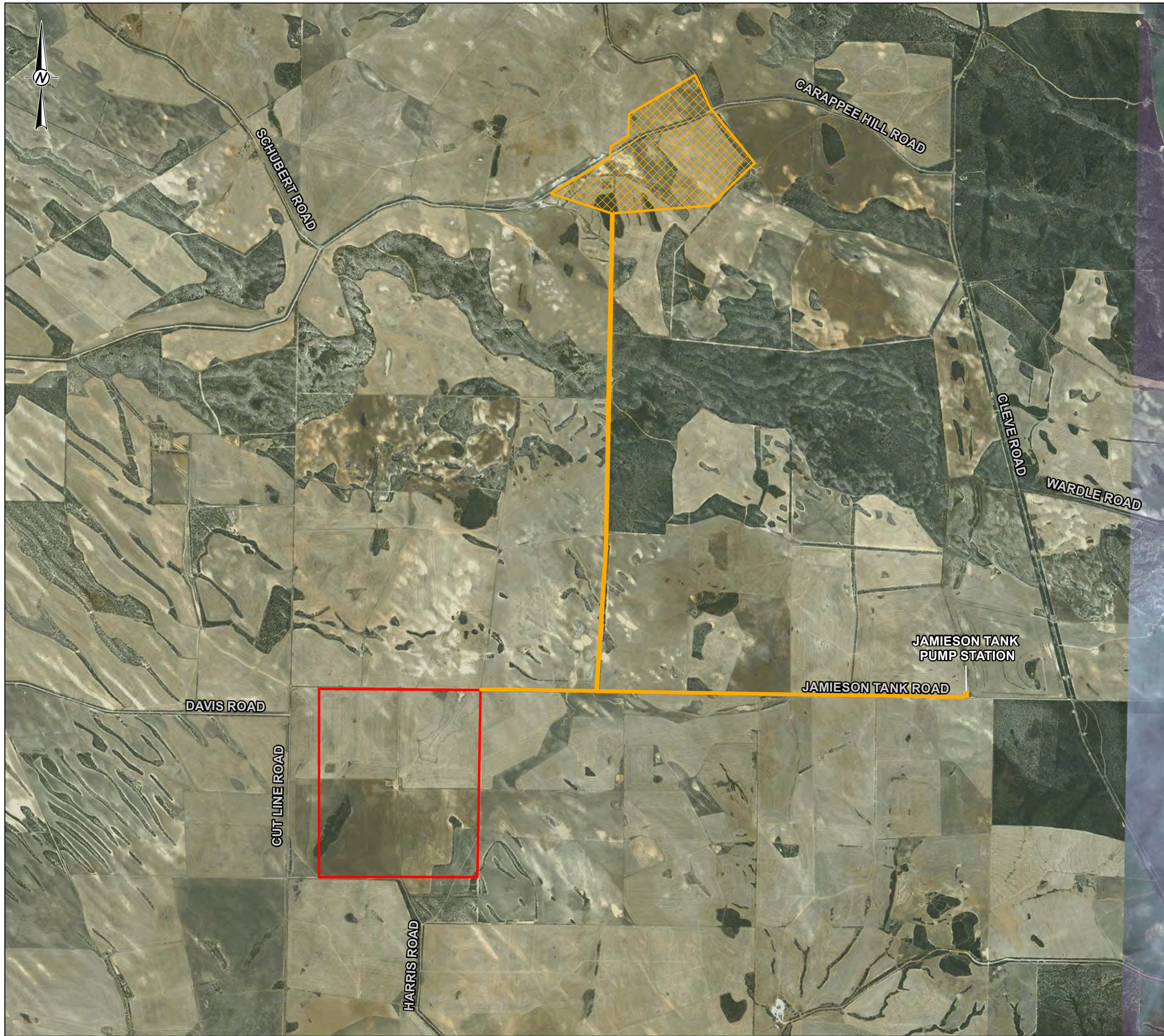


REFERENCE SCALE: 1:10,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

**FIGURE
1.2**

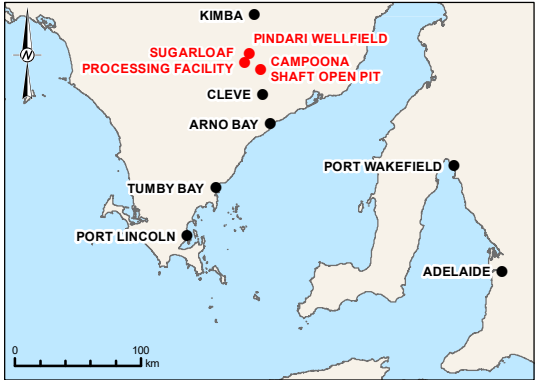




CAMPOONA PROJECT
MINING LEASE PROPOSAL

**PROPOSED MPL (SUGARLOAF)
AND MPL (WATER)**

LOCATION MAP



LEGEND

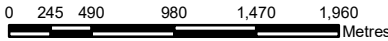
- Approximate Water MPL
- Approximate Sugarloaf MPL

NOTES

- 1. Township data sourced from MapInfo StreetPro.

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1. World Imagery - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



REFERENCE SCALE: 1:45,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

**FIGURE
1.3**





GRAPHITE PROJECT MLP AND MPS

The area required to develop this project comprises approximately 68 hectares (ha) at Campoona and 499 ha at Sugarloaf. An additional 242 ha is required to cover the MPL Water, encompassing the Pindari Wellfield and process water pipeline, as well as the Jamieson Tank potable water pump and pipeline to MPL Sugarloaf. This land falls within the current exploration licence areas EL5804 and EL4861. The Campoona Shaft deposit has a JORC 2012 Resource (based on 5% lower cut-off grade) as shown in Table 1-1.

Table 1-1: Campoona Shaft JORC resource (Archer 2014)

Resource Category	Million tonnes (Mt)	Graphite (% Total Graphitic Carbon (TGC))	Contained graphite (t)
Measured	0.32	12.7	40,600
Indicated	0.78	8.2	64,000
Inferred	0.55	8.5	46,800

1.3 Project proponent

The proposed ML and MPLs will be in the name of Pirie Resources Pty Ltd, a wholly-owned subsidiary of Archer Exploration Ltd. All community consultation has been in the name of Archer. For the purpose of this MLP and supporting documentation, Pirie Resources is interchangeable with Archer.

Archer Exploration has been listed on the Australian Stock Exchange (ASX) and registered as an Australian business since August 2007. Pirie Resources has a number of Exploration Licences in South Australia with exploration activities focused on graphite, magnesite, copper, gold and manganese. A summary of the proponent details is provided in Table 1-2.

Table 1-2: Proponent details

Item	Detail
Proposed Mining Lease holder	Pirie Resources Pty Ltd
Company name	Pirie Resources Pty Ltd
Contact name	Greg English
Address	Level 1, 28 Greenhill Road, Wayville SA 5034
Telephone	61 8 8272 3288
Facsimile	61 8 8272 3888
e-mail contact	grege@archerexploration.com.au

1.3.1 Project location and tenements

The underlying tenure of the proposed ML and MPLs is freehold land. Pirie Resources owns the subject land of the MPL Sugarloaf and has a binding Agreement to purchase the land needed at ML Campoona Shaft to support the mine plan.

EL5804 covers an area of 816 km² on the Eyre Peninsula in South Australia and is held by Pirie Resources Pty Ltd; a wholly-owned subsidiary of Archer Exploration Ltd. The tenement and land title details for the site are summarised in Table 1-3. A copy of the Certificates of Title (CT) can be found in Appendix A. Figure 1-4 outlines the boundaries of the land parcels and mineral tenements subject to this MLP and management plan.

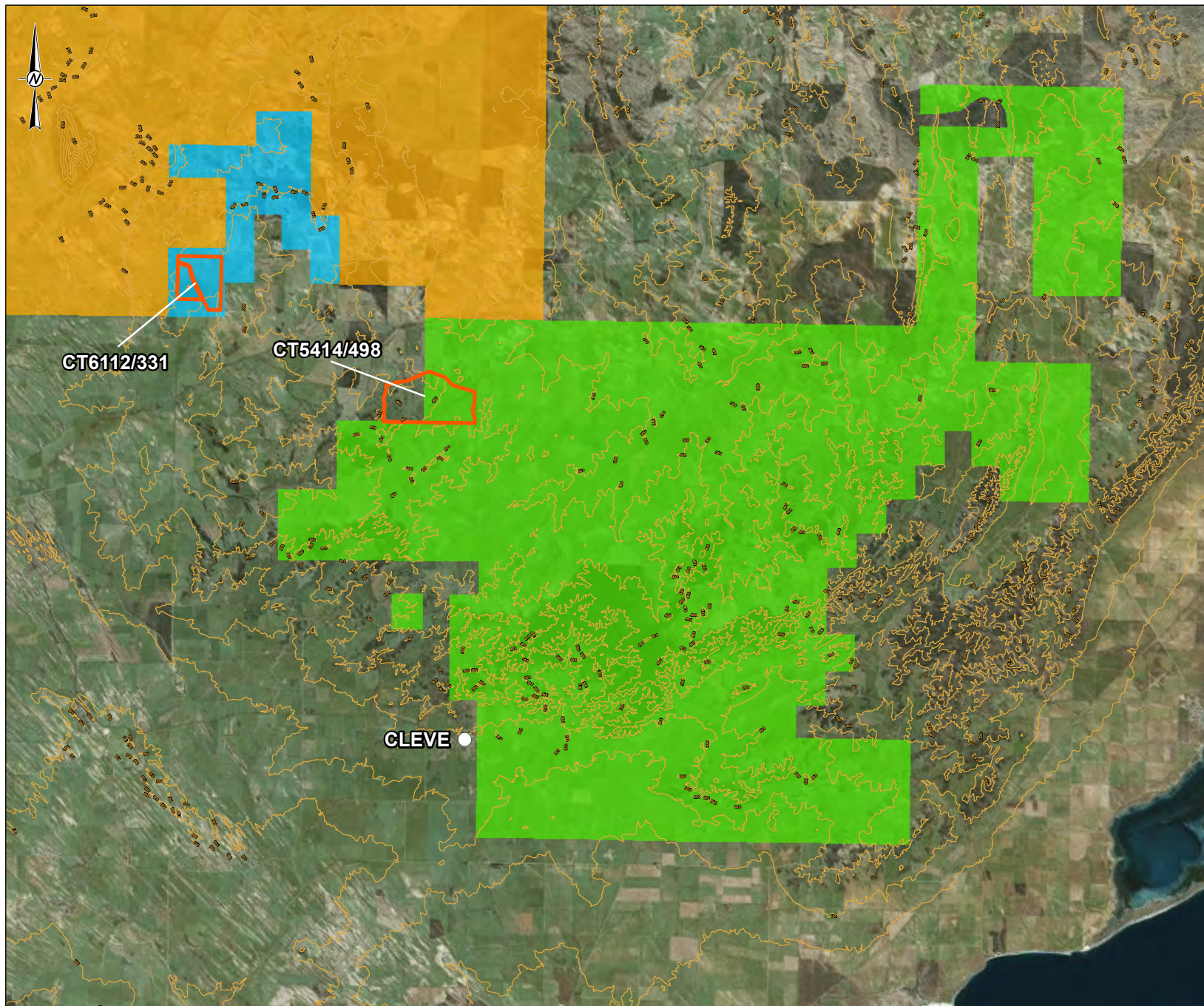


GRAPHITE PROJECT MLP AND MPS

Table 1-3: Tenement and land title summary

Tenement	Name	Ownership	Estimated tenement area (km ²)	Certificate of title	Site
EL5804	Wildhorse Plain	Pirie Resources Limited	816	CT5414/498	Campoona
EL4861	Carappee Hill	Pirie Resources Limited	54	CT6112/331	Sugarloaf and Pindari
EL5815	Waddikee	Pirie Resources Limited	999	CT5934/679	Waddikee and Pindari

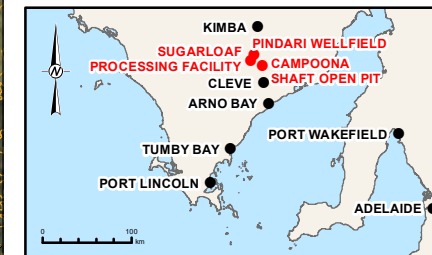
The Pirie Resources tenement interests on EL5804, EL4861 and EL5815 are shown on Figure 1-4. Photographs of each location are also provided in Figure 1-5.



CAMPOONA PROJECT MINING LEASE PROPOSAL

MINING TENEMENTS AND LAND TITLE, SHOWING ELEVATION CONTOURS

LOCATION MAP



LEGEND

Certificate of Title Boundary

Mineral Tenement Boundary

EL 4693

EL 4861

EL 4662

Contour (50m)

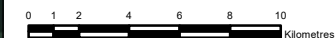
Township

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Contour data sourced from DEWNR, Department of Environment, Water and Natural Resources, South Australian Government.
3. Mineral Tenement Boundary data sourced from SARIG, Department of State Development Resources and Energy Group, South Australian Government.

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REFERENCE SCALE: 1:300,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-12-03
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

**FIGURE
1.4**





(a)



(b)



(c)

Figure 1-5: Site photo of (a) Campoono Shaft (b) Sugarloaf and (c) existing structures at Sugarloaf



2.0 DESCRIPTION OF THE ENVIRONMENT

2.1 Local community

The proposed mine site, processing site and pipeline alignment are located within the District Council (DC) of Cleve and the local community has been identified as being Cleve, Darke Peak, Cowell and Arno Bay. The region encompasses the north-eastern section of the Eyre Peninsula.

2.1.1 Regional context

The population of the region is widely distributed. Whyalla and Port Lincoln are the two major population centres on Eyre Peninsula (ABS Census Data 2011). Strong community networks and community groups play a major role in delivering regional services including the provision of natural resources management, recreation, sport and various community initiatives.

2.1.2 Population and demographics

Historically the Cleve District population has been stable however has experienced a decline since 2010 by around 180 people. The population distribution is in medium and small sized towns and in rural environments that support agriculture, aquaculture, fishing, mining and tourism.

Changes in population distribution of the region are being driven by the establishment of larger and fewer agricultural properties and changing industry.

Using statistics reported by the Australian Bureau of Statistics (ABS), population and demographics for Cleve have been collated in Table 2-1.

As at the 30 June 2012, the census data showed that the population of Cleve was 1,743, Whyalla was 22,716 and the Eyre Peninsula was 58,066 persons, or 3.5% of the State's population. The Indigenous population on the Eyre Peninsula was around 3,310 persons, or 5.7% of the population (ABS 2012).

Table 2-1: Population and demographics comparison between Cleve and South Australia

	Cleve District Council	South Australia
Population		
Total population	1,743	1,656,299
Male	921	820,358
Female	822	835,941
Dominant age group	0 –14yo (20.9%)	0 –14yo (17.7%)
Median Age	44.1	39.6
Population density (people/km ²)	0.4	1.7
Aboriginal or Torres Strait Islander peoples	0.6%	1.9%
Persons born overseas	6.6%	26.7%
Number of households (hh) and average household size	690 hh 2.3 people / hh	619,039 hh 2.4 people / hh
Employment and income		
Dominant employment by industry sector	Agriculture, forestry and fishing (39.2%)	Health Care & Social Assistance (13.6%)
Dominant business by industry (based on no. of businesses)	Agriculture, Forestry and Fishing (178 businesses; 58.5%)	Construction (21,822 businesses; 14.7%)
Dominant occupations of employed persons	Labourers (21.1%) Clerical and Administrative Workers (12.6%) Technicians and Trades Workers (12.6%) Professionals (12.3%)	Professional (19.6%) Clerical and Administrative Workers (14.4%) Technicians and Trades Workers (14.2%) Managers (12.6%)



GRAPHITE PROJECT MLP AND MPS

	Cleve District Council	South Australia
Working age population (15 – 64 yo)	59.7%	65.9%
Labour participation rate	66.1%	59.9%
Persons undertaking voluntary work	53.2%	19.8%
Unemployment rate	5.1%	5.7%
Average total taxable income (2011) (excl. pensions)	\$57,147	\$47,853

Source: ABS 2012

The Socio-Economic Indexes for Areas (SEIFA) is a suite of four indexes generated from social and economic Census information. SEIFA allows areas to be ranked across Australia according to their relative socio-economic advantage and disadvantage. The four indexes are:

- Relative Socio-Economic Disadvantage
- Relative Socio-Economic Advantage and Disadvantage
- Economic Resources
- Education and Occupation.

Based on the 2011 SEIFA data for Relative Socio-Economic Advantage and Disadvantage, the most advantaged areas in the region are Kimba followed by Wudinna and then Cleve, which rank 95, 84 and 83 respectively out of 123 areas across the state (ABS 2012).

2.1.3 Economy

The Eyre Peninsula contributed \$2.3 billion to the SA economy in 2006 / 2007 or 3.4% of the gross state production (SA Centre for Economic Studies 2011).

The region's agricultural industry produces more than 45% of South Australia's wheat crop and 20% of the state's barley crop. The average annual volume of all grain crops is around 2.2 Mt. The industry is reliant on seasonal conditions. Under favourable weather conditions the total value of the agriculture industry exceeds \$450 million (SA Centre for Economic Studies 2011).

The agriculture and fishing group is the largest sector in terms of employment in the Cleve District Council (Cleve DC) area, accounting for 39.2% of employment. The sector employs around 350 people in Cleve and 3,391 people throughout the Eyre Peninsula.

Tourism is one of the region's key growth industries with a rapidly growing reputation for its unique and diverse range of nature based visitor experiences and premium seafood products.

Significant mining and exploration activity also occurs throughout Eyre Peninsula.

2.1.4 Employment

Traditionally the main employment industry on Eyre Peninsula has been primary production (agriculture fishing and forestry). As indicated above, 3,391 people are employed by the industry across the Eyre Peninsula. Whilst a strong employer, the industry has experienced a 16.5% decline in job numbers since 2001.

The second highest employer is the health care and social assistance industry employing regionally 2,986 people. Employment in this industry sector has increased 29.5% between 2001 and 2011.

The mining sector has had the largest increase (almost 80%) in regional employment from 199 in 2001 to 987 in 2011. This has been due to more workers from the South Middleback Ranges, Olympic Dam and other mine sites living in coastal communities such as Cowell opting to drive-in/drive-out to the workplaces (SA Centre for Economic Studies 2011).



2.1.5 Services

Cleve is the north-eastern Eyre Peninsula's largest business town (District Council of Cleve population 1,743) offering wholesale trading and retail shopping outlet and a health and community centre that includes educational, recreational and sporting facilities.

The Cleve tourism industry is supported by hotels, motels and caravan parks along with necessary services, including service stations, a Royal Automobile Association contractor, supermarket, specialty shops, bakery, butcher, and banks. Medical facilities are also available locally with an accredited hospital and resident doctor. Retail rural supplies stores are available to help support the local agricultural economy.

Residents and tourists have the benefit of a number of recreational and sporting facilities such as an 18 hole all season golf course, a skate park, bowling greens, netball/tennis/basketball courts, a town oval and playgrounds, along with the natural attractions that the outback and coastline provide.

2.2 Land use

Prior to the arrival of European pastoralists, Eyre Peninsula was home to the Barngala people, who occupied the land from just north of Port Augusta to Port Lincoln. The Barngala people have a native title claim over two thirds of the Eyre Peninsula, including the proposed ML and MPL sites.

Historically, the proposed ML and MPL sites have been used for cultivated land with some mixed farming including grazing. Agricultural production in the region is dominated by wheat along with some barley and legumes. Pastoral activities have predominantly consisted of sheep farming; however, cattle farming is also a significant land use (DPTI 2012). Due to Cleve's eastern location on Eyre Peninsula it has developed a district base for industrial and commercial activity associated with the agricultural industry. It is likely that Cleve will continue and expand as a key service centre in the region.

The Eyre Peninsula has a history of exploration, mining and extractive industry activities, including (but not limited to):

- Iron Road Ltd (Central Eyre Iron Project / EIS currently being prepared for magnetite mining, processing and associated infrastructure).
- Eyre Iron Pty Ltd (Project Fusion / proposed magnetite mine).
- Valence Industries Limited (Graphite mine and processing facility in care and maintenance).
- Australian Graphite Limited (Kookaburra Gully / proposed mine and processing facility).
- Gemstone Corporation of Australia's mining of nephrite jade deposits.
- Various quarries for road base and construction aggregate.

The area around Cleve is also recognised for its wind energy project potential, including the Mount Millar Wind Farm located on an escarpment between the towns of Cowell and Cleve that produces up to 70 megawatts of electricity from 35 turbines.

Other smaller settlements in the district which include Rudall and Darke Peak mainly provide grain storage and handling activities. Arno Bay to the south of Cleve is a key tourism destination in the area and has aquaculture, a planned marina and attracts high amenity housing to take advantage of its coastal position.

2.2.1 Existing land use

The current land use of the area for the proposed ML (Campoona Shaft) and the MPLs (Sugarloaf and Water) is agriculture. The areas have been extensively cleared of native vegetation for cropping. The MPL (Water) also extends along the Jamieson Tank Road alignment through the road reserve until it reaches the north-east corner of the Sugarloaf.

Pirie Resources has a binding agreement to purchase the land at Campoona Shaft needed to mine the Campoona Shaft graphite resource.



Pirie Resources purchased the 568.3 ha Sugarloaf property that will host the Sugarloaf processing facility. There is a known undeveloped road reserve (public road) within the Sugarloaf property. Pirie Resources has an agreement with the District Council of Cleve to purchase this road reserve.

2.2.2 Final land use

Pirie Resources intends to implement a closure plan that not only complies with legal obligations, but also reflects community expectations and delivers a sustainable outcome for the proposed ML and MPL sites. All sites will be progressively rehabilitated (where practicable) to a safe and stable condition with a post-mining land use as agreed with stakeholders.

As part of closure planning, Pirie Resources has identified the following:

- The end land use should be designed so as to minimise the amount of disturbance to agricultural land and where practicable rehabilitate land back to a productive use.
- The final landscape should be acceptable to the community.
- The post-mining landscape should be rehabilitated.

It is envisaged that the final land use will involve a mix of agricultural pursuits and native vegetation.

Cropping activities will be undertaken on areas that have a gradient suitable for associated farming equipment, with grazing on land with a greater slope. Native vegetation will be planted in strategic locations to reinstate and improve vegetation corridors and on slopes which are unsuitable for agricultural pursuits. Future uses for the pit void on closure are being conceptualised.

2.2.3 Local planning

The Development Plan for the District Council of Cleve (2013) acknowledges that mineral exploration and the development of known mineral deposits in the region may have an impact upon employment and population growth in the region. The Development Plan recognises that development of support infrastructure for the mining industry in the region is needed.

The Development Plan describes the objectives and principles of development control associated with Mineral Extraction. The area proposed for the project development is within a designated Primary Production Zone under the Development Plan. Approved mining operations are an envisaged land use within this zone. The objectives seek to promote exploitation of mineral deposits compared to other forms of development. The Development Plan envisages minimum impacts of mining on adjacent land owners and the environment and maximization of economic opportunities arising from extractive industries.

Consultation in relation to the proposed mining development has been undertaken with the District Council of Cleve along with other stakeholders and interested parties (refer to Section 5.0).

There are no other known Council or Zone specific policies relevant to the land.

There are no known future land use changes currently planned by other parties.

2.2.4 Other interests or restrictions on the land

2.2.4.1 Public utilities and easements

There is a council-owned undeveloped road reserve through the Sugarloaf facility. Pirie Resources has commenced discussions with the District Council of Cleve regarding the road reserve. As a result, an agreement has been prepared in which Pirie Resources agrees to purchase the road reserve for an agreed sum and the associated land title transfer fees, when the MLP and PEPR are approved.

2.2.4.2 Protected areas

The proposed ML and MPLs under application do not fall within a known Protected Area.



2.2.4.3 *Overlapping or adjacent tenements under Petroleum and Geothermal Energy Act 2000*

There are no Petroleum and Geothermal tenements overlapping, or directly adjacent to the Project.

2.3 Proximity to housing and infrastructure

2.3.1 Housing and infrastructure

As a broad acre farming area, the population is relatively sparse outside of the main town centre. There are seven residences within 5 km of the proposed ML for Campoona Shaft (Figure 2-1), with the closest residence 0.8 km away.

At MPL (Sugarloaf), there are sheds and a dilapidated dwelling on site, and these have been considered in the site layout. The closest residence is more than 4 km south of the proposed processing operation.

The closest residence to the MPL (Water) is around 0.8 km from the main Pindari bore location.

2.3.2 Transport infrastructure

There are several possible road routes between the proposed ML Campoona Shaft and MPL Sugarloaf. Pirie Resources plans to use the Elson-Campoona Road, Cleve Road, Jamieson Tank Road to access the Sugarloaf processing site.

Based on a traffic and transport review (see Section 2.15), upgrades or increased maintenance may be required to improve the road surfaces and ensure that they are suitable for all-weather haulage. Pirie Resources proposes to upgrade the Elson-Campoona Road from the main Kimba-Cleve Road to the proposed ML Campoona Shaft mine entrance if the project proceeds. The upgrading will be done in consultation with the Cleve District Council and would involve the formation of a coarse aggregate base or bituminising.

Road haulage will be used to transport ore from Campoona Shaft to Sugarloaf and to take graphite concentrate product from Sugarloaf to an appropriate port facility (e.g. Port Adelaide).

The Cummins to Buckleboo railway line runs generally north-south, around 6 km west of the proposed ML Campoona Shaft. Rail is not currently considered as an option for Project transportation.

Pirie Resources is anticipating employing locally based personnel rather than hosting a fly-in-fly-out (FIFO) workforce. However, there will be a need for specialist contractors and engineers potentially employed on a FIFO basis as required, in particular during construction. The closest commercial airports are at Whyalla and Port Lincoln. Cleve also has a small airport.

Further discussion on transport requirements for the Project is provided in Section 2.15.

2.3.3 Electricity

The transmission network on Eyre Peninsula comprises a 132 kilovolt (kV) single circuit overhead line which runs between Whyalla and Port Lincoln and crosses the Kimba-Cleve Road approximately 20 km from Sugarloaf. The ElectraNet Pty Ltd 2012 Annual Planning Report indicates that this line is severely constrained, with no spare capacity available for major network connections. During peak summer loads, additional 'peak' generation must be fired up at Port Lincoln in order to meet the load at Port Lincoln and the surrounding area.

The existing capacity limitation has already been recognised as a constraint on mining and wind farm developments on Eyre Peninsula and ElectraNet has instigated a project that will replicate the 132 kV line with a new high capacity 275 kV overhead line. The new line is tentatively scheduled for completion in 2018, although planning permission has yet to be granted.

Whilst the 275 kV line will remove constraints on development in the region, the cost of installing a 275 kV tee-off transformer substation to feed the Project would exceed \$20 million and this is not a viable economic proposition for the small load required (less than 1 megawatt (MW) at full scale production) and the timing for completion of the overhead line does not fit with the planned development timeframe for the Project.



SA Power Networks has advised that between 1 and 5 MW can be available at Darke Peak with voltage regulation. This will be supported by an 11 kV transmission line and transformer at Sugarloaf.

For the small-scale start-up operation electricity will be supplied to Sugarloaf via the existing mains infrastructure and if needed augmented by a small diesel generator. For full scale production electricity will be supplied via the 11 kV transmission line or as an alternative, two diesel generators with a generating voltage of 3.3 kV could also be used.

Pirie Resources will preferentially use mains power for the ML at Campoona Shaft, and preferentially at both the MLPs at Sugarloaf and Pindari.

2.3.4 Water supply

Process water requirements for the small-scale start-up phase are minimal (expected to be less than 10 megalitres (ML) of water each year, i.e. 10 ML/a). It is planned that the supply will be sourced from an existing well at the proposed Pindari Wellfield site, located 10 km north of the processing facility at MPL Sugarloaf, trucked to site and stored in a process water pond.

Full-scale production (Stage 1 -3) process water requirements (approximately 100 ML/a) will be sourced from a combination of Pindari Wellfield (MPL Water), the recycling of decant water from the tailings storage facility and potable water from Jamieson Tank (also forming part of the MPL Water).

Groundwater at Pindari averages around 22,500 mg/L total dissolved solids (TDS), which is too saline for use in either stock water or in crop irrigation. There are no identified beneficial uses other than for mineral processing water. An assessment of users was undertaken based on WaterConnect data (Appendix F). A comprehensive farmer-based survey will be undertaken and results presented in the PEPR to confirm that the proposed extraction does not unduly affect existing users of the saline groundwater resource.

Supply testing conducted to date suggests that 100 ML/a would be available for the start of the project. However, further evaluation will be necessary. The long term viability of the proposed wellfield will be assessed progressively over time, including carefully designed monitoring during the early period of wellfield operation.

The South Australia Water Corporation (SA Water) has existing infrastructure in the area that provides mains water. SA Water's Jamieson Tank has sufficient water for the Project. SA Water and Pirie Resources signed a potable water supply agreement enabling 40 ML per annum rising to 80 ML per annum at Pirie Resources' election to be supplied from the existing Jamieson Tank water system. Pirie Resources will install a pump at Jamieson Tank and construct a pipeline along Jamieson Tank Road to supply potable water to the MPL Sugarloaf site.

2.3.5 Other infrastructure

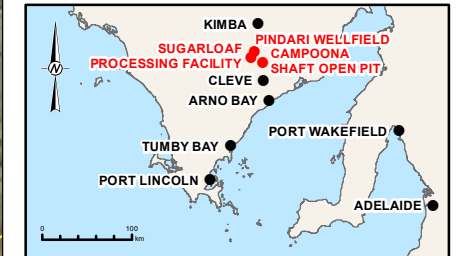
Other infrastructure that surrounds the Project is shown in Figure 2-1.



CAMPOONA PROJECT MINING LEASE PROPOSAL

PROXIMITY OF THE PROJECT SITES TO HOUSING AND INFRASTRUCTURE

LOCATION MAP



LEGEND

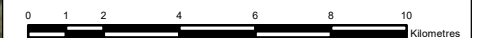
- Project Site
- Residence
- Cleve Area School
- Scenic Lookout
- Dam / Reservoir
- H Cleve District Hospital and Aged Care
- 132kV ElectraNet Transmission Line
- 66kV Overhead Transmission Line (ETSA)
- 19kV Overhead Transmission Line (ETSA)
- Railroad
- Township

NOTES

- Township data sourced from MapInfo StreetPro.

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REFERENCE SCALE: 1:200,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

**FIGURE
2.1**





2.3.6 Exempt land

The owners of land within the proposed ML and MPL areas include a person who holds a registered estate or interest in the land, a person who has by statute care, control or management of the land or a person who is lawfully in occupation of the land (such as cropping). In addition to the owner of the exempt land on which mining operations are being proposed, persons owning a building used as a place of residence within 400 m or having a commercial or industrial structure valued at \$200 or more within 150 m of the proposed mining operation also have the benefit of exemption.

For mining operations to occur, including those that may occur within a MPL the benefit of exemption needs to be waived. This can be through an agreement between the person(s) and the operator or through statutory forms 23A and 23B under the Mining Act.

A waiver of the exempt status of the land to undertake the mining operation impacting on that land is required before mining operations can commence. If the negotiations to waive the benefit of exemption fail, the matter may be taken to the Environment Resources and Development Court by the mining operator to determine if exemption should be waived and the amount of compensation payable.

Waivers for exempt land are presented in the summary table at the start of this document.

2.3.6.1 Exempt land at ML Campoona Shaft

The Campoona Shaft land is the subject of a binding Agreement to purchase the land covered by the proposed ML. On purchase, Pirie Resources will lease the land back to the previous owner to allow cropping, until the land is required for mining purposes.

Land within Campoona Shaft is currently cropped (and therefore exempt land) and has two small farm dams within the proposed ML area; one south west of the shaft and one north west of the shaft in the proposed location of the Western Waste Rock Storage Facility. In this situation, Pirie Resources, once owner of the land and as the ML proponent, will need to provide a formal waiver of exemption under Section 9AA of the Mining Act in order to meet the requirements therein.

2.3.6.2 Exempt land at MPL Sugarloaf

Archer Pastoral Company Pty Ltd is a wholly-owned subsidiary of Archer Exploration Limited. Archer Pastoral owns the proposed MPL site at Sugarloaf. The Sugarloaf property is currently leased to a local landowner for cropping and grazing and is therefore exempt land. Pirie Resources will seek a formal waiver of exemption under Section 9AA of the Mining Act in order to meet the requirements therein. Archer Pastoral Company Pty Ltd entered into a Lease of Rural Land Cropping and Livestock Grazing Agreement on 4th November 2013 with the Agreement renewed on 17th May 2015 for a further period of two years. Clause 32 of the Agreement - Access for exploration and mining operations – states:

- 32.1 The Lessee acknowledges that the Lessor or its Related Bodies Corporate or Associated Entities have rights granted under the Mining Act, 1971 (SA) (Mining Act) in relation to the conduct of activities authorised by an exploration licence granted over the Land or portion of the Land.
- 32.2 The Lessee has entered into the Land Access and Compensation Agreement in relation to any rights it may have as an owner of Land (as that term is defined in the Mining Act) and the Lessee acknowledges that any compensation or other rights it may have are fully dealt with in that Land Access and Compensation Agreement and that no other compensation is payable.
- 32.3 The Lessee acknowledges and agrees that the Lessor or any of its Related Bodies Corporate or Associated Entities and their representatives retain the absolute right to undertake any exploration or mining activity on the Land.
- 32.4 Should the Lessor or any of its Related Bodies Corporate or Associated Entities wish to undertake such activity the parties shall work together, prior to such activity being undertaken, to minimise any damage to the Lessee's crops or Livestock which may be caused by such activity, subject to clause 32.5 below.



- 32.5 The Lessee acknowledges and accepts the right of the Lessor and any of its Related Bodies Corporate or Associated Entities to undertake such activity on the Land and that under no circumstances will any compensation be payable (other than that payable in accordance with the Land Access and Compensation Agreement) for such activity undertaken or damage caused by such activity during the term of the Lease or any renewal of that term.
- 32.6 The Lessor may excise as much land as it needs from the Lease in the event it wishes to erect and operate a processing facility and any associated infrastructure to support such a facility. If such circumstances eventuate then rental is to be calculated, on and from the date of such circumstances, based on the new arable acreage.
- 32.7 In circumstances as described in sub paragraph 32.6 the parties shall work together to minimise any damage to the Lessee's crops and Livestock.
- 32.8 The Lessee acknowledges and accepts that the Lessor's right to excise Land as set out in paragraph 32.6 above is unrestricted and under no circumstances will any compensation or damages or other award be payable for such excise, activity undertaken or damage caused to the Lessee during the term of the Lease or any renewal of the term.

2.3.6.3 Exempt land at MPL Water

The MPL for water is linear over several kilometres and adjacent to lands used for cropping, or following a fence line within cropping lands (Figure 2-2).

Pirie Resources will seek a formal waiver of exemption from the landowners for any exempt land outside of the proposed ML and MPL boundaries.

Exempt land is shown on Figure 2-2.

2.3.7 Visual amenity

The hills of the Cleve Uplands area are moderately sloping with elevations ranging between 200 m referenced to Australian Height Datum (AHD) and 370 m AHD.

A visual amenity review was undertaken to determine the potential visual effect to residences closest to the Sugarloaf processing facility and Campoona Shaft open pit. The visual amenity review also included an assessment of visual amenity from view point of adjacent public roads.

A number of Key Observation Points were chosen to assess the visual impacts of the sites, as detailed in Appendix B. Key Observation Points were selected along Carappee Hill Road, Cut Line Road, Harris Road, Cleve Road, Story Road, White Road, Elson-Campoona Road and Jamieson Tank Road. Photographs were taken at each of the viewpoints, and while some photographs have been selected for inclusion in this section, all have been provided in Appendix B.

The ML Campoona Shaft and MPL Sugarloaf sites are typical of the rural farming landscape, and contain no key landmarks or features.

The MPL Water includes an existing concrete water storage tank that is used to supply farms. A water supply pipeline will be used to connect the potable water along the road reserve to the MPL Sugarloaf boundary. This is consistent with other pipelines in the District. Similarly, the Pindari process water pipeline between the wellfield and MPL Sugarloaf boundary will follow an existing fence line predominantly through private property. The MPL Water will not impact local amenity.

2.3.8 Site setting

2.3.8.1 ML Campoona Shaft

The northern boundary of Campoona Shaft abuts Elson-Campoona Road whilst the site's eastern, southern and western boundaries are adjacent to rural properties. The Campoona Shaft is flanked to the south, east and west by small hills, including Campoona Hill to the south which ranges in elevation from 360 m to 410 m AHD. The Campoona Shaft site ridgeline has an elevation of around 370 m AHD.



GRAPHITE PROJECT MLP AND MPS

The Campoona Shaft site is located within cleared open farmland with small stands of degraded natural vegetation. It lies within the Salt Creek Catchment (Figure 2-1).

There are two residences within 2 km of the site, located on Elson-Campoona Road and Cleve Road, whilst another two residences are within 3.5 km of the site, located on Story Road and Cleve Road (refer to Figure 2-1).

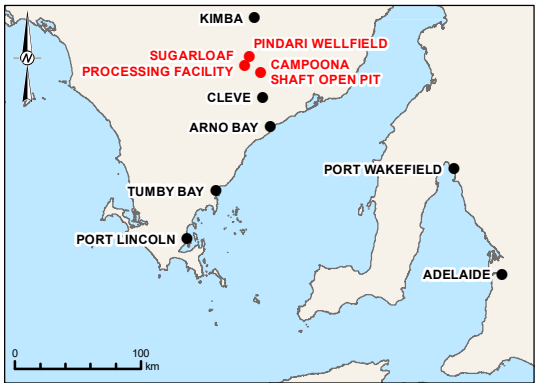
The proposed entrance to Campoona Shaft is lined by vegetation, predominately medium sized trees and low shrubs, which partially screen between the site and users of Elson-Campoona Road. Viewpoints at Campoona are provided in Figure 2-3.



CAMPOONA PROJECT
MINING LEASE PROPOSAL

EXEMPT LAND FEATURES
(CAMPOONA)

LOCATION MAP



LEGEND

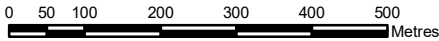
- Residence
- Dam
- ▨ 150m Dam Buffer
- Cropping Land
- ▭ Mineral Claim Boundary

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.

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1. Aerial image sourced from Mapland, Department of Environment, Water and Natural Resources, South Australian Government.

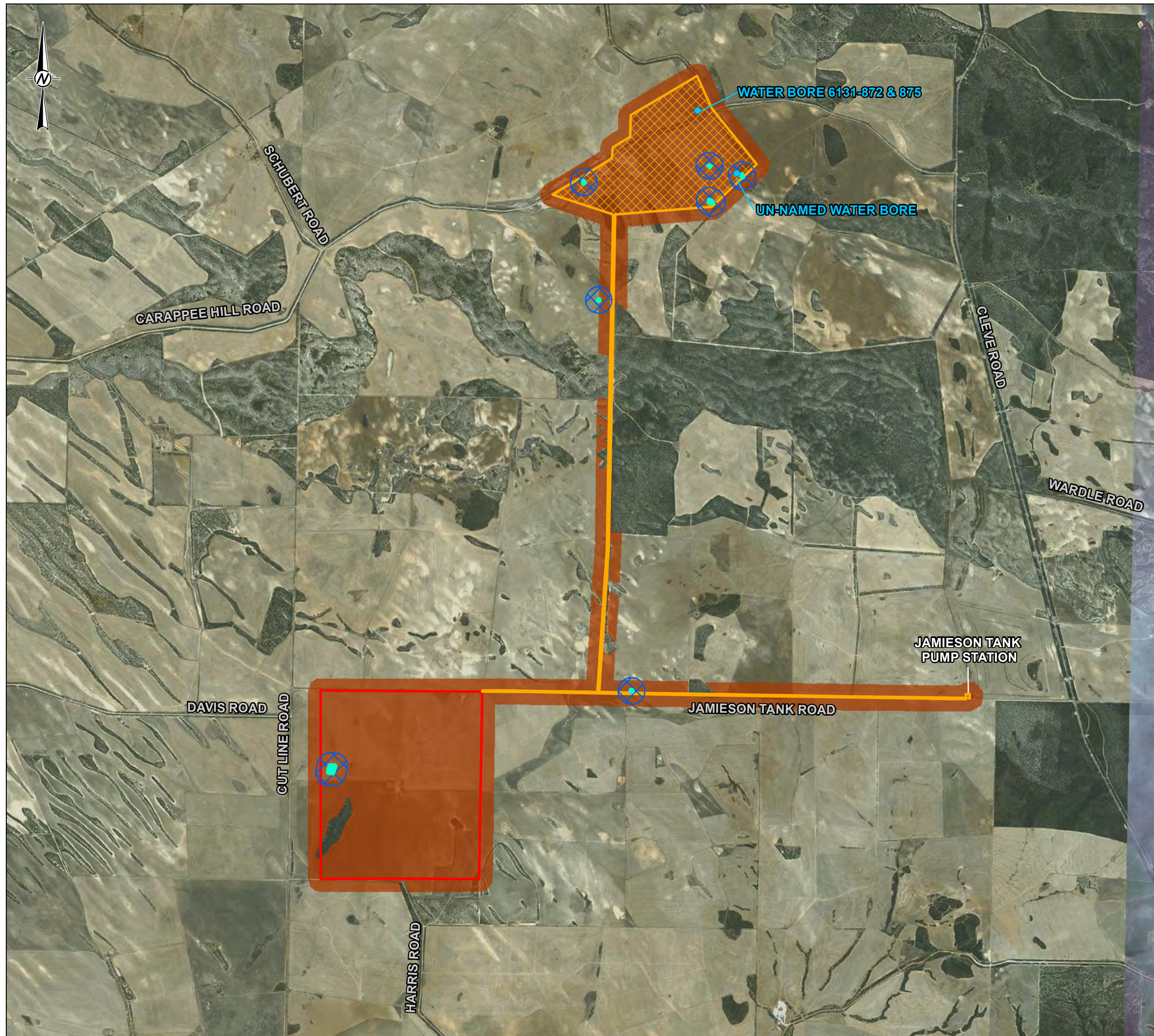


REFERENCE SCALE: 1:10,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

FIGURE
2.2A

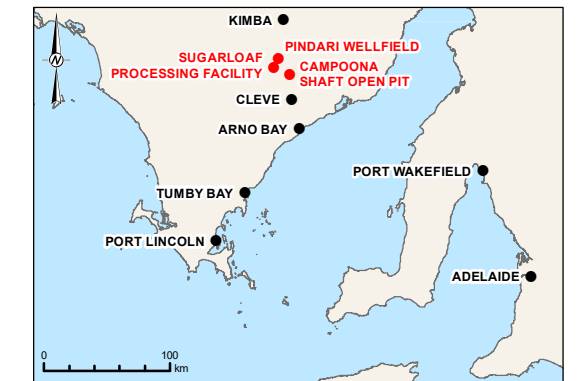




CAMPOONA PROJECT
MINING LEASE PROPOSAL

**EXEMPT LAND FEATURES
(SUGARLOAF)**

LOCATION MAP



LEGEND

- Water Bore
- Dam
- 150m Dam Buffer
- Cropping Land
- Approximate Water MPL
- Approximate Sugarloaf MPL

NOTES

- Township data sourced from MapInfo StreetPro.

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1. World Imagery - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

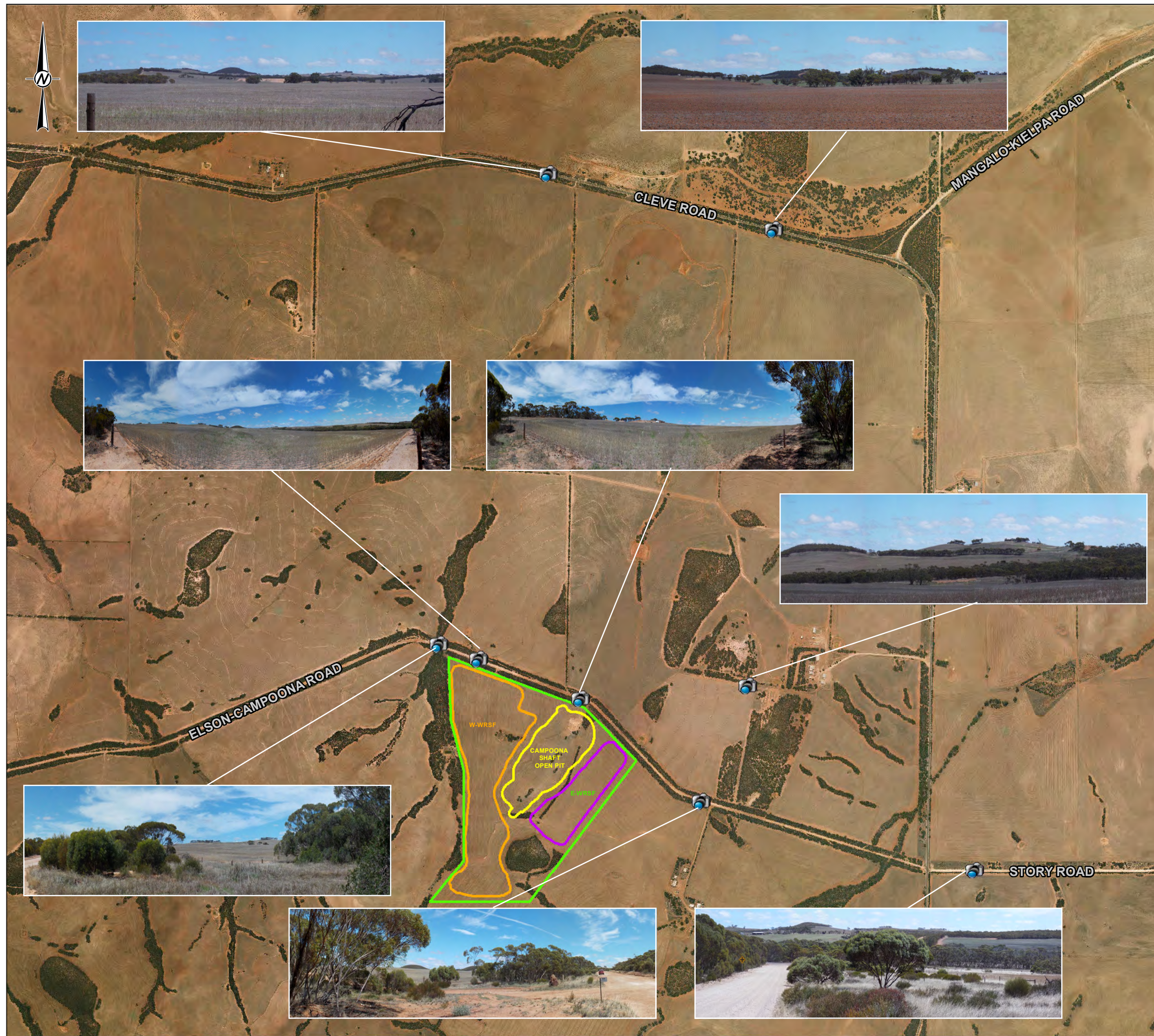
0 250 500 1,000 1,500 2,000
Metres

REFERENCE SCALE: 1:45,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

**FIGURE
2.2B**

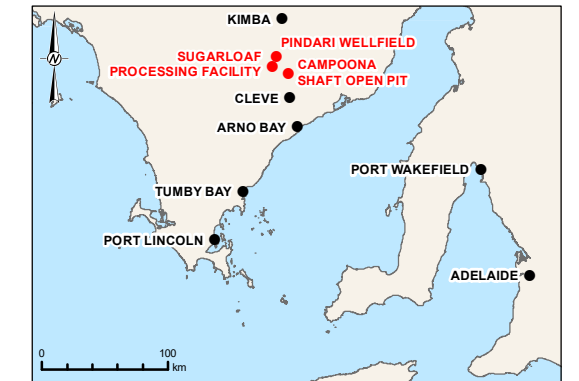




CAMPOONA PROJECT MINING LEASE PROPOSAL

LOCATION OF VIEWPOINTS AT CAMPOONA AND EXISTING VISUAL AMENITY

LOCATION MAP



LEGEND



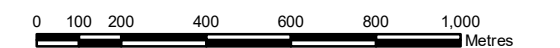
- Campoona Shaft Open Pit
- E-WRSF
- W-WRSF
- Mineral Claim Boundary

NOTES

- Township data sourced from MapInfo StreetPro.
- Site layout data sourced from Archer Exploration Ltd.
- Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.

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- Aerial image sourced from Mapland, DEWNR, Department of Environment, Water and Natural Resources, South Australian Government.



REFERENCE SCALE: 1:17,815 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

**FIGURE
2.3**





2.3.8.2 MPL Sugarloaf

The MPL Sugarloaf is bounded by three public roads: Jamieson Tank Road to the north; Cut Line Road to the west; and Harris Road to the south. The site's eastern boundary is a neighbouring rural property.

The location of Sugarloaf site rises in elevation from 250 m AHD at the south-east corner to 290 m AHD at the north-eastern corner then falls to 250 m AHD at the north-western corner of the site. The site is flanked to the east by small hills where elevation ranges between 330 m to 390 m AHD. The elevation to the north and south of the site is approximately 240 m to 300 m, AHD whilst the elevation to the west of the site is between 170 m to 260 m AHD.

In general, the site is open farm land and is currently used for cropping. There are a number of sheds and a disused residential dwelling on site. Some of these structures have been incorporated into the proposed infrastructure for the site. There is only one residence within 5 km of the site. A further three residences occur within 10 km of the site located on Carappee Hill Road, Plane Road and Cleve Road (refer to Figure 2-1).

The site entrance is located on Jamieson Tank Road, an unsealed road, approximately 1.3 km east of the intersection with Cut Line Road and approximately 8.2 km west of the intersection with Cleve Road. The exploration licence northern boundary is approximately 2.3 km in length (1 km to the east and 1.3 km to the west of the site entrance) and runs parallel to Jamieson Tank Road. Viewpoints are provided in Figure 2-4.

2.3.8.3 MPL Water - Pindari well and pipeline, Jamieson Tank pipeline

The wellfield and pipelines are located approximately 10 km north of the MPL Sugarloaf in a landscape that has been described as gently undulating. The dominant land use has been farming, with both cropping and grazing present along the proposed route. The alignment is proposed to follow part of Carappee Hill Road but largely traverses five allotments and cannot be seen. Accordingly, there are no visual amenity issues anticipated.

The potable water supply from Jamieson Tank will comply with the District Council of Cleve's directives and follow the southern side of the road reserve along Jamieson Tank Road. This road alignment is largely dominated by introduced grasses and weeds and sparsely vegetated with trees.

2.4 Noise, dust and air quality

This section describes the existing conditions for noise and air quality at the sites, considering both natural and agricultural sources and describes the potential sensitive receptors. Pirie Resources has consulted with and obtained the endorsement of the SA Environment Protection Authority in relation to the approach used for the assessment of air quality and noise baseline conditions.

2.4.1 Noise

The nearest sensitive receptors (residences) are shown in Figure 2-1. The closest residential property is within 1 km of the Campoona Shaft site (800 m). The nearest inhabited residential property to the Sugarloaf processing facility is located more than 4 km to the south.

2.4.1.1 Regulatory context

Protection of the amenity values of an area are afforded under legislation including *Environment Protection (Noise) Policy 2007* which specifies noise levels that should not to be exceeded at sensitive receptors.

The noise levels specified vary depending on time of day, i.e. daytime (0700-2200)) and night time (2200-0700).

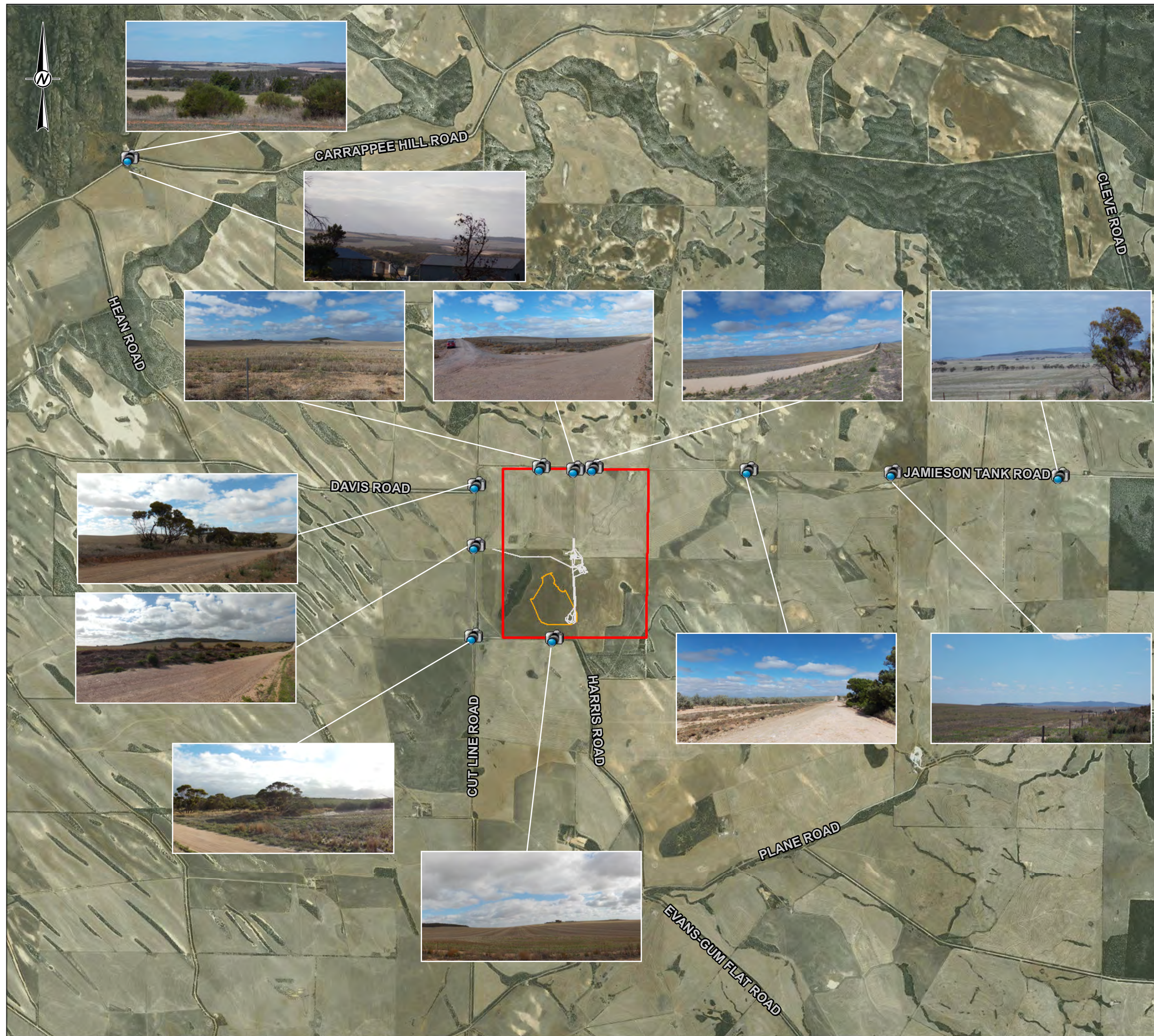
The noise limits used in the assessment were conservation (i.e. 52dB(A) during the day and 45dB(A) during the night); however, in accordance with the Cleve Development Plan, without adjustments for noise character, the limits are 57dB(A) and 50dB(A) for day and night respectively.



2.4.1.2 Existing noise levels

As the Project areas (i.e. ML Campoona, MPL Sugarloaf and MPL Water) are in a rural environment, existing noise levels are expected to be low, i.e. less 30 dB(A) and rising above this for effects such as wind in trees and wind over structures, as well as farming equipment use and trucking activities (Appendix C).

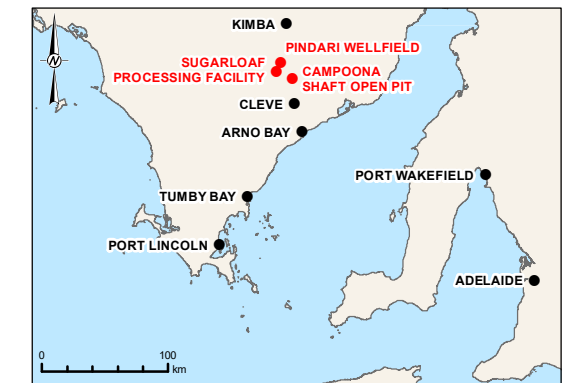
As a rural area, the main contributions to background noise are environmental (e.g. wind) and those associated with current activities in the area including vehicle movements, road transport and farming activities. The noise levels experienced at sensitive receptors can be influenced by factors such as proximity to and conditions of roads, weather, vegetation and topography.



CAMPOONA PROJECT
MINING LEASE PROPOSAL

LOCATION OF VIEWPOINTS AT
MPL SUGARLOAF AND EXISTING
VISUAL AMENITY

LOCATION MAP



LEGEND

- Viewpoint
- Infrastructure Footprint
- South West Cross Valley TSF
- Approximate Sugarloaf MPL

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Site layout data sourced from Archer Exploration Ltd.
3. Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.

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1. World Imagery - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 250 500 1,000 1,500 2,000
Metres

REFERENCE SCALE: 1:50,000 (AT A3)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

FIGURE
2.4





2.4.2 Dust and air quality

The conditions that can influence air quality include dispersion effects from topography and weather, the nature of the operation and the location of sensitive receptors, which are discussed in Sections 2.5 and Section 2.6 respectively.

The assessment of air quality was discussed with DSD and the South Australian Environment Protection Authority (EPA) at a meeting held on 13 August 2013 and further telephone discussions were held between relevant technical personnel (consultants and EPA) on 15 August 2013 to confirm the approach used.

2.4.2.1 Regulatory context

The principal legislation governing air quality in South Australia is the *Environment Protection Act 1993*. Regulation of air pollution is primarily administered through the *Environmental Protection (Air Quality) Policy 1994*. However, schedule 1 of the air quality policy only refers to maximum pollution levels that may be discharged from an exhaust stack, while the emissions relevant to this study are fugitive particulate matter emissions (i.e. a mixture of non-point sources) that would be generated through the operational mining activities. For this reason, the adopted ambient air quality criteria were based on national legislation.

The SA EPA does not endorse a single methodology to derive background concentration levels from observed data. The Victorian *State Environment Protection Policy (Air Quality Management)* (SEPP[AQM]) stipulates that where no appropriate hourly background data exists, the 70th percentile of one year's observed hourly concentrations as a constant value must be added. Where a 24-hour averaging time is used in the model, the background data must be based on 24-hour averages. In the absence of site specific data, background 24-hour average TSP, PM₁₀ and PM_{2.5} concentrations are derived from data sets relevant to the location and conditions to the Site.

2.4.2.2 Existing dust and air quality levels

Existing air quality is dependent on the type and number of other emission sources in the area and is usually determined from the results of ambient air quality monitoring. The SA EPA operates a network of nine ambient air quality monitoring stations (AAQMS). Of these stations, the closest to the project site are located in Whyalla (Waltz Street and Shultz Street) and Port Pirie (Oliver Street), over 250 km north-east of the project sites. The remaining network sites are located in and around Adelaide. In contrast to the Site, these stations are situated in an urban environment characterised by light industrial and residential land use.

Given the general similarities in topography, the relative proximity and existing information, data collected at the proposed Wilgerup Mine on the Eyre Peninsula were considered more appropriate in representing the background environment at the project site. The 70th percentile of the 24 hour averaged 2009-2010 Wilgerup Mine dataset represents:

- Background Particulate Matter of less than 10 micrometers in diameter (PM₁₀) concentration of 14 µg/m³.
- Concentrations of Particulate Matter of less than 2.5 micrometers in diameter (PM_{2.5}) in urban environments are approximately 40% of PM₁₀ concentration. In the absence of PM_{2.5} background data, it is conservatively assumed that the representative PM_{2.5} background concentration is equal to 50% of the PM₁₀ concentration; i.e. 7 µg/m³.
- In the absence of TSP background data, based on the ratios of the emission factors for TSP and PM₁₀, it is conservatively assumed that the representative TSP background concentration is equal to 300% of the PM₁₀ concentration and therefore 42 µg/m³.



2.5 Topography and landscape

To assist with land conservation, a national and regional planning framework has classified Australia's landscapes into 89 geographically distinct bioregions that are based on common climate, geology, landform and species present.

The ML and MPL areas lie within Eyre Yorke Block bioregion. This block is defined as:

"Archaean basement rocks and Proterozoic sandstones overlain by undulating to occasionally hilly calcarenite and calcrete plains and areas of aeolian quartz sands, with mallee woodlands, shrublands and heaths on calcareous earths, duplex soils and calcareous to shallow sands, now largely cleared for agriculture."

The ML and MPL local topography is generally characterised by a network of gentle hills and shallow valleys with limited upslope areas. The topographic contours are shown on Figure 1-2.

The hills of the Cleve Uplands area are moderately sloping with elevations ranging between 200 m AHD and 370 m AHD. The district landscape is defined by incised hills and valleys which drain to gently sloping plains toward the coast and inland. Remnant dunes occur from place to place, particularly around the Pindari groundwater supply area (MPL Water).

The Campoona Shaft graphite deposit strikes north east - south west occurring immediately west of a low ridgeline with an elevation of around 370 m AHD. Sugarloaf is approximately 270m to 310 m AHD.

The pipeline from Sugarloaf to the Pindari Wellfield (MPL Water) runs through undulating country ranging from 280m AHD elevation at Sugarloaf to around 210 m AHD towards the north and then rising to the east to the Pindari Wellfield which lies at approximately 245 m AHD.

Topography and site setting was discussed in the assessment of existing visual amenity (Section 2.3.7).

2.6 Climate

The Eyre Peninsula has cool moist winters and hot mostly dry summers with maximum temperatures occurring between November and March. Most of the rain falls between May and October peaking during the winter months of June to August. High intensity summer rains can also occur. The average annual rainfall (AAR) in the Cleve Uplands area ranges from 260 mm to 430 mm. The AAR at Darke Peak, which is 13 km west of Sugarloaf, is around 378 mm (BOM 2013) and 361 mm at Cleve Aerodrome, which is located approximately 20 km south of Campoona (BOM 2013a). Rainfall monitoring data for adjacent monitoring stations are summarised in Table 2-2 (BOM 2013). Summary details of the weather station locations are provided in Table 2-3. These weather stations were selected based on proximity, length of recording period and parameters (rainfall and temperature data).

Table 2-2: Rainfall monitoring data - western Cleve Hills

Monitoring Location Name	Monitoring period	Years of monitoring data	Rainfall (mm)			
			5th Percentile	95th Percentile	Median	Mean
Darke Peak	1914-2013	9	257	526	370	379
Mangalo	1999-2013	14	271	474	340	357
Cleve (Mangalo)	1906-1999	93	199	481	326	339
Waddikee	1927-2013	86	86	501	326	335



GRAPHITE PROJECT MLP AND MPS

Table 2-3: Project area BOM weather station details

Monitoring Location Name	Station Number	Coordinates (Lat. + Long.)		Elevation (m AHD)	Distance from Project area (km)
Darke Peak	18024	33.47° S	136.21° E	165	20.97
Mangalo	18173	33.57° S	136.65° E	295	21.98
Cleve (Mangalo)	18048	33.53° S	136.62° E	260	19.98
Waddikee	18089	33.32° S	136.25° E	175	30.57

The annual average minimum temperature for the Cleve area is 11°C and the average maximum temperature is 22°C. Average temperatures in summer range between 16°C and 29°C and in winter between 5°C and 15°C.

In Eyre Peninsula's dry climate, evaporation and transpiration are generally limited because there is not sufficient water available from rainfall. Actual evapo-transpiration for the Eyre Peninsula ranges between 200 mm/year and 600 mm/year; whereas, potential evapo-transpiration ranges between 1,100 mm/year and 1,300 mm/yr. District evapo-transpiration is likely to be in the order of 300 mm/year.

Data from the Cleve Airport (2008) shown in Table 2-4 indicate an average wind speed of 5.3 m/s and the average wind direction to be 349 degrees (blowing from the north and west) for most of the year, except in summer when the winds from the south east dominate (see Figure 2-5).

Table 2-4: Climatic data - Cleve airport, 2008

Climate Statistic	Temperature (°C)	Relative Humidity (%)	Barometric Pressure (hPa)	Average Wind Speed (m/s)	Average Wind Direction (degrees)	Daily Rainfall (mm)
Average	16	59	99.7	5.3	349	0.36
Maximum recorded	42	92	101.6	18	NA*	11.7
Minimum recorded	2.6	5	97.5	0	NA*	0

*Not applicable.

The mean monthly temperatures and rainfall from 46 years of data from the Bureau of Meteorology Kimba station between 1967 and 2013 are shown in Figure 2-6 and Figure 2-7.



GRAPHITE PROJECT MLP AND MPS

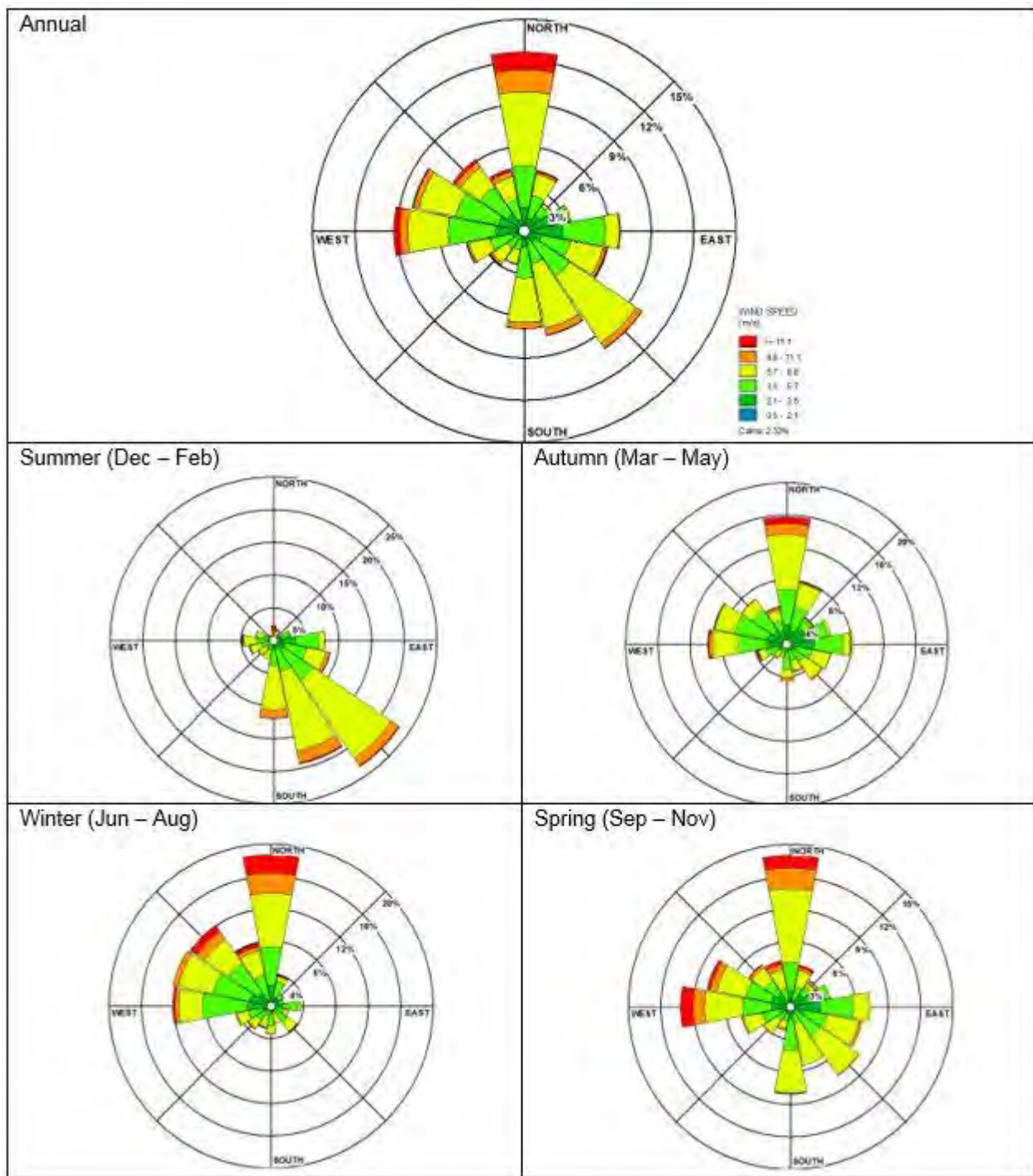


Figure 2-5: Annual and seasonal wind roses – Cleve Airport 2008



GRAPHITE PROJECT MLP AND MPS

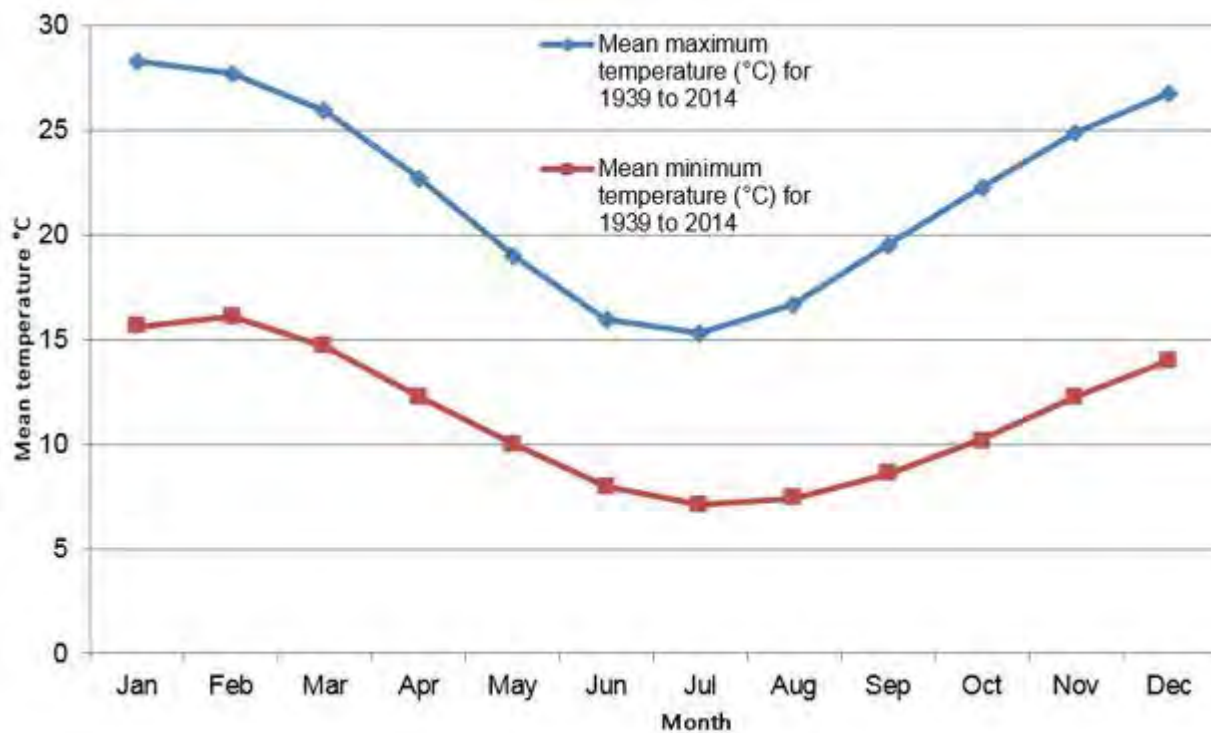


Figure 2-6: Mean monthly temperatures (Cleve) (BOM 2015)

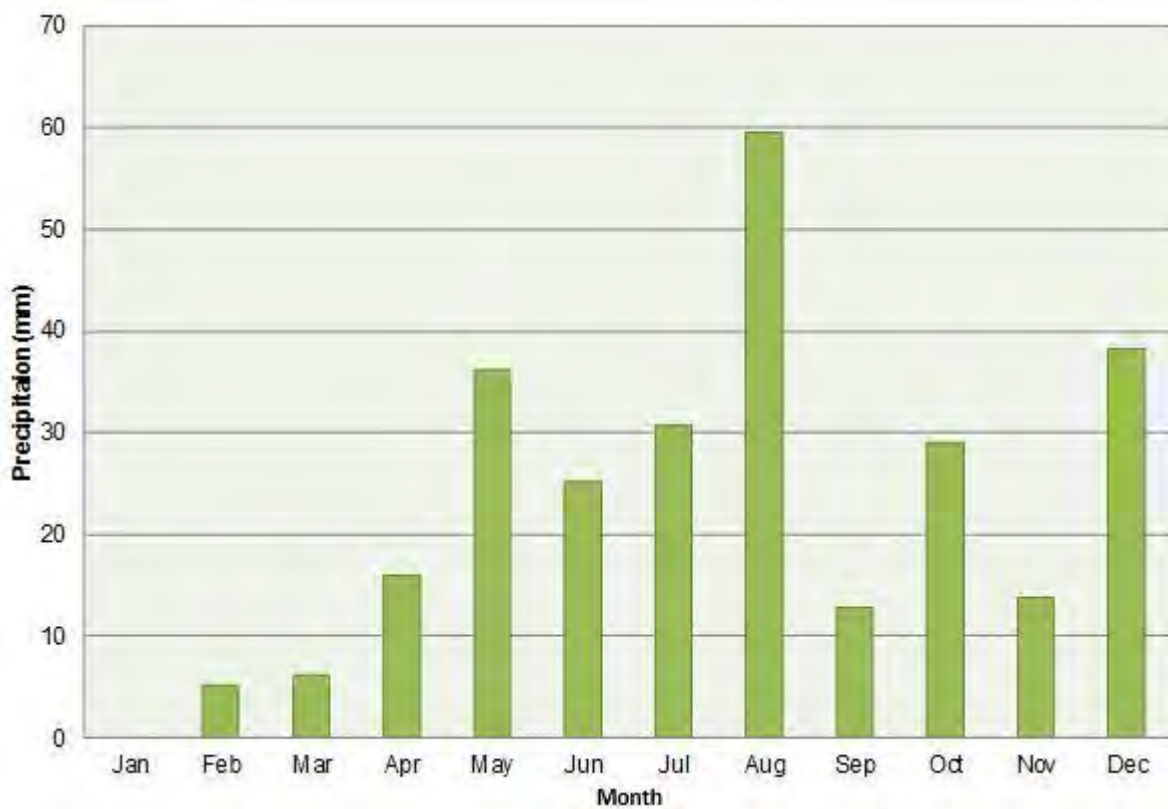


Figure 2-7: Mean monthly rainfall (Cleve) (BOM 2014)



2.7 Geohazards

2.7.1 Earthquakes

The Earthquake hazard map of Australia (Figure 2-8; Geoscience Australia, 2012 - based on Gaul, Michael-Leiba & Rynn 1990) shows the acceleration coefficients (10% chance of exceedance in 50 years). The design of structures in Australia is governed by Australian Standard, AS 1170.4–2007 which provides acceleration coefficients for a 1 in 500-year probability of exceedance. For the Campoona Graphite project area the acceleration coefficient is 0.10 g. For comparison, the published acceleration coefficients for Adelaide and Melbourne are 0.10 g and 0.08 g, respectively, and for Meckering in Western Australia, which has the highest acceleration coefficient in Australia, it is 0.22 g.

A 4.4 Richter magnitude earthquake has been recorded approximately 3 km south of Jamieson Tank. In the last 6 months, the closest earthquake recorded was of a magnitude 1.3 around 8 km North West of Campoona Hill and 25 km north east of Cleve on 29 August 2014. There have been no earthquakes recorded in the area of the Pindari Wellfield and pipelines within the last six months.

The following is a summary of earthquakes in the area for the last 6 months (downloaded 3 December 2014 from SARIG), which the most recent shown in **bold** and a map showing their location is shown in Figure 2-9.

Table 2-5: Earthquake data 6 months to 3 December 2014 (SARIG)

Magnitude	Date	Time	Seconds	Longitude	Latitude	No. Stations	Place	Depth	Intensity	Accuracy	Arrivals	Residual
1.4	21/08/14	1308	57	136.442	-33.414	12	CLEVE 32KM N	13.01	-	D	21	0
2.8	21/08/14	1448	56	136.479	-33.82	27	CLEVE 14KM S	7.05	-	C	56	0
1.4	21/08/14	1500	14	136.483	-33.83	9	CLEVE 15KM S	6.35	-	D	16	0
1.3	29/08/14	1659	1	136.409	-33.482	5	CLEVE 25KM NW	2.99	-	D	9	0
0.7	29/08/14	1910	55	136.466	-33.816	4	CLEVE 14KM S	4.43	-	E	8	1
3.3	30/08/14	1043	56	136.466	-33.816	27	CLEVE 14KM S	4.43	-	C	52	0
3.3	30/08/14	1044	34	136.466	-33.816	24	CLEVE 14KM S	4.43	-	C	31	0
1.6	30/08/14	1241	24	136.477	-33.822	10	CLEVE 14KM S	0.44	-	D	15	0
0.9	30/08/14	1301	33	136.466	-33.816	4	CLEVE 14KM S	4.43	-	E	8	0
1.4	30/08/14	1447	4	136.466	-33.816	12	CLEVE 14KM S	4.43	-	D	18	0
1.3	30/08/14	1729	43	136.466	-33.816	5	CLEVE 14KM S	4.43	-	E	9	0
1.3	31/08/14	539	21	136.466	-33.816	5	CLEVE 14KM S	4.43	-	E	9	0
2.8	20/09/14	1352	25	136.6678	-33.2477	-	KIMBA 26KM SE	-	-	-	-	-
1.7	23/09/14	2124	57	136.9495	-33.3408	-	COWELL 38KM N	-	-	-	-	-
1.3	29/09/14	1541	57	136.7633	-33.3967	-	CLEVE 42KM NE	-	-	-	-	-
1.3	7/10/14	808	16	136.4897	-33.7677	-	CLEVE 7KM S	-	-	-	-	-
1.9	7/10/14	1219	48	136.8307	-33.3877	-	COWELL 33KM N	-	-	-	-	-
2	11/10/14	2009	12	136.7494	-33.5448	-	CLEVE 29KM NE	-	-	-	-	-
1.2	12/10/14	47	31	136.5365	-33.7486	-	CLEVE 6KM SE	-	-	-	-	-
1.2	15/10/14	1714	39	136.7674	-33.5726	-	COWELL 19KM NW	-	-	-	-	-
1.6	23/10/14	539	45	136.7607	-33.5662	-	COWELL 20KM NW	-	-	-	-	-

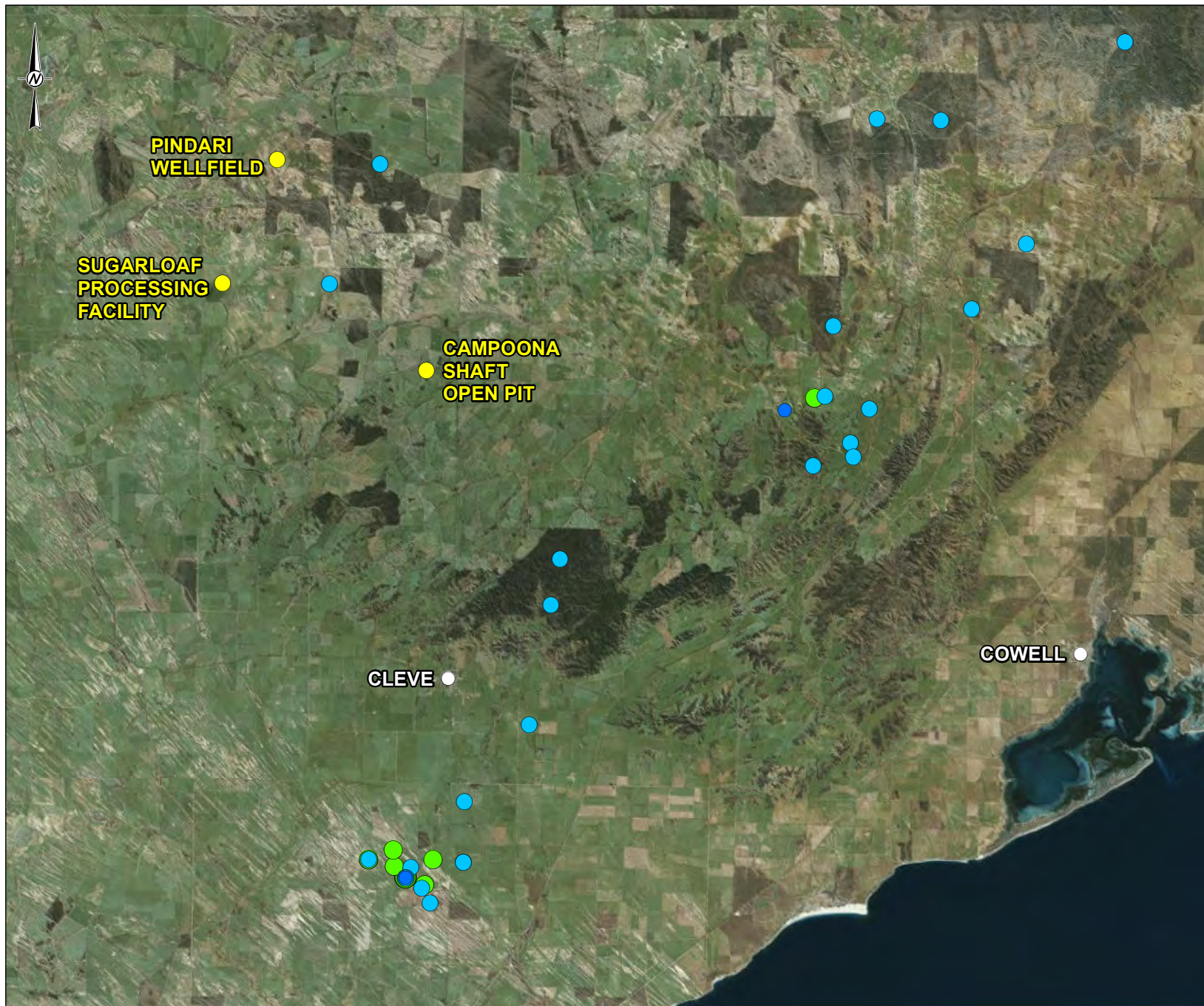


GRAPHITE PROJECT MLP AND MPS

Magnitude	Date	Time	Seconds	Longitude	Latitude	No. Stations	Place	Depth	Intensity	Accuracy	Arrivals	Residual
1.5	25/10/14	806	3	136.7343	-33.5493	-	CLEVE 27KM NE	-	-	-	-	-
1.8	13/08/14	1858	2	136.737	-33.58	21	CLEVE 26KM NE	13.81	-	D	37	0
1.6	30/10/14	527	53	136.5049	-33.8088	-	CLEVE 12KM S	-	-	-	-	-
1.2	30/10/14	539	10	136.5049	-33.8088	-	CLEVE 12KM S	-	-	-	-	-
1.2	1/11/14	555	53	136.7741	-33.5474	-	CLEVE 31KM NE	-	-	-	-	-
1.1	12/11/14	2000	25	136.5672	-33.6351	-	CLEVE 10KM NE	-	-	-	-	-
1	16/11/14	1536	18	136.7171	-33.549	-	CLEVE 26KM NE	-	-	-	-	-
1.1	18/11/14	1012	41	137.0293	-33.2479	-	WHYALLA 58KM SW	-	-	-	-	-
1.6	26/11/14	1215	58	136.8419	-33.4903	-	COWELL 23KM NW	-	-	-	-	-

Source: SARIG 2014

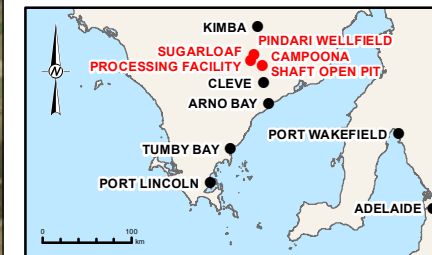
Geoscience Australia has recently revised the earthquake risk zoning for Australia (Geoscience Australia 2012). This indicates an acceleration coefficient of 0.053 for a return period of 500 years for the Campoona and Sugarloaf area. Geosciences Australia has indicated that there should be a revision of Australian Standard 2007 to take account of the revised acceleration coefficients.



CAMPOONA PROJECT MINING LEASE PROPOSAL

EARTHQUAKES IN THE REGION IN THE 6 MONTHS TO 3 DECEMBER 2014

LOCATION MAP



LEGEND

● Project Site

Order of Magnitude

● less than 1

● 1.00 - 1.99

● 2.00 - 2.99

● 3.00 - 3.99

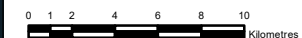
○ Township

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Earthquake data sourced from SARIG, Department of State Development Resources and Energy Group, South Australian Government.

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1. World Imagery - Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Aerial Imagery Copyright ESRI.



REFERENCE SCALE: 1:350,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: BMC
APPROVED: AMB

**FIGURE
2.9**





2.7.2 Orebody characterisation (other hazards)

2.7.2.1 Acid metalliferous drainage

Based on a review of the geological materials present at Campoona, the site has a low potential for acid forming materials, and the drainage from the site is likely to be non-acid metalliferous drainage (Appendix O).

The mineralisation in the Campoona area occurs as graphitic schist within low-grade graphitic protogneisses. Late-stage north-west trending cross faulting, often associated with amphibolite intrusions, has segmented the graphite units (Appendix L and M).

The geological formations have been subjected to intense lateritic weathering over millennia. Total oxidation occurs to depths of at least 60 metres below ground level and strong weathering persists to the projected base of the Campoona Shaft open pit at 100 metres below ground level.

The graphitic schist now consists of quartz, clay (dominantly kaolin) and graphite with minor and trace amounts of muscovite, tourmaline and iron oxides (hematite and goethite). The enclosing granitic protogneiss has a very similar weathering profile and mineralogy but with less graphite which occurs in trace amounts.

A common approach for the preliminary assessment of Acid Metalliferous Drainage (AMD) potential is to identify samples with high (total) sulphur content. If trends exist in the spatial or lithological distribution of samples with high sulphur, then this can inform future sampling plans and AMD management strategies. To assess whether the sulphur contents in the units assessed should be considered high, or low, a commonly applied value of 0.2% S was applied.

The evaluation of the potential for AMD used assay data from 64 drill holes which were drilled on a nominal 50 m × 20 m grid pattern over the entire Campoona Shaft graphite deposit. The assay data consisted of X-ray fluorescence (XRF) results for the major elemental constituents. Carbon and sulphur were assessed by combustion methods (LECO). The median sulphur and carbon content of each of the geological units was calculated. Data regarding the spatial distribution of the economic carbon units was compared to the sulphur results to allow an assessment of where high sulphur (>0.2% S) was encountered. The cumulative probability of the occurrence of sulphur and carbon in each unit was plotted to assess the likelihood of encountering high sulphur bearing materials.

Eight samples from four different geological units were submitted for static analysis, with the key objective to assess the potential for acid and non-metalliferous drainage from waste rock.

- The major lithological units present in the proposed mine area are graphitic schist and gneiss.
- Intense lateritic weathering has resulted in limited remaining minerals solubility.
- Sulphur distribution is not controlled by lithology.
- Lithological units with sulphur present are all considered to pose a risk, to some degree, of acid generation. The probability of this acid being generated is variable.
- Groundwater quality at the site is not known precisely. Based on available regional data, it is expected to be saline (around 40,000 mg/L TDS) and dominated by sodium chloride.

Sulphur above the base of complete oxidation (~60 m bgl) occurs only in trace to minor amounts. The average of all drill hole assays to 60 metres below ground level is 0.04% S and that number is skewed by an assay of 1.13% S from a depth of just 16 metres which in all likelihood is attributed to the presence of sulphate minerals. Due to extensive weathering many of the rock forming minerals have been heavily leached with quartz and kaolinite being the dominant minerals. All other material is oxidized (weathered rock) which has been hydrolized to a variety of clay species with remnant mica minerals (W. Bollenhagen, Archer, pers. comm. 2015). Given the base of complete oxidation occurs at least 60 metres below ground level, Pirie Resources will undertake to conduct kinetic tests prior to the open pit reaching a depth of 60 metres (Year 6 of operations for Pit Stage 1) to further refine the Conceptual Acid and Metalliferous Drainage Management Plan (Appendix O).



Considering all the information available, the drainage quality from the site is likely to be non-acid metalliferous drainage.

2.7.2.2 *Fibrous material*

Fibrous material has not been encountered in the Campoona area during exploration. The type of rocks and their alteration are not conducive to acicular mineral formation (W. Bollenhagen, Archer, pers. comm. 2015).

2.7.2.3 *Radioactive material*

Radioactive material has been recorded at the surface or at depth from historical reports. Pirie Resources has assayed for uranium, arsenic, cadmium, caesium, thorium and barium as a part of its multi-element suite and no significant values have been observed. Sulphur recorded above the base of complete oxidation is predominantly present as sulphates.

2.8 Surface hydrology

The Cleve Uplands consist of two main surface water catchment areas. The ridge between Campoona Shaft and Sugarloaf is the main surface water catchment divide in the Project area.

Campoona Shaft lies within the catchment for Salt Creek and surface water runs off towards the northeast. The creeks surrounding Campoona Shaft are ephemeral, with some salt-tolerant vegetation along Salt Creek.

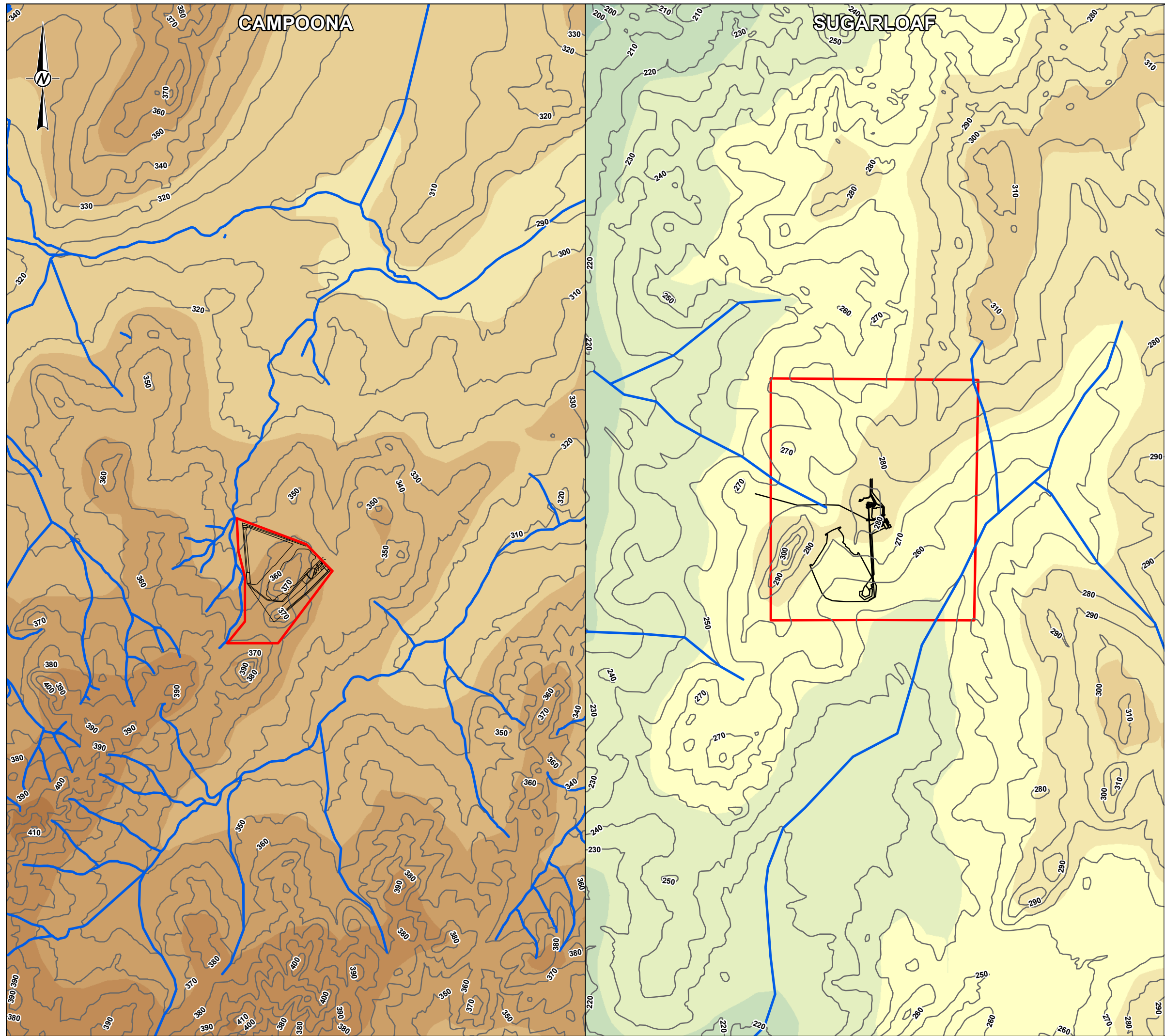
Sugarloaf lies within the Driver River catchment and surface water runs off towards the southwest (Figure 2-10). There are no permanent surface water bodies in the area, other than agricultural dams. Streams and creeks are ephemeral and tend to flow only briefly during the wetter months, or after episodic summer rains. Surface water runoff at Sugarloaf is less defined but is expected to generally flow both to the North West and south east.

2.8.1 Regional hydrology

The hydrology of the Eyre Peninsula is defined by three river basins: the Eyre Peninsula and Spencer Gulf River Basins of the South Australian Gulf Drainage Division and the Gairdner Basin of the Western Plateau Drainage Division. Surface water resources on Eyre Peninsula are scarce due to low rainfall over much of the Peninsula, (less than 500 mm near Cleve), high evaporation and permeable soils.

The Eyre Peninsula Basin covers the southern end of the catchment from the south of Cummins to the east of Coffin Bay and to the coast. The Spencer Gulf Basin covers the area south of Whyalla to south of Cummins and drains to the eastern coast of Eyre Peninsula. The region also includes a small portion of the Mambray Coast Basin. It includes a number of catchments that discharge to the Spencer Gulf. The vast Gairdner Basin has no major surface water drainage system and the majority of the rainfall in the area contributes to the recharge of the local groundwater system.

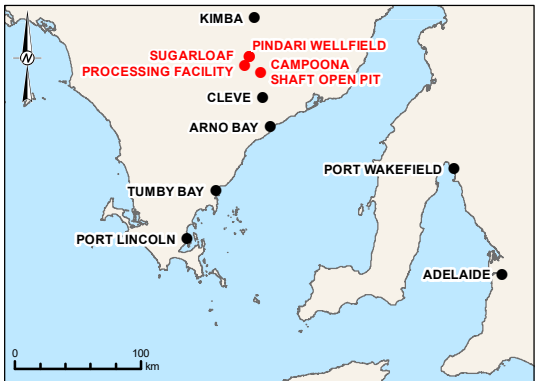
The Tod River is the main surface water body located approximately 120 km south from the proposed project site and which discharges to the Spencer Gulf just north of Port Lincoln; otherwise there are no significant surface water resources on the Peninsula. Streams on the Peninsula tend to originate in the harder, higher country of the Cleve Hills and are generally ephemeral with variable flow and salinity.



CAMPOONA PROJECT
MINING LEASE PROPOSAL

REGIONAL SURFACE WATER
ENVIRONMENT

LOCATION MAP



LEGEND

Surface Elevation (m)	
77 - 100	Campoona ML and Sugarloaf MPL
101 - 125	Infrastructure Footprint
126 - 150	Flow Paths
151 - 175	Surface Contour (10m interval)
176 - 200	
201 - 225	
226 - 250	
251 - 275	
276 - 300	
301 - 325	
326 - 350	
351 - 375	
376 - 400	
401 - 425	
426 - 450	

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Site layout data sourced from Archer Exploration Ltd.

0 200 400 800 1,200 1,600 2,000
Metres

REFERENCE SCALE: 1:35,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: MS / SS / KB
REVIEW: BMC
APPROVED: LVC

FIGURE
2.10





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A hydrological review for the project was undertaken in 2013 (refer to Appendix D). There are no watercourses on the immediate Campoona Shaft or Sugarloaf sites.

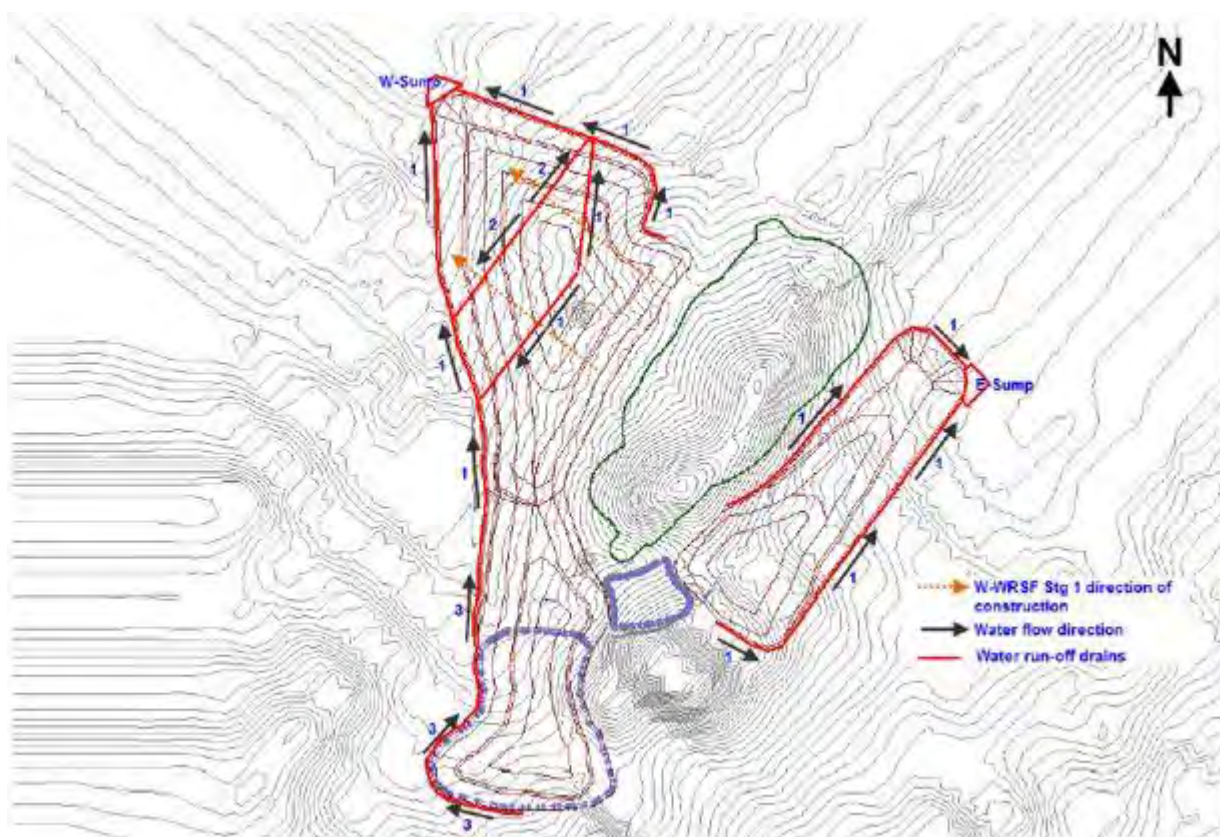
Surrounding the ML Campoona Shaft is a network of ephemeral drainage paths to the south and west. Runoff is generally conveyed off-site in a north-easterly direction. Nearby creeks flow northerly into the east-flowing Salt Creek. Surface water run-off will be controlled by a series of drains and sumps around the E-WRSF and W-WRSF. The drainage system will be series of trenches to accommodate expected run-off. Perimeter drains will be constructed first (Figure 2-11). Additional drainage will be constructed with the staged WRSF construction.

In addition to the trenches and management of the WRSFs, material dug during the drain construction will be used to build bunds on the lower side of the drains. Sumps will be monitored and cleaned. Water captured in the sumps will be pumped into water tanks and used for dust suppression. Silt will be loaded into dump trucks and deposited in the WRSFs.

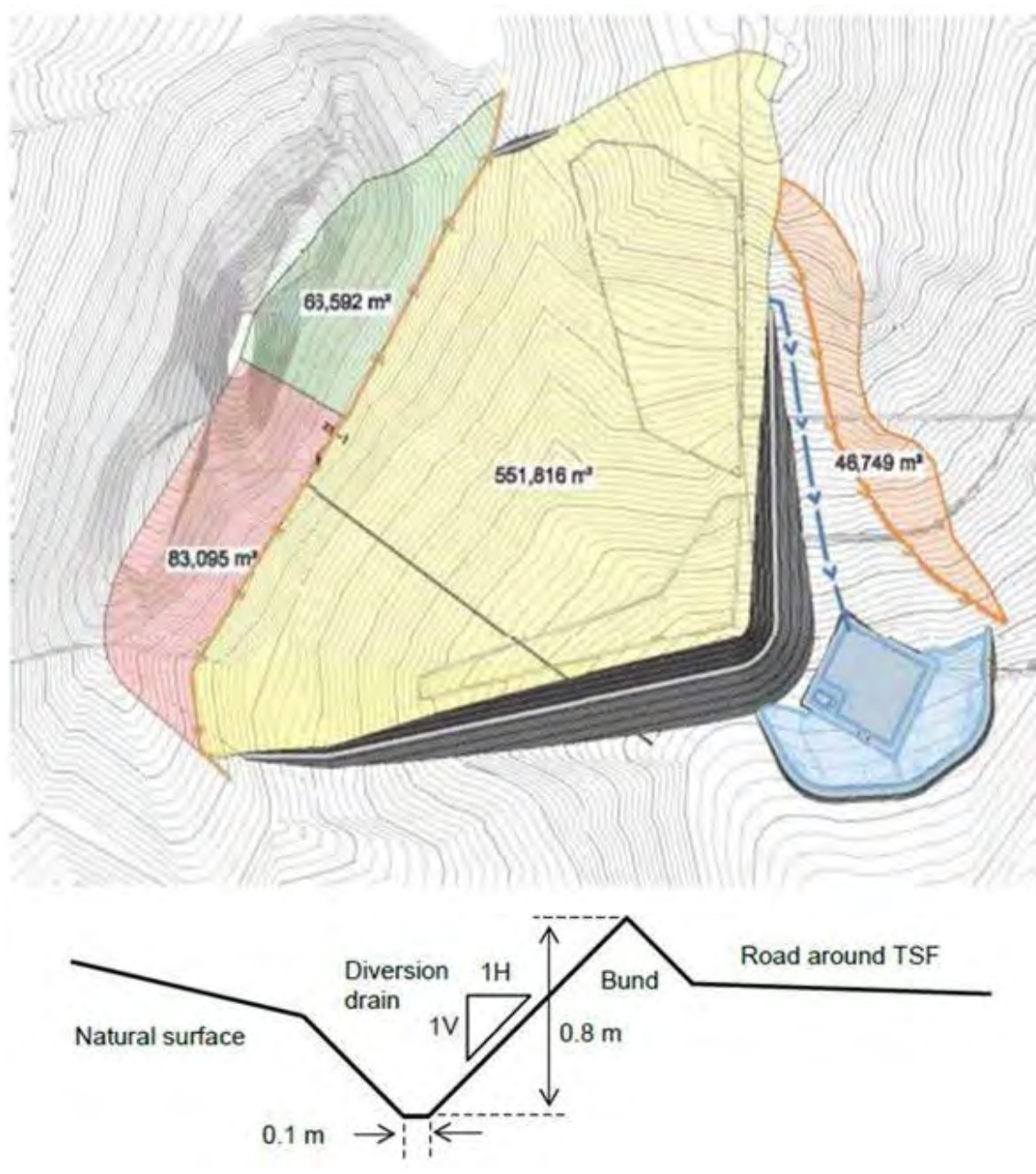
Surface water drainage patterns at Sugarloaf are indistinct and runoff is unlikely from the site except after high rainfall events. The main surface water feature associated with the Pindari-Sugarloaf pipeline is an inundated area south of Carrappee Hill through which the pipeline will traverse over a small cross section, as well as a soak located south of the pipeline route.

The sites are not within a water protection area or water resources area under the *Environment Protection Act 1993* and *Natural Resources Management Act 2004* respectively. Permits in relation to water affecting activities for surface water management are not considered applicable given the proposed controls described in the following sections for Campoona and Sugarloaf sites.

The potential impacts and mitigation measures are described in Section 6.4.6.



(a)



(b)

Figure 2-11: Surface water controls at (a) ML Campoona and (b) MPL Sugarloaf

2.9 Hydrogeology

2.9.1 Groundwater overview

The fractured, metamorphic rocks that underlie the project area have poor groundwater supply potential, are brackish to saline and do not constitute regional aquifers in the normally accepted sense. The site is remote and effectively hydrogeologically separate from the freshwater aquifer systems of Eyre Peninsula, i.e. the Poldia Lens in the Musgrave Prescribed Wells Area (PWA), some 100 km to the west of the project and the Southern Basins PWA near Port Lincoln.

Groundwater is mostly saline in the part of eastern Eyre Peninsula where the project is located. The groundwater near the Campoona Shaft and Sugarloaf sites is not used by local residents and farmers due to its high salinity and therefore there is a heavy reliance on other water sources, particularly scheme water supply.



2.9.2 Regional hydrogeology

A desktop groundwater assessment was undertaken in January 2012 (Appendix E) and test pumping for water bores installed at Pindari was undertaken in May 2014 and March 2015 (Appendix F). The assessment included searches of public regional and local geological and hydrogeological reports and data including from WaterConnect and SARIG websites, along with drillers' logs and local knowledge gained from a questionnaire provided to landholders in the area. The potential for interaction of surface water and groundwater was also assessed.

The occurrence of aquifers on the Eyre Peninsula is sporadic and variable (Berens *et al.*, 2011). The majority of groundwater utilised is sourced from the Tertiary and Quaternary sedimentary aquifers of the Uley-Wanilla Basins near Port Lincoln and the Poldas Lens, west of Campooona, which provide groundwater of low salinity for municipal and agricultural purposes. These groundwater resources are closely managed as PWAs. The Campooona Shaft, Sugarloaf and Pindari sites lie well outside all of the recognised groundwater basins and the associated PWAs.

The Project is not in a Prescribed Wells Area. A summary of the principal hydrogeological units of the Eyre Peninsula is presented in Table 2-6 for completeness. The nearest PWA is the Musgrave PWA, some 100 km or more to the west of the project.

Table 2-6: Principal hydrogeological units of the Eyre Peninsula

Age	Unit, Lithology	Hydrogeology	Relevance to Campooona
Pleistocene Pleistocene	<i>Pooraka Formation</i> : alluvial, red-brown clayey sand and gravel, capped in general by soft powdery carbonate and/or calcrete. Occurs in the Cleve Hills, between Kimba and Venus Bay.	There is limited groundwater quality data available. Salinity between 7500-22,500mg/L. Yields between 0.08 and 2.7L/s.	Slight but not as a source of groundwater
	<i>Bridgewater Formation</i> : Aeolianites, fine to medium-grained, cross-bedded weakly to moderately cemented. Grains are calcite and shell fragments, mainly 0.1 to 1.5mm. Generally calcreted at surface.	<i>Unconfined aquifer</i> , generally low salinity. Permeability ranges from low to very high, mainly moderate. Transmissivity ranges from 2.0×10^{-3} m ³ /day/m to 8.0×10^{-3} m ³ /day/m. The nearest Bridgewater formation is 50 km to the west of the project site. The well-known Poldas Lens is at least 100 km west.	None
Tertiary - undifferentiated	<i>Unnamed</i> : Clays, ranging from stiff to soft, sandy and highly plastic. Becoming sandier near base.	Largely acts as a confining bed on the Eyre Peninsula.	None
Tertiary Eocene	<i>Wanilla Formation</i> : Clays, sands and gravels with thin lignites. Sand is generally fine-grained, less than 0.5 mm, uncemented or weakly cemented.	<i>Aquifer</i> with permeability low to moderate but with marked variations vertically and laterally. Salinity variable and generally higher than upper unconfined aquifer. Does not occur at the project sites.	None
Jurassic	<i>Unnamed</i> : Sands, silts and clays. Sand consists of quartz grains usually less than 0.5 mm, occasionally up to 3 mm. Sediments generally carbonaceous and contain lignite beds. Associated with the Poldas basin.	<i>Aquifer</i> with very low permeability, and high salinity (TDS) generally exceeding 14,000 mg/L. Closest occurrence is at least 25 km west of the study area.	None



GRAPHITE PROJECT MLP AND MPS

Age	Unit, Lithology	Hydrogeology	Relevance to Campoona
Lower Proterozoic	<i>Flinders Group, Middleback Group, Hutchison Group</i> : Schists, gneisses and quartzites intruded by granites and basic rocks. Deeply weathered in places. Host rocks for the Campoona graphite deposit.	Usable groundwater obtainable in the southern parts of the peninsula. Salinity (TDS) generally at least 7,000 mg/L, but in a few localities lower. In the Cleve Hills salinity may range from brackish to 40,000 mg/L or more and yields are typically low.	Relevant

Sources: Shepherd, 1983 and Berens *et al.* 2011

As indicated in Table 2-6, the only groundwater at the project area and surrounds occurs within Lower Proterozoic metamorphic basement rocks. Groundwater in these fractured basement rocks generally has neither been studied nor used much as a consequence of low or zero yields and brackish to saline quality

Pirie Resources' exploration drilling at the Campoona Shaft and Sugarloaf sites has indicated the presence only of sporadic low yields of high salinity groundwater. Many drill holes produced no groundwater despite being tens of metres deeper than the likely water table and the small yields were restricted to areas of fracturing and jointing. Only three drillholes produced water at Campoona Shaft. This groundwater has not been historically targeted for water supply due to its salinity and it is not considered to be a significant potential source of stock, domestic or agricultural water. One potential beneficial use would be for mineral processing where yields are adequate.

As discussed below, aquifer zones have been identified and tested at the Pindari location, where locally higher fracture densities are inferred. It would be practically impossible for activities at the site to affect the groundwater of the Musgrave PWA or the Southern Basins PWA. There is an extraordinarily low potential for hydraulic connection between the Project area and these sedimentary aquifers.

2.9.3 Local hydrogeology

The groundwater system within the Project area occurs within fractured and shallow weathered zones within the Hutchison Group metamorphic bedrock. The most permeable zones typically occur near the interface between the weathered zone and fresh rock in these geological settings. Groundwater divides are expected to coincide with the major drainage divides.

Area with localised groundwater seepage are known in the eastern Cleve Hills in the Upper Salt Creek and the Upper Driver River catchments (refer Section 2.9.8.1). These saline seeps may be modern: they are typical of hydrological changes caused by wide-scale vegetation clearance for agriculture in gently undulating terrain underlain by fractured rocks.

Recharge is likely to be from incident rainfall, at the low end of the approximate range 0.1% to 1% of the annual rainfall (i.e. at 0.5-3.5 mm/a approximately). The recharge is expected to occur mostly in areas underlain by shallow bedrock or through fractured outcrop. Concentration of cyclic salt in the rain by evaporation and transpiration during the recharge process probably accounts for much of the salinity observed at and surrounding the site. Recharge rates have probably increased towards the high end of the estimate since the clearance of eucalyptus woodland for agriculture.

Figure 2-12 shows a diagrammatic representation of the groundwater system in the project area. Figure 2-13 shows a section across the Campoona Shaft area to Salt Creek, the main local surface drainage feature which includes identified GDEs (see Section 2.9.8.2).



GRAPHITE PROJECT MLP AND MPS

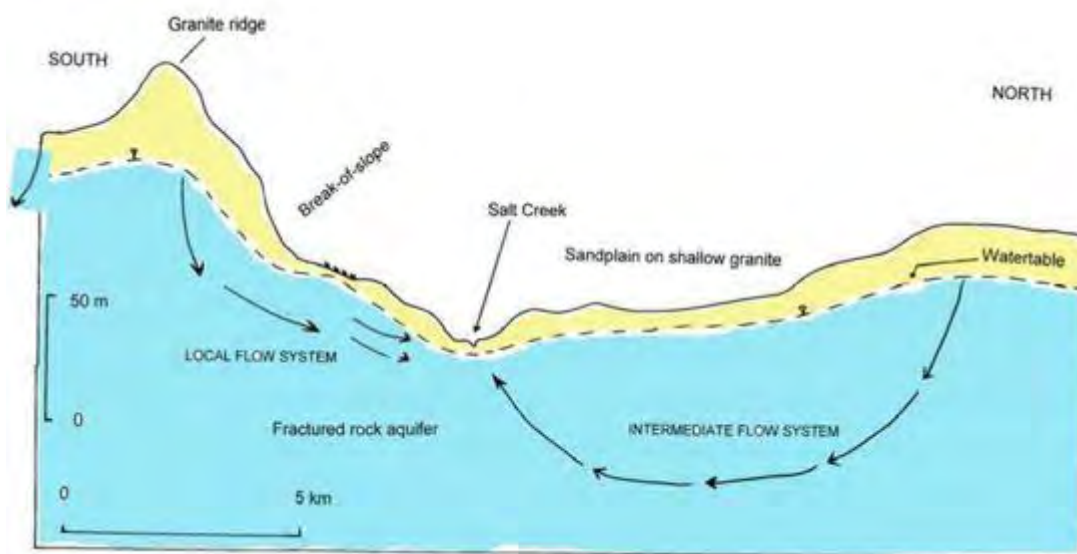
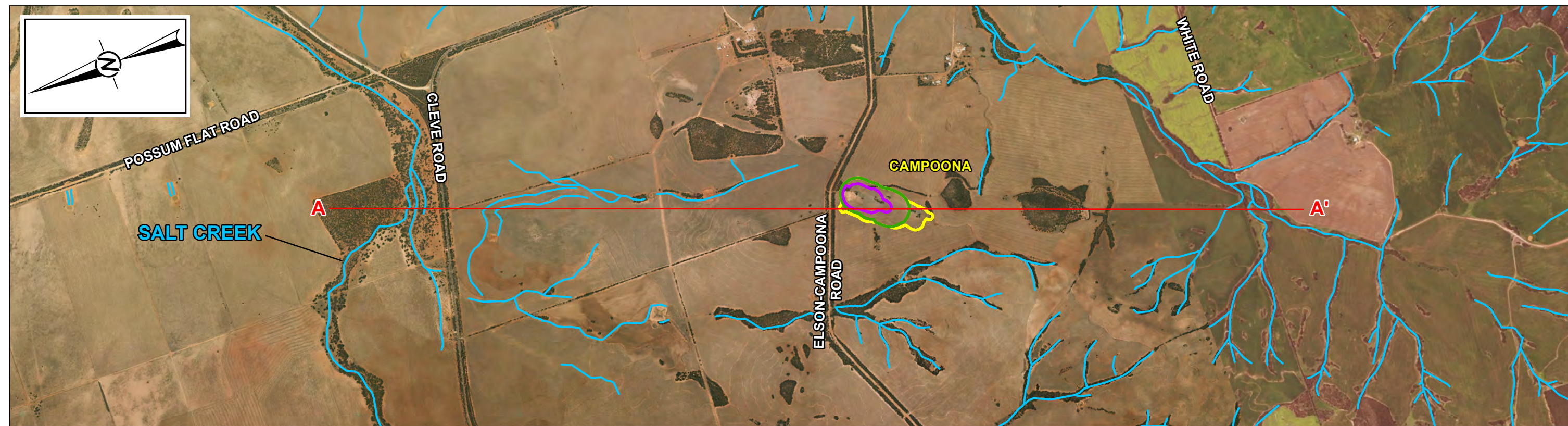
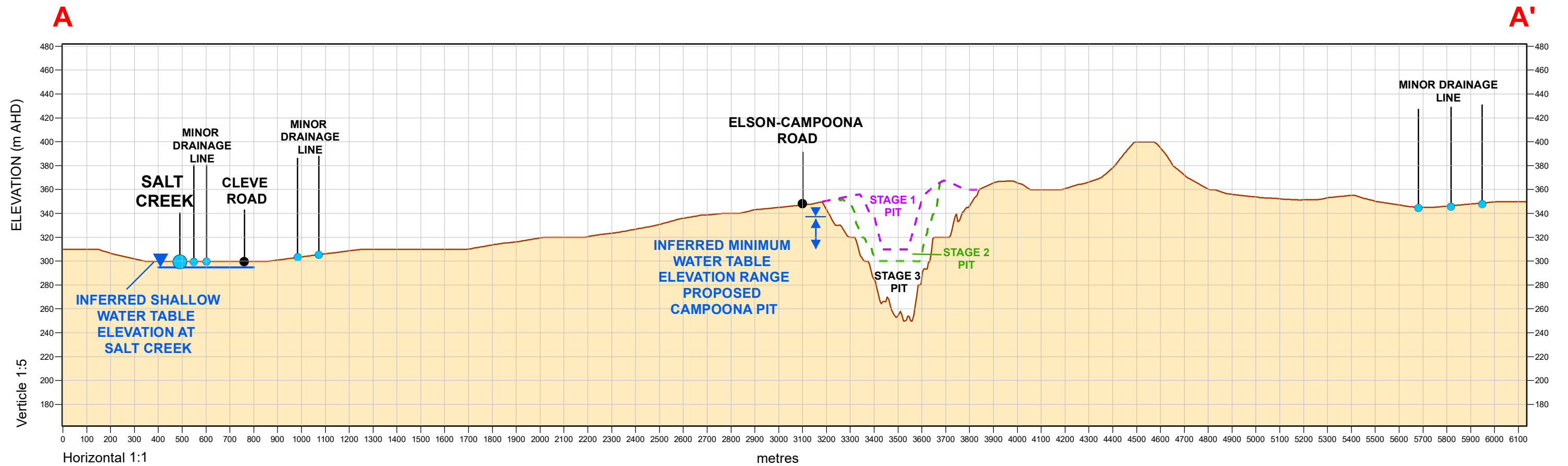


Figure 2-12: Diagrammatic representation of groundwater in the project area



CAMPOONA PROJECT
MINING LEASE PROPOSAL

**SECTION ACROSS THE
CAMPOONA SHAFT AREA
TO SALT CREEK**

LEGEND

- ▭ Stage 1 Pit
- ▭ Stage 2 Pit
- ▭ Stage 3 Pit
- ~ Ephemeral Drainage Line or Creek
- Section Line

NOTES

1. Water course data sourced from WaterConnect, South Australian Government.
2. Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.
3. Site layout data sourced from Archer Exploration Ltd.

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1. World Imagery - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Aerial Imagery Copyright ESRI.
2. Aerial image sourced from Mapland, Department of Environment, Water

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: LVC
APPROVED: JW

**FIGURE
2.13**





Based on the regional interpretation and exploration drilling conducted by Pirie Resources at the ML, the groundwater occurrences and resources of the Project area can be summarised as follows:

- It is extremely unlikely that there are significant fractured rock aquifer zones other than local occurrences of saline groundwater, brackish in places. The test pumping at Pindari (Appendix F) is consistent with this interpretation, as are the negligible airlift yields at most holes drilled at the Campoona Shaft and Sugarloaf sites. The mineral exploration and tailings site investigation drilling and the test pumping (Section 2.9.4) strongly suggest low to negligible values of transmissivity and storativity. In summary there is not a regional-scale aquifer system in the fractured basement rocks.
- Tertiary and Quaternary sediments up to 10 m thick occur near the project areas. Pirie Resources has not observed water within these units during extensive drilling campaigns at either the Campoona Shaft or Sugarloaf sites.
- Exploration drilling at the Campoona Shaft site in 2012 included 48 “deep” drillholes greater than 50 m deep (of a total 64 drilled). Free moisture was encountered in only three of these deep drillholes, all of which were outside the planned open pit.
- While no measurable groundwater yields were identified by Pirie Resources during drilling at the site, there is no doubt that the planned pit would be deeper than the water table. However, all the information suggests strongly that there would be little or low rates of groundwater inflow. If there are discrete inflows from local fracture zones, best judgement is that they are unlikely to have practical effects on mining operations. Any inflows are expected to be so small that groundwater impacts, particularly as far away as the nearest GDEs, would be unmeasurable.
- Groundwater investigation drilling at the Sugarloaf site (in proximity to the proposed tailings storage facility) in January 2015 included five boreholes to a maximum depth of 31 m bgl. The five boreholes were drilled to ‘fresh’ rock and observed to be dry. Three boreholes were installed as groundwater wells, screened across the interface of weathered rock/soil and fresh rock. The three groundwater wells were dipped approximately one week after installation and were observed to be dry.
- Groundwater salinity in the Project area ranges from 1,500 mg/L to 41,800 mg/L (in the Campoona Shaft area). A groundwater sample collected from a Pindari site bore in 2014 reported total dissolved solids (TDS) of 20,980 mg/L. Based on groundwater salinity this groundwater is not useful for agriculture.
- Department for Water (2011) reported on Eyre Peninsula water resources and stated that DFW (now DEWNR) does not consider the basement fractured rock aquifers to be a significant groundwater resource in the Cleve district.

2.9.4 Groundwater levels

A review of the Department of Environment, Water and Natural Resources (DEWNR) groundwater database (10 km search radius around each site indicated by red line on Figure 2-14 below for Campoona Shaft and Sugarloaf) indicates that the majority of wells (with data) in the Project area have groundwater depths of less than 10 m below ground level. In the Campoona Shaft area, the majority of wells have groundwater depths of less than 5 m from ground level although these are concentrated in gullies/valleys. However, as the deposit is on a ridge line, the depth to groundwater is likely to be greater at the proposed mine site.

Pirie Resources’ exploration drilling provided more comprehensive data which confirmed the proposed open pit is unlikely to have groundwater inflows of significance (Figure 2-15; Appendix E). Drilling at Sugarloaf also determined that there is limited groundwater interaction (Figure 2-16; Table 2-7).



GRAPHITE PROJECT MLP AND MPS

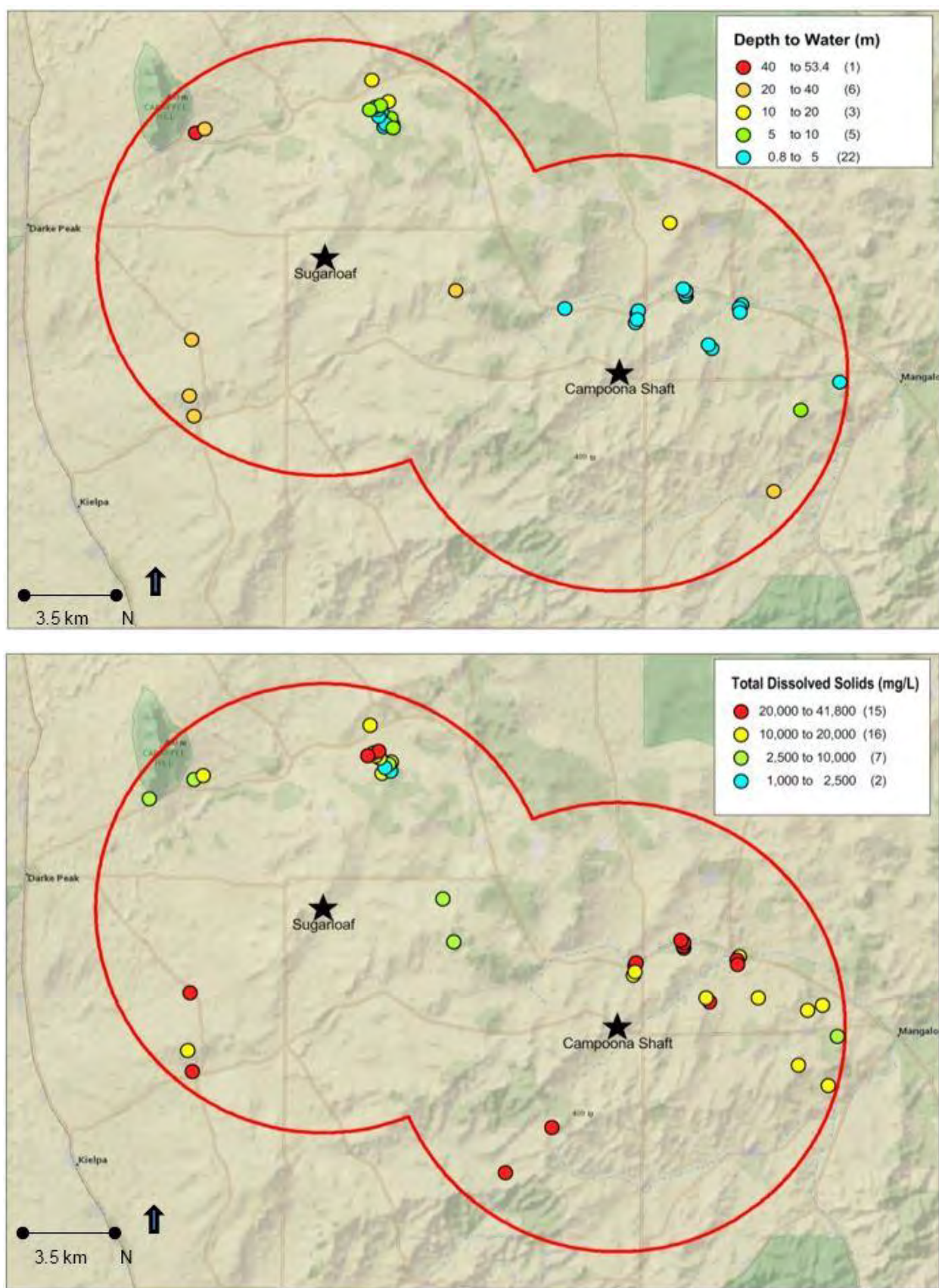


Figure 2-14: Groundwater depth (upper) and quality (lower) for registered bores (DEWNR WaterConnect database 2013)



GRAPHITE PROJECT MLP AND MPS

As groundwater levels generally follow the topography of the bedrock surface topography, most wells in the area have been installed where depths to groundwater are shallow, such as near creeks. There is shallow groundwater in surrounding areas within 1 km of the Campoona Shaft site as indicated on the DEWNR WaterConnect well search (see Figure 2-14).

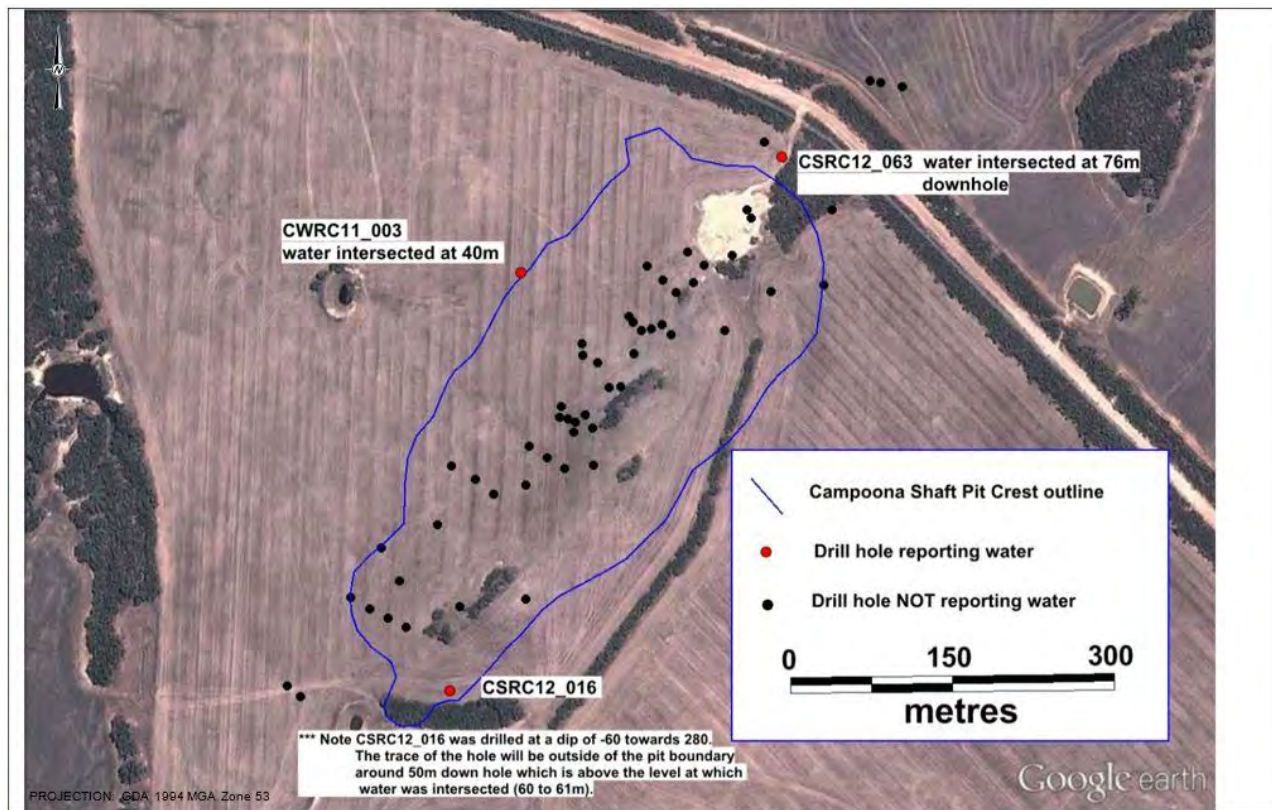


Figure 2-15: Drilling at Campoona Shaft showing where groundwater was intersected (provided by Archer)



GRAPHITE PROJECT MLP AND MPS

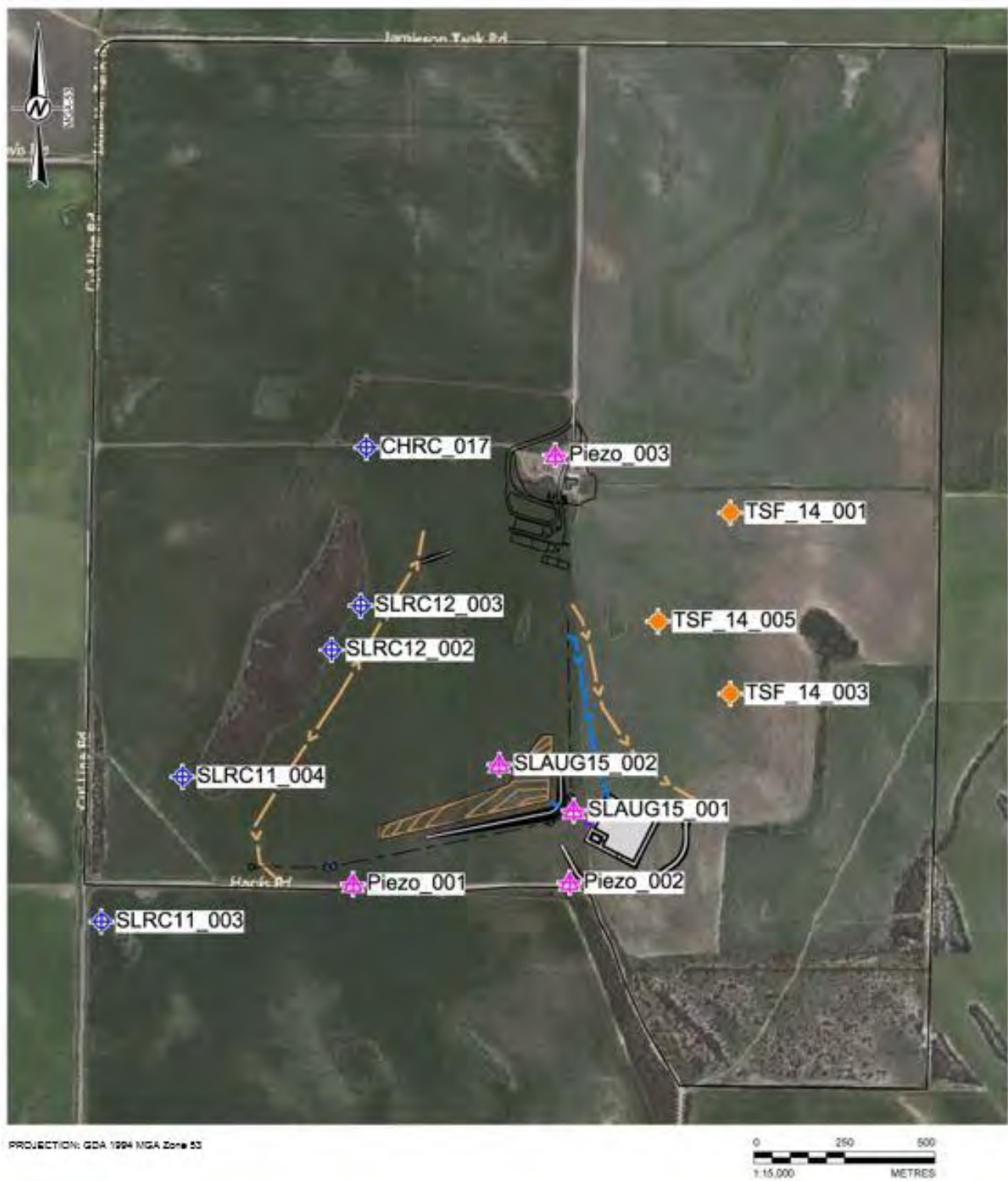


Figure 2-16: Location of boreholes at Sugarloaf in 2014 (orange), 2015 (pink) and groundwater wells (blue)



GRAPHITE PROJECT MLP AND MPS

Table 2-7: Groundwater borehole information for MPL Sugarloaf

Borehole Reference	Groundwater Observation	RL of Observation (m bgl)	Comment
CHRC_017	intersected	165 m (105)	-
SLRC11_003	wet	180 m (83)	-
SLRC11_004	intersected	184 m (96)	-
SLRC12_002	damp	229 m (66)	-
SLRC12_003	damp	236 m (55)	-
Piezo_001	dry	-	Boreholes drilled to fresh rock (16 m)
Piezo_002	dry	-	Boreholes drilled to fresh rock (12 m)
Piezo_003	dry	-	Boreholes drilled to fresh rock (31 m)

There were 38 water wells registered in the DEWNR database within a 10 km radius of the pumping well at Pindari with standing depths to water reported between 1 m bgl and 54 m bgl (Figure 2-17). The closest operational wells in the database to Pindari bore are a private well located approximately 1.5 km west and observation wells located approximately 1.4 km southwest and water levels are generally less than 30 m below ground level. During installation of wells for a pumping test conducted in May 2014 at Pindari, groundwater was encountered in fractured basement rock/schist layers located between 22 m and 31 m bgl (Figure 2-14), with the depth to groundwater at 3.5 m bgl. A second well test pumped encountered water in “broken schist” between 18 m and 21 m bgl with the depth to groundwater at 7 m bgl.

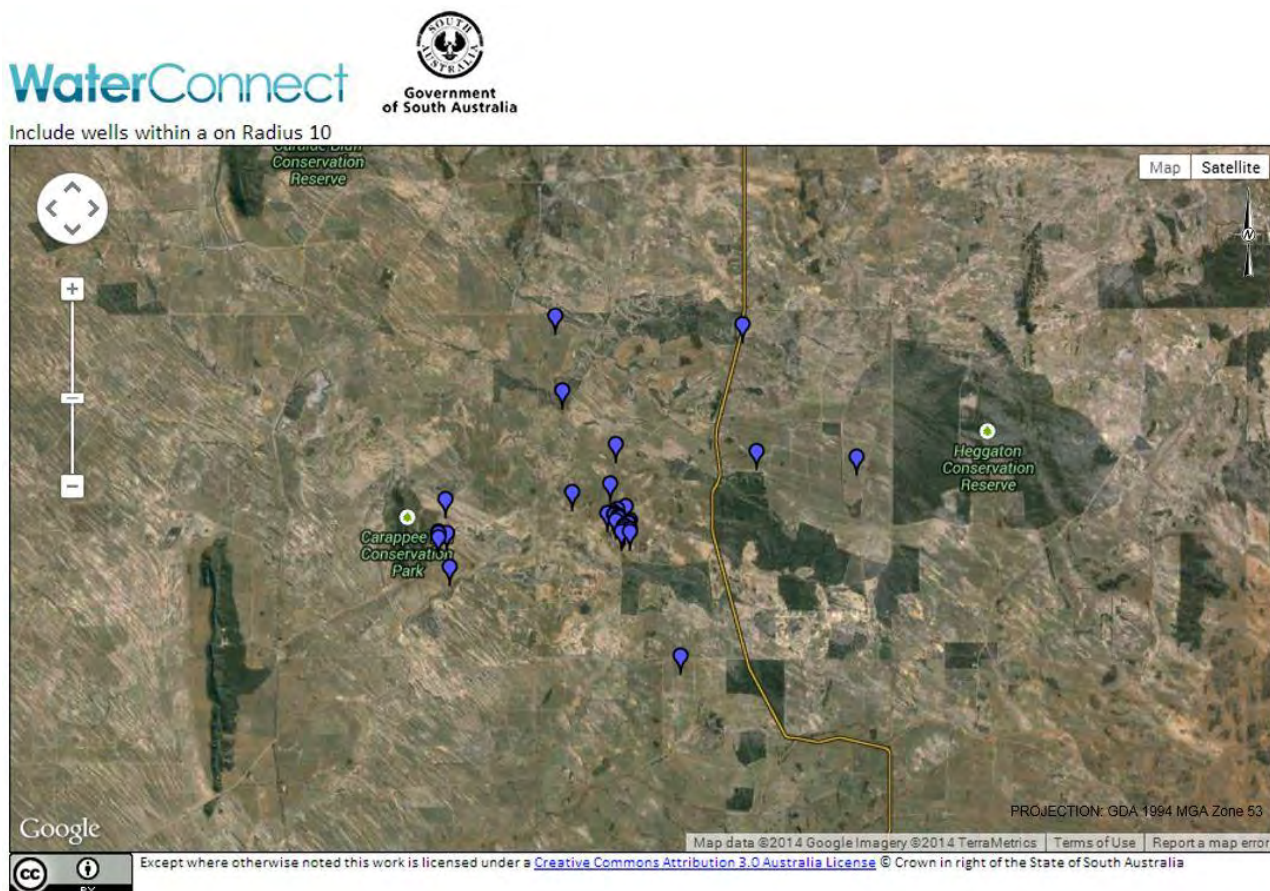


Figure 2-17: Registered groundwater wells near to Pindari (DEWNR WaterConnect database 2014)



2.9.5 Groundwater supply potential

Likely well discharge rates and potential for a useful groundwater supply for the Project were assessed by:

- review of yield potential of the different geological units;
- review of yield from online WaterConnect database; and
- pumping and recovery tests conducted at the proposed Pindari Wellfield location to:
 - assess drawdown and estimate aquifer parameters.
 - make a preliminary assessment of sustainable pumping rates.
 - make a preliminary assessment of the potential for drawdown to affect GDEs located at distances of approximately 1 km and 4 km from the proposed wellfield location.

Two wells were installed at Pindari in May 2014 and a third in March 2015 to assess whether the area could supply sufficient water to meet the process plant's expected full scale operational needs (i.e. ~100 ML/year of water to treat 140,000 tonnes of ore per annum). This Pindari location was selected as data available show that wells there have higher yields than recorded elsewhere near Campoona and that might usually be expected from groundwater in the region in general. The 2014 pumping well (permit number 231280) was drilled to a depth of 109 m bgl and the observation well, located 19 m to the south-west, was drilled to a depth of 121 m bgl. During well construction, groundwater was encountered in fractured basement rock/schist layers located between 22 m bgl and 31 m bgl. The 2015 pumping well, drilled to a depth of encountered water in "broken schist" between 18 m and 21 m bgl (permit number 240043) was drilled to a depth of 50 m bgl and groundwater was encountered in "broken schist between 22 m bgl and 31 m bgl. The tests were analysed and reported, the document being provided in Appendix F.

The yields of wells on the DEWNR WaterConnect website that are located within 10 km of Pindari range from (for those with data) 0.04 L/s (around 83 m bgl) to 10 L/s (around 84 m bgl) but are mostly around 0.05 L/s to 0.3 L/s for wells that are 10 m bgl to 70 m bgl.

The analysis of pumping test results completed in May 2014 and March 2015 estimated the aquifer parameters as summarised in Table 2-8.

Table 2-8: Estimated values for aquifer parameters for Pindari pumping tests

Aquifer Parameter	Test 1	Test 2
Transmissivity	20 m ² /day	1 m ² /day
Storativity	0.0001	No observation well data
Hydraulic conductivity	2 m/day	0.4 m/day

A comparison of the theoretical drawdown in the observation well (estimated using the Cooper-Jacob solution using values for aquifer parameters obtained from the constant rate analysis above (6 L/s for the first 17 hours) and the measured drawdown in the field), indicates that while radial flow exists (first 500 minutes of the pumping test) the approximation is representative of field conditions. It was assumed that the well losses in the pumping well would be of the same magnitude as the calculated aquifer losses (drawdowns). Projection of groundwater levels in the pumping well and observation well at a constant well yield of 1.7 L/s are shown in Figure 2-18.

The long-term sustainable pumping rate over approximately 20 years, assuming that hydrogeological boundaries are not encountered, is expected to be approximately 1.7 L/s (which equates to approximately 53.6 ML/annum). The second well was drilled at the site during March 2015 and confirmed these estimates. The drawdown will be reviewed annually.



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The projection indicates that after approximately 20 years of pumping at 1.7 L/s there would be a 4 m decrease in groundwater levels at the closest wells to the site (around 1.4 km west/southwest). As such, pumping rates will be revised and water requirements will be supplemented by a second well at Pindari (drilled so as not to adversely impact on cumulative drawdown) and SA Water mains from Jamieson Tank (allocation of 40 ML/yr rising to 80 ML/yr if required).

Should the wellfield be developed, ongoing monitoring would aim to confirm predictions progressively with time and, should supply limitations be identified, further work would be undertaken to try and obtain additional water.

There is also potential for an onsite bore at Campoona Shaft for a smaller volume to augment site supply needs such as for dust suppression. This will only be investigated if sufficient surface water cannot be captured on site.

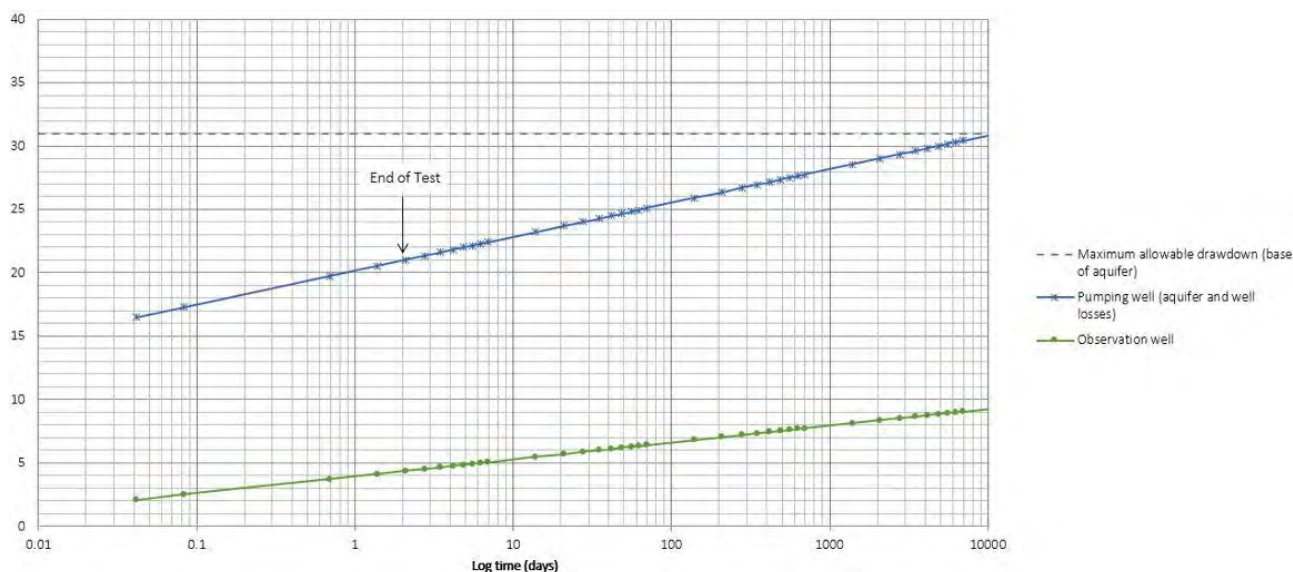


Figure 2-18: Plot of projected drawdown in Test 1 pumping well and observation well at 1.7 L/s

Projection of groundwater levels in the pumping well and observation well for Test 2 at a constant well yield of 2.3 L/s are shown in Figure 2-19.

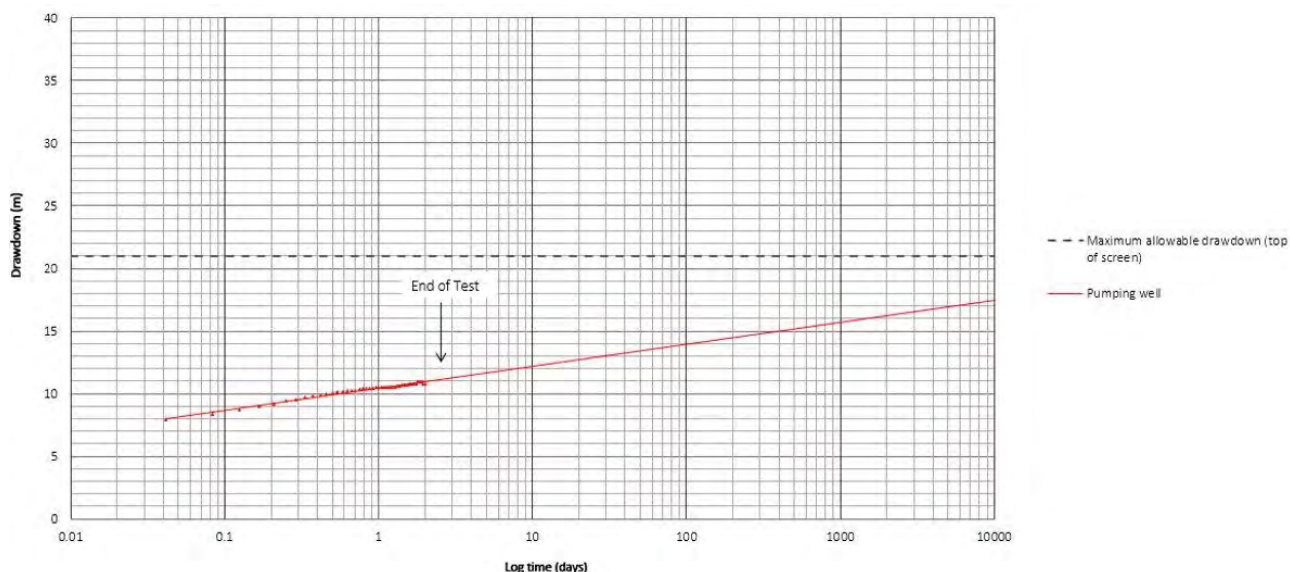


Figure 2-19: Plot of projected drawdown in Test 2 pumping well and observation well at 2.3 L/s



It is judged that the supply is expected to provide at least part of the project demand, but given the heterogeneous nature of the fractured rock aquifer system at Pindari, barrier boundaries are likely to be shown by longer term pumping than the 48-hour tests. Barrier boundaries would be formed by the limits of the fracture zone or zones that have been encountered in the test work at Pindari and they have the effect of increasing the rate of drawdown in the production wells. There is not sufficient data to predict quantitatively drawdown of the water table at various distances from a Pindari wellfield. However, drawdowns of a few metres at distances of 1 km, approximately, would be expected over time.

Further work, including longer term testing, would logically form part of more detailed project studies.

Using similar logic, the presence of such barrier boundaries reduces the risk of the wellfield affecting the degraded saline wetland in the area.

A supplementary water supply is available from SA Water mains at Jamieson Tank (allocation of 40 ML/yr rising to 80 ML/yr if required).

Should the wellfield be developed, ongoing monitoring would aim to confirm predictions progressively with time and, should supply limitations be identified, further work would be undertaken to try and obtain additional saline groundwater supplies, or SA Water mains would be used to make up any shortfall.

Drilling has shown potential for a small groundwater supply near the Campoona Shaft. Low yielding wells there might provide a small supplementary supply for dust suppression to augment the Pindari Wellfield. This option might be pursued if studies and actual observations suggest sufficient surface water cannot be captured on site.

2.9.6 Groundwater quality

Information about groundwater conditions near the Project area has been sought from 40 locations.

A survey of landowners during community consultation revealed that groundwater in the area is highly saline and has low yield. For this reason, most landholders use mains for domestic water and dam water for stock watering.

The salinity of basement rocks is variable and ranges from 1,500 mg/L to >50,000 mg/L TDS.

Groundwater salinity data were also obtained from the government database (see Figure 2-14). Based on the data available the local groundwater is saline, and the salinity is slightly lower immediately to the east and north of Sugarloaf. The data show that groundwater salinity in the area is generally higher than 10,000 mg/L TDS and up to 41,800 mg/L TDS.

2.9.7 Groundwater uses

Landholder discussions and interviews were carried out by Pirie Resources, with two questionnaires formally returned indicating that no groundwater was being used by those particular landholders. Based on the discussions and feedback, it is assumed that few landholders use groundwater. This is likely to be due to the lack of availability of good quality groundwater. In the Project area, the majority of the water for agricultural use is sourced from either local dams or SA Water mains supply.

There are 38 groundwater wells on the DEWNR WaterConnect database within 10 km of the Pindari pumping well installed in May 2014. Total drilled depths of the wells in the database search ranged from 1.2 m to 84 m. The uses of those wells that are still operational and are within 10km of the Pindari pumping well are mostly for observation, but may also include some used for include stock watering and irrigation. Twelve of the wells listed in the Pindari search were identified as abandoned. Further discussions with landholders that may utilise Pindari Wellfield will be undertaken in the future stages of the project (i.e. during development of the PEPR).



2.9.8 Environmentally sensitive areas

2.9.8.1 Seepage areas

Groundwater seeps are known to be present in the eastern Cleve Hills (Upper Salt Creek catchment) and the Upper Driver River Catchment areas. No seeps are recorded in the Project area. Seeps have been mapped to the west of Campoona Shaft and to the east of Sugarloaf (Harding *et al.* 2002 and Henschke *et al.* 2001, respectively).

No seeps are recorded in the Project area.

2.9.8.2 Groundwater dependant ecosystems (GDEs)

Groundwater dependant ecosystems (GDEs) are ecosystems which rely on groundwater discharge for some or all of their water requirements.

There are numerous areas of native vegetation (e.g. in drainage lines) with a low potential for groundwater interaction. These are not considered relevant in the context of potential groundwater-related environmental impacts and are not discussed further.

The South Australian Government carried out a substantial program of documentation of wetlands on Eyre Peninsula (Wainwright, P. (2008). *2007 Wetland Inventory for the Eyre Peninsula, South Australia*. (Department for Environment and Heritage, South Australia). Hundreds of wetlands were identified, visited and classified according to their condition. There are several wetlands regarded as having a high potential for groundwater interaction (Figure 2-20) one partly within the Pindari Wellfield lease area and one some 10 km due east, and several to the west and north-west of Campoona Shaft.

The BOM GDE Atlas indicates there are two GDEs within a 10 km radius of the pumping well installed at Pindari in May 2014 (Table 2-9).

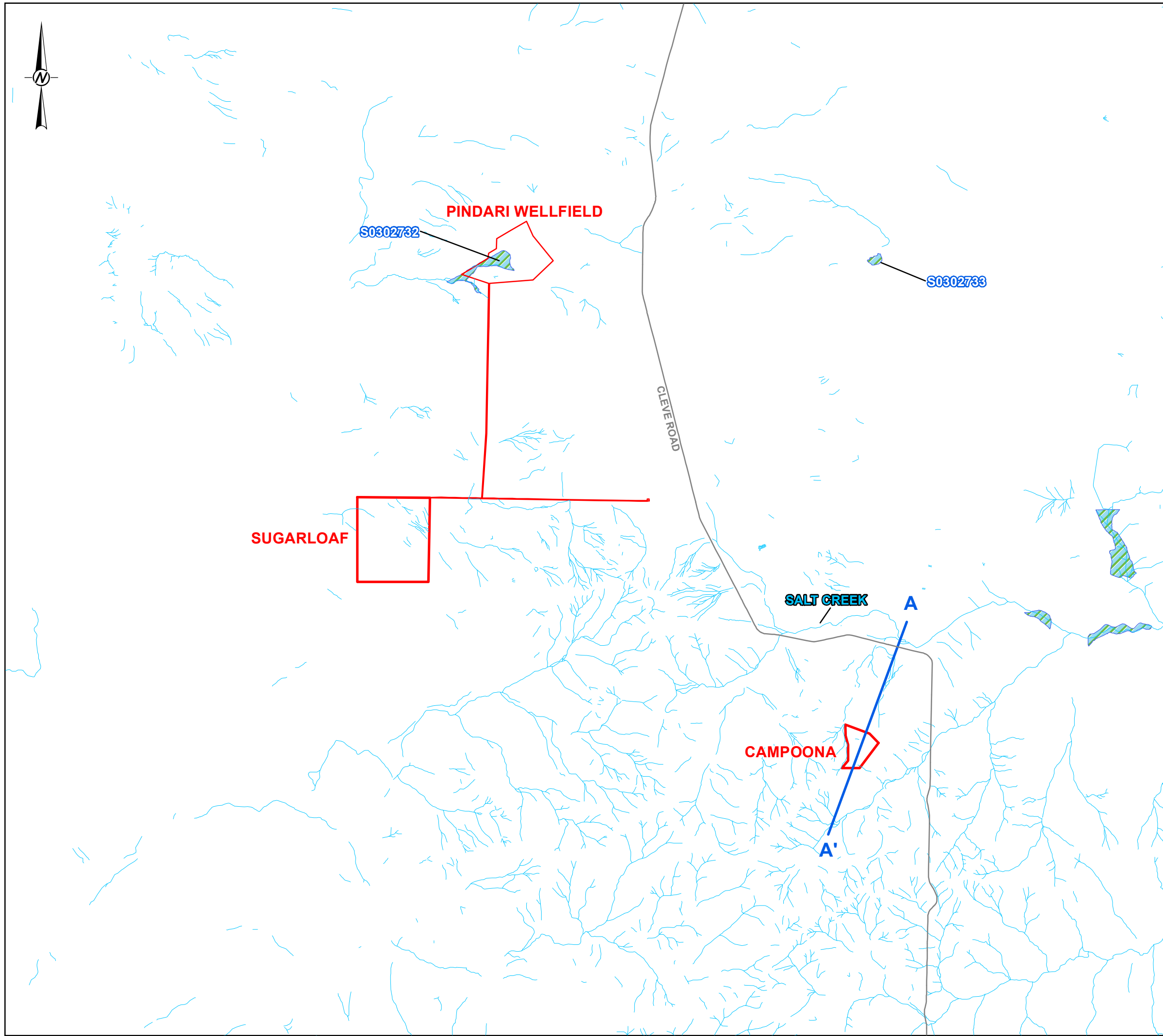
Table 2-9: Wetlands identified within 10 km of the proposed Pindari wellfield

Wetland ID	Condition	Distance and \Direction from Pindari	Comments
S0302732	Degraded	Occupies west part of lease area	Groundwater levels would be drawn down but the wetland is already degraded
S0302733	Moderate	9 km east	No effects expected

Notes on "Condition" of wetland:

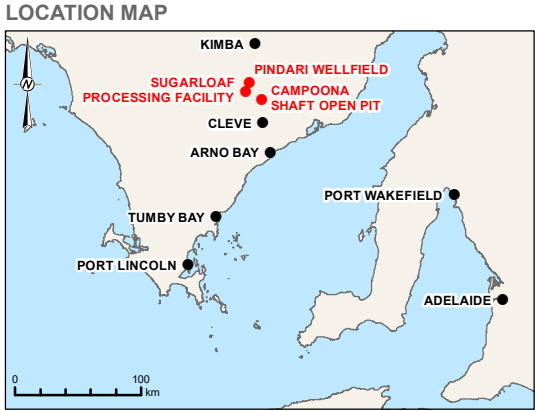
Degraded means "High level of degradation evident verging on un-rectifiable damage. Few natural values remaining. Water regime somewhat to considerably altered from pre-European state." Moderate means "Degradation obvious although many natural values remaining. Most damage rectifiable with improved management. Native vegetation buffer typically absent. Water regime somewhat to considerably altered from pre-European state."

Four wetlands are identified to the north west of Campoona Shaft, the closest being 5 km distant. All are severely degraded. Given that at most a small quantity of groundwater might be pumped for dust suppression at Campoona, there is extremely unlikely to be any impact at these features and they are not discussed further.



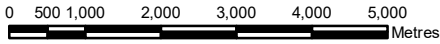
CAMPOONA PROJECT
MINING LEASE PROPOSAL

**GROUNDWATER DEPENDENT
ECOSYSTEMS NEAR THE ML AND
MLPS**



- LEGEND**
- Mineral Claim Boundary - Campoona
 - Approximate Sugarloaf MPL
 - Approximate Water MPL
 - Wetland
 - Ephemeral Drainage Lines and Creeks
 - Section Line

- NOTES**
- Township data sourced from MapInfo StreetPro.
 - Watercourse data sourced from WaterConnect, South Australian Government.
 - Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.
 - GDE data sourced from Bureau of Meteorology, Australian Government.



REFERENCE SCALE: 1:100,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

**FIGURE
2.20**





2.10 Flora and fauna

This section describes the flora and fauna in the proposed ML, MPL Sugarloaf site and the MPL Water and the broader area (approximately 25 km²). Three terrestrial ecology surveys were completed to assess baseline conditions including:

- a spring survey completed in 2012 (Golder 2013).
- a listed flora survey (Donato Environmental Services 2013), which was completed to encompass a targeted survey (coinciding with flowering times for the majority of target listed species identified in the spring survey).
- a survey of the Sugarloaf site (Donato Environmental Services 2014).

All surveys included both desktop searches and field survey methods and information provided in this section, including references to source information are provided in Appendix G.

2.10.1 Regional native vegetation

It is estimated that 55% of the original vegetation on the Eyre Peninsula has been cleared. Many of the largest blocks of the remaining native vegetation are in areas that are not ideal for agriculture (EPNRMB 2009).

Seven major vegetation structures have been recognised on Eyre Peninsula. Survey work carried out by Pirie Resources in the Cleve Hills identified a mixture of open scrub, woodland and mallee vegetation associations. Mallee is the dominant vegetation structure, dominated by *Eucalyptus* species. Eyre Peninsula Blue Gum (*Eucalyptus petiolaris*) was also found in the Cleve hills and along creek lines on the adjacent plains.

2.10.2 Local vegetation

All of the vegetation communities within the project sites have been impacted by agricultural clearance and farming practices.

The Project area has been largely cleared of native vegetation in order to provide open land for farming. DEWNR's Nature Maps and aerial photography (available since 1978) highlights the extent of clearing and agricultural development and its impact on habitat presence and connectivity. Similar disturbance is evident in the area surrounding the study area, with habitat fragmentation evident. At present, pre-European vegetation mapping on DEWNR's Nature is not available for the Cleve district.

Aerial imagery from 1978 showed the extent of clearing in the study area (refer Figure 2 Appendix G). By 1978 the project area was already greatly altered by clearance. Vegetation only occurred along drainage lines, creeks and rocky outcrops at that time. One large tract of vegetation evident in 1978 has since been cleared for cropping (within the centre, on Lot A100 on D49340). Vegetation corridors have also narrowed since 1978, with cropping and grazing encroaching further on the remaining habitat.

Where habitat has not been fenced from livestock, grazing has severely impacted on the presence of understorey and mid-storey species. Similarly, the local Western Grey Kangaroo (*Macropus fuliginosus*) populations utilise vegetation patches to rest during the day. This concentration of activity has also impacted upon the understorey in most of the vegetation patches.

No evidence of recent burning was observed at any of the flora survey sites within the proposed ML, or at the MPL Sugarloaf and MPL Pindari. The study areas have remained unburnt for at least 50 years. Fire is an integral part of the ecosystem dynamics within Mallee.

2.10.3 Listed species and communities

There are no listed communities present within the proposed ML Campoona Shaft, MPL Sugarloaf or MPL Water.



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The Eyre Peninsula Blue Gum (*Eucalyptus petiolaris*) woodland community is listed as endangered in South Australia and it is also listed under the EPBC Act as an endangered ecological community for which there is EPBC national conservation advice (Threatened Species Scientific Committee 2013). It is known to occur in the region several kilometres south of the Campoona Shaft site.

Site investigations detected six protected species in the greater study area (Table 2-10). No triggers for an EPBC Act referral relating to listed flora have been identified.

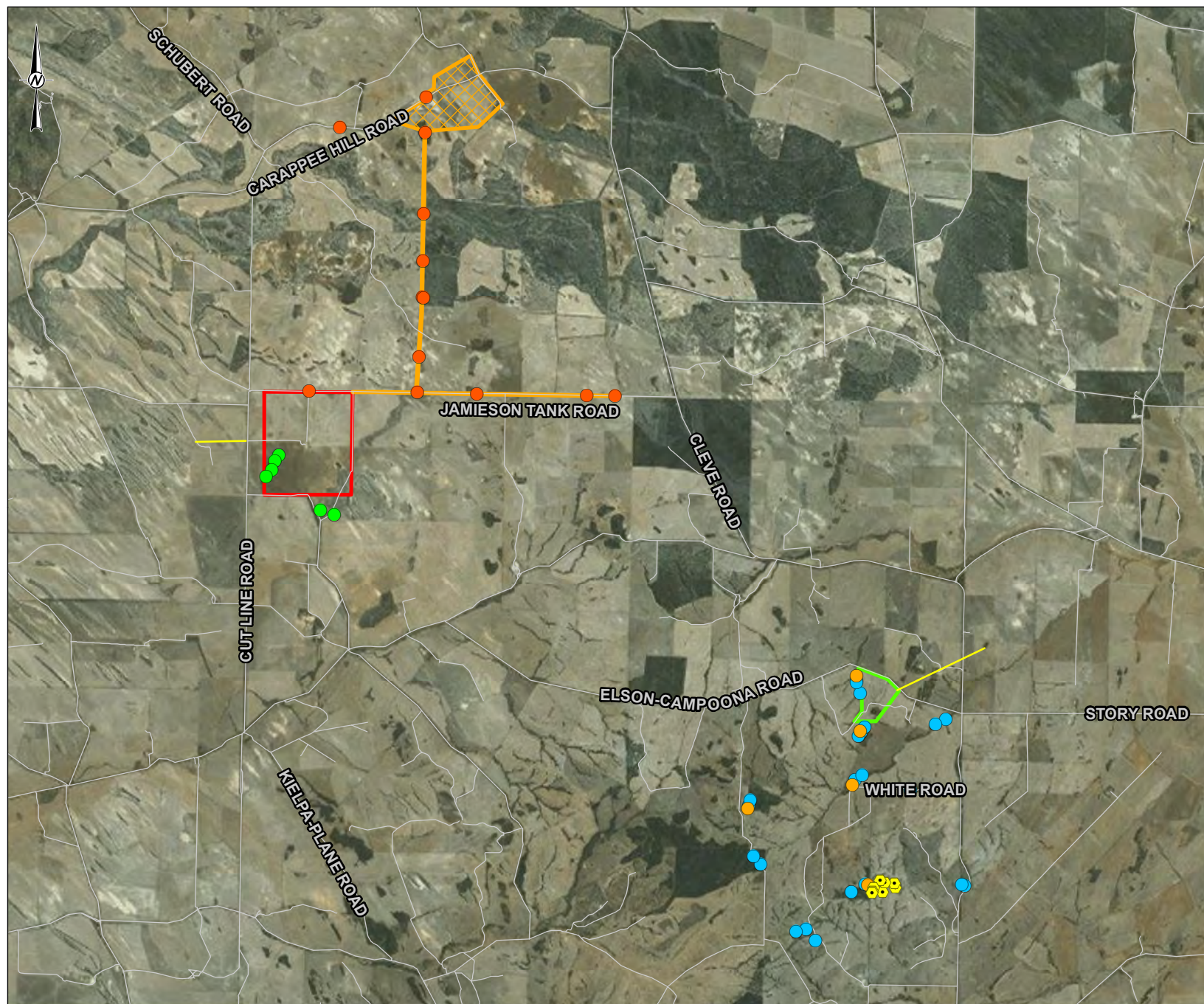
Table 2-10: State-listed flora species found in the study area

Scientific Name	Common Name	NPW Act Status	Sites Found
<i>Daviesia pectinata</i>	Zig-zag Bitter-Pea	Rare	Campoona
<i>Daviesia benthamii</i> ssp. <i>humilis</i>	Mallee Bitter-Pea	Rare	Campoona
<i>Eremophila gibbifolia</i>	Coccid Emubush	Rare	Campoona
<i>Goodenia benthamiana</i>	Bentham's Goodenia	Rare	Campoona
<i>Spyridium erymnocladum</i>	Cloaked Spyridium	Vulnerable	Campoona
<i>Arachnorchis brumalis</i> or <i>Arachnorchis fragrantissima</i>	Winter Spider Orchid or Eastern Spider Orchid	Vulnerable	Cleve-Kimba Road, property #12 (south of Campoona)

The Zig-zag Bitter-Pea, Mallee Bitter-Pea, and the Coccid Emubush are widespread in the locality, occurring in high densities in some areas. Cloaked Spyridium was found in mainly sparse but some higher density patches in locations outside of the ML. Only two individual Bentham's Goodenia were found. Zig-zag Bitter-Pea, Coccid Emubush and Bentham's Goodenia were found near the Campoona Shaft. The orchid species (*Arachnorchis brumalis* or *Arachnorchis fragrantissima*) was located 5 km from the Campoona Shaft site.

In summary, the field surveys at Campoona Shaft, Sugarloaf processing facility and Pindari found the following:

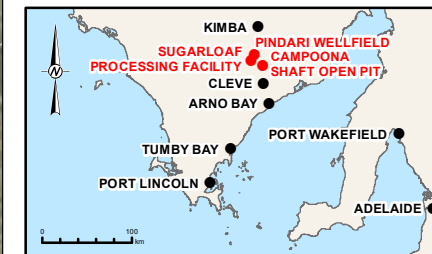
- No EPBC threatened or listed species were identified.
- No NPW listed species were found at Sugarloaf or at the Pindari pipeline assessment sites.
- Four species listed (as Rare) under the NPW Act were found at the Campoona Shaft site.
- A sixth taxa (*Arachnorchis* aff. *pattersonii*, spider orchid) was unable to be identified to species as they were not in flower but was considered be either *Arachnorchis brumalis* (Winter Spider Orchid) or *Arachnorchis fragrantissima* (Eastern Spider Orchid); both of these are considered Vulnerable. These were found south of the ML Campoona Shaft. Orchid species are not expected to occur along the pipeline route due to the degraded and grazed nature of the vegetation, other than in the Heritage Agreement area that will be avoided.



CAMPOONA PROJECT MINING LEASE PROPOSAL

FLORA AND FAUNA SURVEY SITES

LOCATION MAP



LEGEND

- Bartells Creekline Transects
- Fauna Survey Location
- Flora Survey Location
- Survey Location
- Survey Quadrat Location
- Approximate Water MPL
- Approximate Sugarloaf MPL
- Campoona Mineral Claim Boundary

NOTES

1. Township data sourced from MapInfo StreetPro.

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1. World Imagery - Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Aerial Imagery Copyright ESRI.



REFERENCE SCALE: 1:125,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

**FIGURE
2.21**





2.10.4 ML Campoona Shaft

The Campoona Shaft ML area has been cleared of native vegetation for agricultural purposes, with only small stands of degraded vegetation remaining.

During the small-scale start-up phase of the operation, graphitic ore will be sourced by excavating directly into ore at the widest portion of the deposit. In this trenching phase no native vegetation will need to be removed. Mining will consist of clearing an area some 50 x 25m in size where thin (~ 0.5m) topsoil will be stripped and 10 m deep trench excavated. There will be no waste rock generated during this stage.

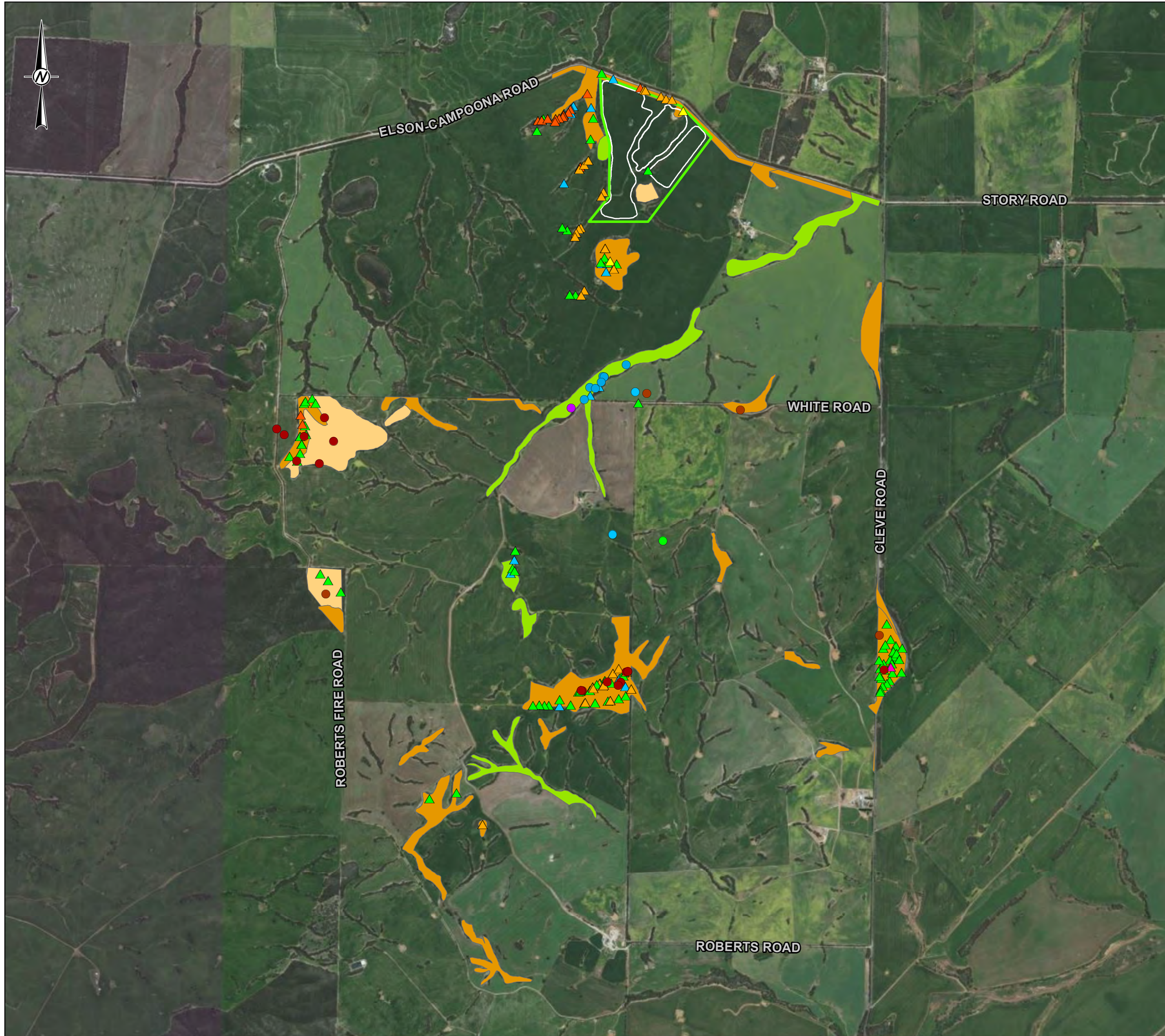
When production expands to full scale output in Stages 1 to 3 in the pit's development, there are small patches of tall open *Melaleuca* shrubland, described as mainly *Melaleuca uncinata* (Broombush / Broom Honey Myrtle) over *Babingtonia behrii* (Silver Broombush) on the southern edge of the proposed pit that will need to be cleared.

Outside the proposed ML (and therefore not in the control of Pirie Resources) there are patches of remnant vegetation along creek lines, ridges, slopes and valley floors, and along roadways and fence lines. These vegetation communities are considered to be moderately to highly disturbed and have lower species richness and diversity than undisturbed communities. However, some rare or threatened species are supported by these refuge habitats, which are connected by roadside and riverine vegetation and provide corridors for species movement, including:

- a watercourse in the northern part of the study area but outside the proposed ML (west and south of Campoona Shaft), and
- vegetation communities further to the west and outside the study area.

To the north west, north and north east along the Elson-Campoona Road verge and along an ephemeral creek depression is *Eucalyptus* mallee forest and mallee woodland, denoted as comprising mainly *Eucalyptus odorata* (Peppermint Box) and *Eucalyptus phenax* ssp. (Green-leaf Mallee) mallee woodland over *Melaleuca uncinata* (Broombush) shrubs and *Avena barbata* (a species of wild oat), and or tussock grasses *Lasiopetalum baueri* (Slender Velvet-bush) and perennial herbs *Gonocarpus mezianus* (Hairy Raspwort).

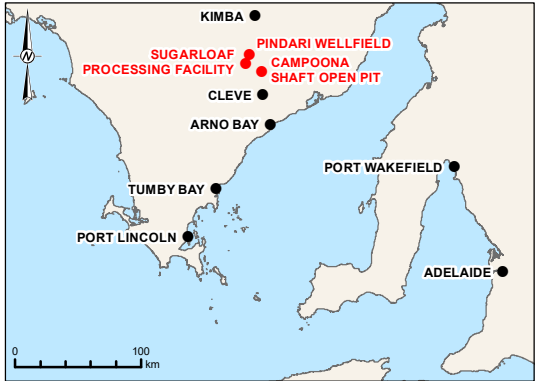
To the south and south west are strips of low open *Eucalyptus* forest and woodland of mainly *Eucalyptus petiolaris* (Blue Gum) and possibly *E. odorata*. There is a large area of *Melaleuca* shrubland around 4.5 km further to the south west of the site and an area of *Eucalyptus* mallee forest and mallee woodland around 4.3 km west. The remaining area is mainly agricultural land.



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MAP OF REMAINING NATIVE
VEGETATION AND LISTED
SPECIES NEAR CAMPOONA

LOCATION MAP



LEGEND

- Threatened Fauna**
- Australasian Grebe
 - Diamond Firetail
 - Purple-gaped Honeyeater
 - Rainbow Bee-eater
- Flora Threatened Species - Orchid**
- Arachnorchis
 - (Caladenia) aff. patersonii complex
- Flora Threatened Species**
- Davesia benthamii ssp. humilis
 - Davesia pectinata
 - Eremophila gibbifolia
- Vegetation**
- Goodenia benthamiana
 - Spyridium erymnocladum
 - Eucalyptus forest and woodland
 - Eucalyptus mallee forest and mallee woodland
 - Melaleuca shrubland >1m
- Other**
- Campoona Mineral Claim Boundary

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Vegetation data sourced from DEWNR, Department of Environment, Water and Natural.
3. Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.
4. Site layout data sourced from Archer Exploration Ltd.

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1. Bing Maps Aerial - Source: © Harris Corp, Earthstar Geographics LLC
Earthstar Geographics SIO © 2015 Microsoft Corporation . Aerial
Imagery Copyright ESRI.

0 125 250 500 750 1,000
Metres

REFERENCE SCALE: 1:30,000 (AT A3)
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PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

FIGURE
2.22





Expected vegetation losses at ML Campoona

What native vegetation exists is confined to small ridgeline stands which are classified as highly disturbed (Figure 2-22). There is a planted wind break on the east of the proposed ML.

No native vegetation is expected to be lost in the first three years during the small scale production phase at Campoona.

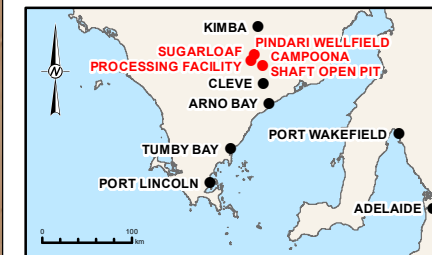
Minor vegetation will be lost over the next 13 years. The location of the pit and Eastern Waste Rock Dump will remove the scattered trees as per Figure 2-23. Further, a stand of vegetation (approximately 0.4 ha in size) is expected to be lost as the Eastern Waste Rock Dump is progressively constructed.



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VEGETATION LOSS WITHIN ML CAMPOONA

LOCATION MAP



LEGEND

- Scattered Native Vegetation
- Vegetation Stand
- Wind Break Planting
- Campoona Mineral Claim Boundary

NOTES

- Township and road data sourced from MapInfo StreetPro.



REFERENCE SCALE: 1:7,500 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

**FIGURE
2.23**





2.10.5 MPL Sugarloaf

The immediate Sugarloaf processing site has been predominantly cleared of native vegetation so that the area could be used for broad acre cropping purposes. Some remnant vegetation remains around the site buildings and roadways where the processing facility is proposed (Figure 2-24).

No native vegetation losses are associated during the small-scale start-up phase of the operation. Works will be undertaken in and around the existing sheds to construct the small modularised flotation facilities.

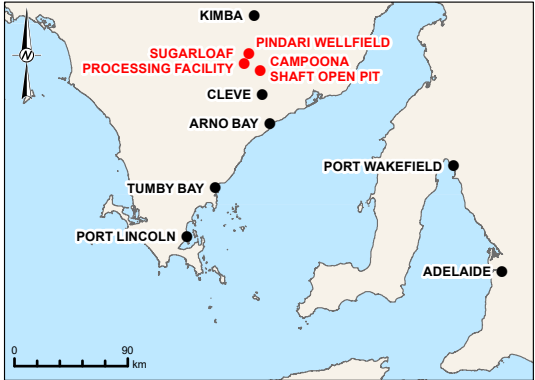
While most of the vegetation communities in the Sugarloaf project area are degraded, two sections of the greater Sugarloaf area contain native vegetation; Sugarloaf Hill and the south east corner of the property. Both areas are unfenced and have been actively grazed. These areas are not expected to be further degraded or impacted by the Project.



CAMPOONA PROJECT
MINING LEASE PROPOSAL

MAP OF REMAINING NATIVE
VEGETATION AND LISTED
SPECIES NEAR SUGARLOAF

LOCATION MAP



LEGEND

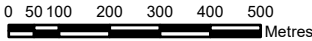
- Infrastructure Footprint
- South West Cross Valley TSF
- Flora Threatened Species - Orchid**
 - Arachnorchis (Caladenia) aff. patersonii complex
- Eucalyptus mallee forest and mallee woodland
- Melaleuca shrubland >1m
- Approximate Sugarloaf MPL

NOTES

- Township data sourced from MapInfo StreetPro.
- Vegetation data sourced from DEWNR, Department of Environment, Water and Natural.
- Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.
- Site layout data sourced from Archer Exploration Ltd.

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- Aerial image sourced from Mapland, Department of Environment, Water and Natural Resources, South Australian Government.



REFERENCE SCALE: 1:15,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

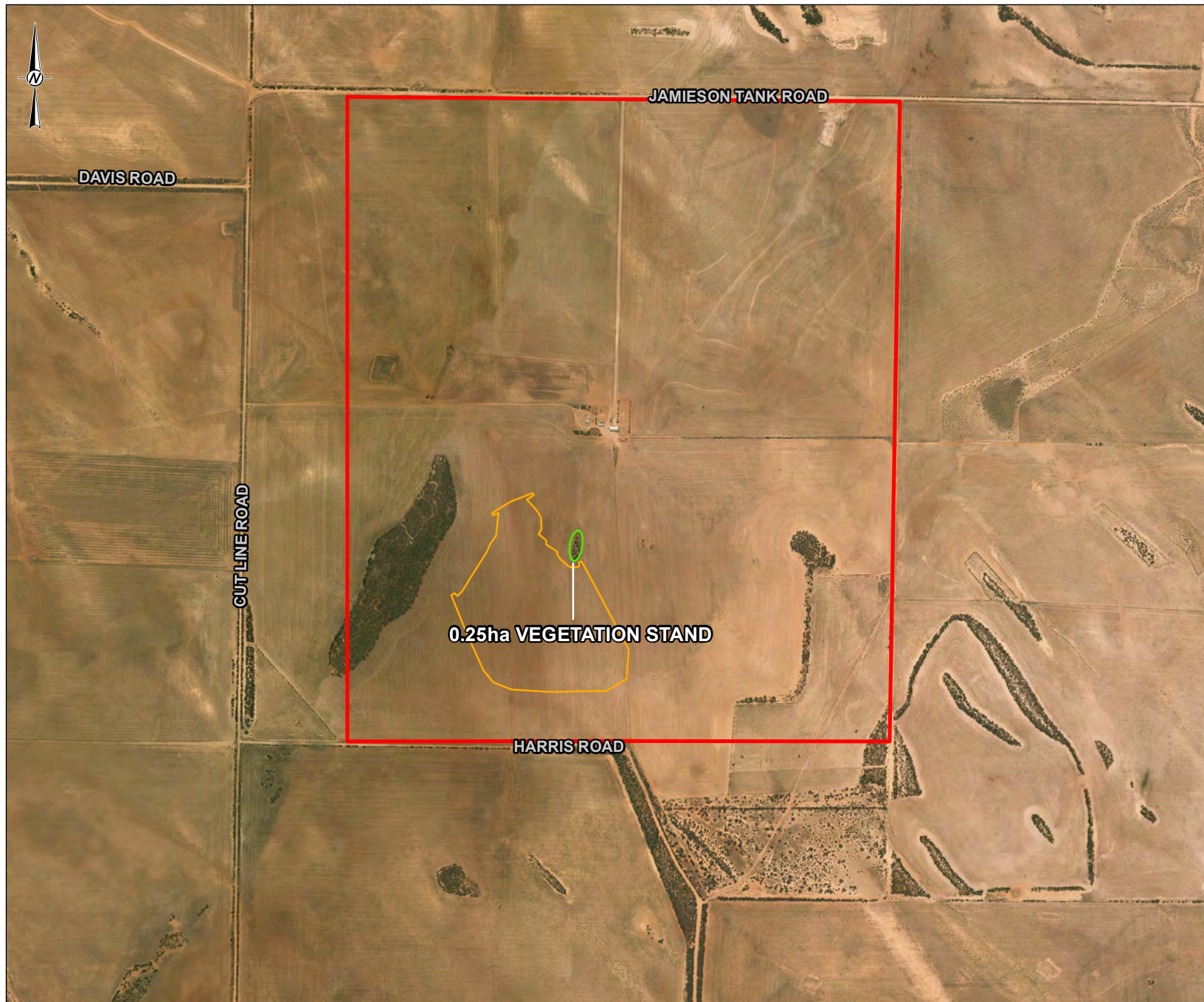
FIGURE
2.24





Expected vegetation losses at MPL Sugarloaf

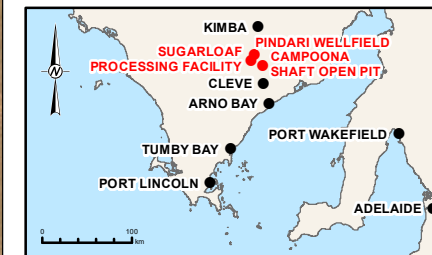
A 0.25 ha stand of degraded vegetation is expected to be lost because of the proposed MPL Sugarloaf (Figure 2-25). Whilst not under the footprint of the TSF, it may be cleared for site access and potential development of borrow pits for construction of the TSF. No other scattered trees are expected to be lost as a result of the processing and tailings storage requirements on MPL Sugarloaf.



CAMPOONA PROJECT MINING LEASE PROPOSAL

VEGETATION LOSS AT THE MPL SUGARLOAF

LOCATION MAP



LEGEND

- South West Cross Valley TSF
- Approximate Sugarloaf MPL

NOTES

- Township and road data sourced from MapInfo StreetPro.



REFERENCE SCALE: 1:20,000 (AT A4)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

**FIGURE
2.25**





2.10.6 MPL Water

Pindari

Vegetation communities collated from biological database records comprised mainly eucalyptus-dominated woodland/forest, particularly Ridge-Fruited Mallee (*E. incrassata*), Narrow-leaved Mallee (*E. leptophylla*) with *Leptospermum* sp. and *Hibbertia* sp. as the subdominant and/or understorey.

Aerial photography and the online Nature Maps tool show the vegetation along the pipeline route between Jamieson Tank Road and Carapsee Hill Road, runs adjacent to large sections of native vegetation, including a Heritage Agreement area (HA 569), crossing through, over a short distance, small sections of:

- Mallee woodland (*Eucalyptus incrassata* (Angular Yellow Mallee) and possibly *Eucalyptus leptophylla* (March Mallee) with an understorey of *Leptospermum coriaceum* (Green Tea-tree), *Melaleuca uncinata* (Broom Bush), *Callitris verrucosa* (Camphor Wood), *Babingtonia behrii* (Silver Broombush) shrubs and *Hibbertia australis* (Erect Guinea-flower), *Glischrocaryon behrii* (Golden Pennants) shrubs.
- Tall open Melaleuca shrubland (*Melaleuca uncinata* (Broom Bush), *Babingtonia behrii* (Silver Broombush), and possibly *Calytrix involucreata* (starflower) low shrubs over possibly *Triodia irritans* (Porcupine Grass) and *Hibbertia glabriuscula* (Guinea flower).

There are also small patches of *Callitris* forest and woodland in the Pindari area. The remaining areas are mainly disturbed, with agricultural activities occurring in the area (Figure 2-26).

During small-scale start-up, up to 10 ML of saline process water will be abstracted from an existing production bore at Pindari and stored either in a holding tank or in a small lined process water pond and from there trucked as needed to Sugarloaf.

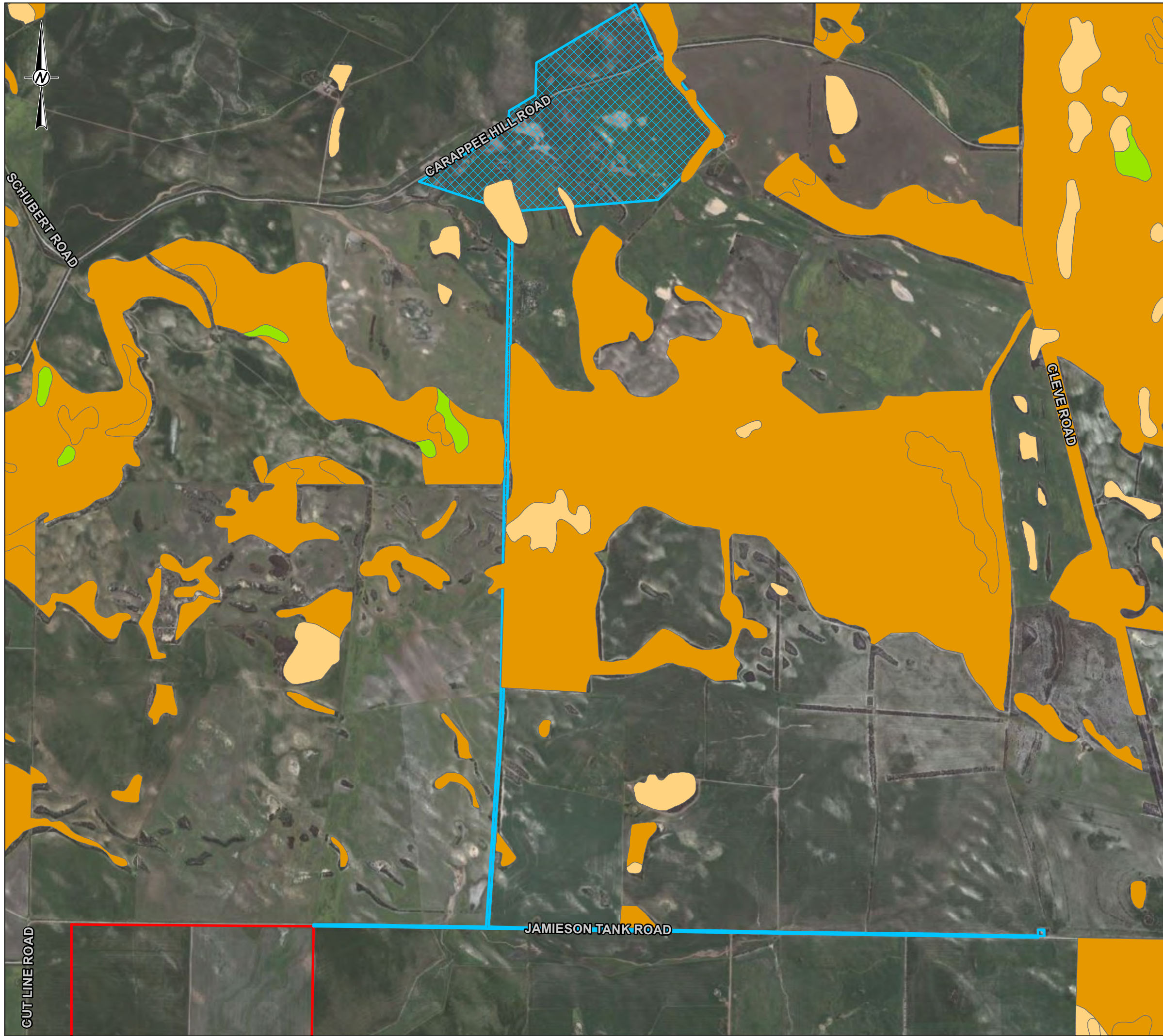
Full-scale production processing will require up to 100 ML of process water per annum that will be delivered to Sugarloaf via a bundled pipeline. TSF decant systems are expected to recycle approximately 80 ML of process water per year. The pipeline will follow the existing fence line and access track that is almost entirely cleared of vegetation, however some pruning is likely required.

Jamieson Tank Road

Pirie Resources has secured a potable water allocation from SA Water of between 40 – 80 ML per annum over the life of the Project. Potable water is needed at Sugarloaf for final concentrate washing and for domestic requirements.

For the small-scale start-up the existing potable water tanks installed on the main shed will supply much of the expected water requirements. Any additional potable water requirements will be sourced by trucking water from Jamieson Tank to Sugarloaf.

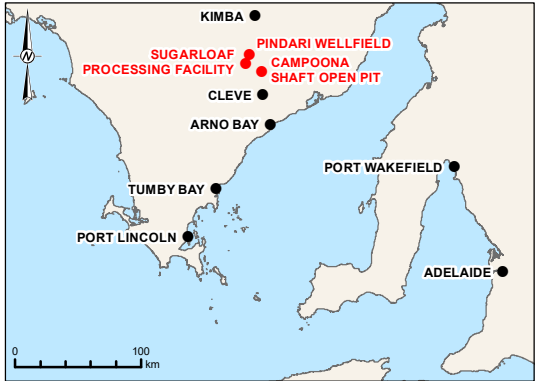
During full-scale production, potable water will be delivered to Sugarloaf via a buried pipeline from Jamieson Tank. To build the pipeline for full-scale processing, there will be a need to remove a small number of the scattered shrubs. The final number will be defined in the PEPR.



CAMPOONA PROJECT
MINING LEASE PROPOSAL

MAP OF REMAINING NATIVE
VEGETATION AND LISTED
SPECIES NEAR PINDARI
WELLFIELD AND PIPELINE

LOCATION MAP



LEGEND

- Callitris forest and woodland
- Eucalyptus mallee forest and mallee woodland
- Melaleuca shrubland >1m
- Approximate Water MPL
- Approximate Sugarloaf MPL

NOTES

- Township data sourced from MapInfo StreetPro.
- Vegetation data sourced from DEWNR, Department of Environment, Water and Natural.
- Road data sourced from DPTI, Department of Planning, Transport and Infrastructure, South Australian Government.

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- Bing Maps Aerial - Source: © Harris Corp, Earthstar Geographics LLC Earthstar Geographics SIO © 2015 Microsoft Corporation . Aerial Imagery Copyright ESRI.

0 125 250 500 750 1,000
Metres

REFERENCE SCALE: 1:30,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

FIGURE
2.26





Expected vegetation losses for MPL Water

Vegetation losses at Pindari are anticipated to be minimal and will only occur during preparations for full scale production when the pipeline is constructed. The pipeline will follow the existing fence line that is almost entirely cleared of vegetation with that remaining heavily infested with weeds and showing signs of heavy grazing by sheep, rabbits and kangaroos (Appendix G). Over the approximate 5.5 km pipeline from the wellfield to Jamieson Tank Road, approximately 450 m has vegetation close to the fence line which may require pruning or tree removal. Any vegetation losses required for the pipeline (and the subsequent SEB) will be detailed in the PEPR.

Potable water during the small-scale start-up operations may be augmented by trucking water from Jamieson Tank to Sugarloaf. No vegetation disturbance is expected during this phase of the operation.

For full scale production the pipeline supplying potable water from Jamieson Tank will be buried on the southern side of Jamieson Tank Road for approximately 5.8 km. Despite the vegetation along the southern side of the road being sparse and dominated by weeds, a small number of the scattered trees will need to be removed. Trees removed for the pipeline construction and operation will be replaced within the alignment.

2.10.7 Weeds and pathogens

A list of introduced species as listed in the BDBSA is provided in Golder (2013) contained within Appendix G. The EPBC Protected Matters Report also identified six invasive plant species that either occur in the Project area, or for which suitable habitat may occur within the area. Invasive plant species listed by the EPBC Act included the following Weeds of National Significance (WoNS):

- Bridal Veil Creeper (*Asparagus asparagoides*)
- Bitou Bush (*Chrysanthemoides monilifera*)
- Athel Pine (*Tamarix aphylla*).

During the field studies completed in 2012, 2013 and 2014, a total of:

- eleven introduced species were recorded within the ML Campoona study area.
- six introduced species were recorded within the MPL Sugarloaf study area.
- four introduced species were recorded within the MPL Water study area.

Of these introduced species, only two are classified as declared weed species under either the State or Commonwealth legislation:

- Bridal creeper (*Asparagus asparagoides*) (Weed of National Significance (WoNS)) - recorded opportunistically along the pipeline route:
 - Is considered to be a major threat to native plant communities, agricultural and forestry industries and communities.
 - The berries are spread by birds, rabbits and foxes that feed on and later excrete the seeds. Movement of soil or dumping of garden rubbish containing Bridal Creeper seeds or roots can also spread the weed (CRC 2003 in Department of the Environment n.d.).
 - Landholders are required by law to control WoNS growing on their properties.
- *Cirsium* sp.
 - Is a declared weed in South Australia.
 - Seed dispersal aided by the consumption of the species sticky red berries by birds and foxes (CRC Weed Management, 2004; Department of Water, Land and Biodiversity Conservation, 2006).
 - Control of *Cirsium* sp. is not required within the Eyre Peninsula local government area (Biosecurity SA, 2012).



Root Rot (*Phytophthora cinnamomi*) and broomrape (*Orobancha* spp.) were not identified during the field surveys.

2.10.8 Fauna

Similar to the vegetation assessments, a review of fauna in the broader area was completed using data from both desktop searches and three field surveys (Appendix G).

2.10.8.1 Listed regional fauna

The Eyre Peninsula supports a range of mammals, birds, reptiles and amphibians. An EPBC Act Protected Matters Report (Appendix G) identified listed species that have a potential to occur within the area. One threatened mammal species is listed as potentially occurring, while three threatened bird species and eight migratory or marine bird species were listed (Table 2-11).

From the Biological Database South Australia (BDBSA), 11 bird, four mammal and two reptile species were identified as species of conservation interest. Three bird species are protected under the NPW Act, while no mammals or reptiles are protected under the Act (Table 2-11). There were no records for amphibians or invertebrates from within the area.

The potential for the identified rare and/or threatened species to occur within the study area is presented as a probability analysis in Appendix G (with resulting likelihood as shown in Table 2-11). Based on that assessment, it was considered that the study area could possibly support individuals or habitat for four EPBC Act-listed species of which two are NPW Act-listed species (Table 2-11).

Table 2-11: Threatened fauna species potentially occurring in the study area (EPBC and NPW)

Species	Common Name	NPW Act Status*	EPBC Act Status**	Likelihood of Occurrence
Birds				
<i>Apus pacificus</i>	Fork-tailed Swift	-	Migratory, Listed Marine	Possible
<i>Ardea ibis</i>	Cattle Egret	Rare	Migratory, Listed Marine	Possible
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater	Rare	-	Probable
<i>Merops ornatus</i>	Rainbow Bee-eater	-	Migratory, Listed Marine	Possible

2.10.8.2 Project area fauna

Fauna surveys were carried out at five 1 ha sites located in and around the Campoona Shaft site to account for fauna mobility.

The following species were identified during the three field surveys (Table 2-12):

- 86 bird species - in general, Campoona Hill had fewer species identified, mainly in relation to birds compared to the other sites, particularly during the 2012 survey.
- 10 reptile species - the majority of reptiles were Scincidae (skinks), Pygopodidae (Legless lizards) and Agamidae (dragons). Although they may be present, snakes, goannas or geckos were not observed.
- No amphibians were recorded during any of the surveys.
- Eight mammal species (including four introduced species) - two Long-eared bat species were identified along with the Western Pygmy Possum, Little Long-tailed Dunnart and Western Grey Kangaroo.

One EPBC migratory species was identified during the field surveys:

- Rainbow Bee-eater (*Merops ornatus*) (migratory) – seen in the broader study area. Potential breeding sites for the Rainbow Bee-eater were also observed outside of the ML and MPL areas, however none of the sites were considered sufficient to support significant breeding activity and no evidence of breeding was observed.



GRAPHITE PROJECT MLP AND MPS

Species listed under the NPW Act identified during the field surveys were:

- Purple-gaped Honeyeater (*Lichenostomus cratitius*) (Rare) – seen at Campoona, Sugarloaf and in the broader study area. Due to the presence of suitable mallee habitat with an open understorey in the vicinity of the ML and MPL sites, breeding activity for this species is considered very likely although was not confirmed. However, due to the degraded habitat in the ML and MPLs, these areas are not considered likely to support breeding activity of the Purple-gaped Honeyeater.
- Diamond Firetail (*Steganopleura guttata*) (Vulnerable) – seen near Campoona. No breeding activity was confirmed for this species however suitable habitat for breeding (eucalypt-dominated vegetation with a grassy understorey) and numerous individuals were observed near Campoona at White Creek which was fenced to exclude stock. Although disturbance of an understorey is less of an influence on the presence of this species than the string canopy, grazing on grasses upon which this species feeds (seeds) does impact its presence. The occasional presence of the Diamond Firetail is possible along the pipeline routes, however due to degraded vegetation and weed infestation, along with grazing, it is not considered likely that this would support the species.

Table 2-12: Species identified during field surveys

Species Name	Common Name	EPBC	NPW	Proposed ML Campoona Shaft and Nearby (incl. Kimba - Cleve Road)	MPL Sugarloaf	MPL Water
Birds						
<i>Acanthagenys rufogularis</i>	Spiney-cheeked Honeyeater	-	-		X	X
<i>Acanthiza apicalis</i>	Inland Thornbill	-	PA	X		X
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	-	PA	X	X	X
<i>Accipiter fasciatus</i>	Brown Goshawk	-	PA	X		
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk	-				X
<i>Alauda arvensis</i>	Skylark	-	-		X	X
<i>Anas gracilis</i>	Grey Teal	-		X		
<i>Anas superciliosa</i>	Pacific Black Duck	-	PA	X		
<i>Anthochaera carunculata</i>	Red Wattlebird	-	UA	X		X
<i>Anthus novaeseelandiae</i>	Australian Pippit	-	PA	X	X	X
<i>Artamus cyanopterus</i>	Dusky Woodswallow	-	PA	X	X	X
<i>Artamus superciliosus</i>	White-browed Woodswallow	-	-	X (Cleve-Kimba Rd, fire track)		
<i>Barnardius zonarius</i>	Port Lincoln Parrot	-	PA	X		
<i>Chenonetta dubatta</i>	Australian Wood Duck	-	-	X		
<i>Cheramoeca leucosternus</i>	White-backed Swallow	-	-	X	X	X
<i>Chrysococcyx basalis</i>	Horsefield's Bronze-cuckoo	-	-	X	X	
<i>Cincloramphus cruralis</i>	Brown Songlark	-	-		X	
<i>Cincloramphus mathewsi</i>	Rufous Songlark	-	-	X	X	



GRAPHITE PROJECT MLP AND MPS

Species Name	Common Name	EPBC	NPW	Proposed ML Campoona Shaft and Nearby (incl. Kimba - Cleve Road)	MPL Sugarloaf	MPL Water
<i>Circus assimilis</i>	Spotted Harrier	-				X
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	PA	X	X	X
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	PA	X (South of project site)	X	X
<i>Corvus coronoides</i>	Australian Raven	-	UA	X		
<i>Corvus mellori</i>	Little Crow	-				X
<i>Corvus mellori</i>	Little Raven	-		X	X	
<i>Coturnix pectoralis</i>	Stubble Quail	-		X (Cleve-Kimba Rd)	X	
<i>Cracticus tibicen</i>	Australian Magpie	-		X	X	X
<i>Cracticus torquatus leucopterus</i>	Grey Butcherbird	-	PA	X	X	X
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	PA	X		
<i>Drymodes brunneopygia</i>	Southern Scrub Robin	-	PA	X	X	
<i>Egretta novaehollandiae</i>	White-faced Heron	-	PA	X (creekline south of project site)		
<i>Elanus axillaris</i>	Black-shouldered Kite	-				X
<i>Elophus roseicapillus</i>	Galah	-	UA	X		X
<i>Eopsaltria griseogularis</i>	Western Yellow Robin	-	PA	X		
<i>Epthianura albifrons</i>	White-fronted Chat	-	PA		X	X
<i>Falco berigora</i>	Brown Falcon	-		X (creekline south of project site)		X
<i>Falco cenchroides</i>	Nankeen Kestrel	-				X
<i>Falco longipennis</i>	Australian Hobby	-		X		
<i>Grallina cyanoleuca</i>	Magpie Lark	-	PA	X	X	
<i>Gymnorhina telonocua</i>	Australian Magpie	-	PA	X		
<i>Hirundo neoxena</i>	Welcome Swallow	-		X	X	X
<i>Lichenostomus virescens sonorus</i>	Singing Honeyeater	-	PA	X		
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	-	PA	X	X	X
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater	-	R	X	X	
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	-				X
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater	-	PA	X		
<i>Lichenostomus virescens</i>	Singing Honeyeater	-			X	X
<i>Malurus lamberti</i>	Variegated Fairy-wren	-	PA			



GRAPHITE PROJECT MLP AND MPS

Species Name	Common Name	EPBC	NPW	Proposed ML Campoona Shaft and Nearby (incl. Kimba - Cleve Road)	MPL Sugarloaf	MPL Water
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren	-	PA	X	X	X
<i>Manorina flavigula</i>	Yellow-throated Miner	-			X	X
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	-	PA	X	X	
<i>Merops ornatus</i>	Rainbow Bee-eater*	M	PA, M			
<i>Morethia obscura</i>	Shrubland Morethia Skink	-		X		
<i>Ninox novaeseelandiae</i>	Boobook Owl	-		X		
<i>Ocyphaps lophotes</i>	Crested Pigeon	-	PA		X	X
<i>Oreoica gutturalis</i>	Crested Bellbird	-	PA			
<i>Pachycephala pectoralis</i>	Golden Whistler	-	PA	X	X	X
<i>Pachycephala rufiventris</i>	Rufous Whistler	-	PA	X		
<i>Pardalopus punctatus</i>	Spotted Pardalote	-	PA	X	X	X
<i>Pardalopus striatus</i>	Striated Pardalote	-	PA	X	X	X
<i>Passer domesticus</i> *	House Sparrow	-	I		X	X
<i>Petrochelidon nigricans</i>	Tree Martin	-		X		
<i>Petroica goodenovii</i>	Red-capped Robin	-			X	
<i>Phaps chalcoptera</i>	Common Bronzewing	-	PA	X	X	X
<i>Phaps elegans</i>	Brush Bronzewing	-	PA	X		
<i>Phylidonyris albifrons</i>	White-fronted Honeyeater	-	PA	X		X
<i>Phylidonyris melanops</i>	Tawny-crowned Honeyeater	-				X
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	-	PA	X		
<i>Platycercus zonarius</i>	Australian Ringneck	-		X		X
<i>Podargus strigoides</i>	Tawny Frogmouth	-	PA	X		
<i>Pomatostomus superciliosus</i>	White-browed Babbler	-	PA	X	X	X
<i>Rhipidura fuliginosa</i>	Grey Fantail	-				X
<i>Rhipidura leucophrys</i>	Willie Wagtail	-	PA	X	X	X
<i>Sericornis frontalis</i>	White-browed Scrubwren	-	PA	X	X	
<i>Smicromis brevirostris</i>	Weebill	-	PA	X	X	X
<i>Staganopleura guttata</i>	Diamond Firetail	-	Vu	X		
<i>Strepera versicolor</i>	Grey Currawong	-	PA	X		
<i>Sturnus vulgaris</i> *	Common Starling	-	I	X		X



GRAPHITE PROJECT MLP AND MPS

Species Name	Common Name	EPBC	NPW	Proposed ML Campoona Shaft and Nearby (incl. Kimba - Cleve Road)	MPL Sugarloaf	MPL Water
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	-	PA	X		
<i>Tadora tadornoides</i>	Australian Shelduck	-				X
<i>Taeniopygia guttata</i>	Zebra Finch	-			X	
<i>Tyto alba</i>	Barn Owl	-	PA	X		
<i>Zosterops lateralis</i>	Silvereye	-	PA	X		X
Reptiles						
<i>Ctenotus orientalis</i>	Eastern Ctenotus	-	PA	X		
<i>Hemiergis peronii</i>	Lowlands Earless Skink	-	PA	X		
<i>Lerista dorsalis</i>	-	-	PA	X		
<i>Menetia greyii</i>	Common Dwarf Skink	-	PA	X		
<i>Pogona spp.</i>	Bearded Dragon	-	PA	X		
<i>Pygopus lepidopodus</i>	Common Scaly Foot	-	PA	X		
<i>Tiliqua rugosa</i>	Sleepy Lizard	-		X		
<i>Tiliqua rugosa</i>	Stumpy-tailed/Sleepy Lizard	-	PA	X	X	
Mammals						
<i>Cercartetus concinnus</i>	Western Pygmy Possum	-	PA	X		
<i>Felis catus</i>	House Cat	-	I	X		
<i>Macropus fuliginosus</i>	Western Grey Kangaroo	-	PA	X		
<i>Oryctolagus cuniculus</i>	European Rabbit	-	I	X		
<i>Vulpes</i>	Fox	-	I	X		

*Notes:

South Australian *National Parks and Wildlife Act 1972*:

En – endangered, Vu – vulnerable, R – rare, PA – protected animal, UA – unprotected animal; I – introduced species

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* listing:

E – endangered, V – vulnerable, M – migratory, LM – listed marine, NL – not listed

2.11 Topsoil and sub-soil

The Campoona Shaft is located in the Mount Desperate Environmental Associations (EA) as defined by Laut *et al.* (1977). This EA is defined by hills on metasediments with short footslopes and fans.

Underlying the soils, the geology as described by the Geological Survey of South Australia Department of Primary Industries and Resources SA's 1:100,000 Verran geological map shows the Campoona project area lying within the area comprising the Quaternary Pooraka formation. This formation is described as colluvial and fluvial dark brown and mottled green gravelly clay, silt and clay. There are areas of the Proterozoic Lower Middleback Jaspilite which is a quartz veined grunerite schist banded with diopside-amphibolite quartzite with variable magnetite content and graphite quartzite. This geology is the target area for the graphite mine. These are within the Middleback subgroup of the Hutchinson formation. Sugarloaf and the Pindari pipeline and bore area within the extent of the 1:100,000 Kimba geological map. This map indicates the Project sites are in the area described as having Quaternary yellow-orange quartz sand and clayey sand overlying the Pooraka formation and area of the Lower Middleback Jaspilite. Geology is further described in Section 3.2.1.



The topsoil at Campoona Shaft is extremely thin (~ 0.5 – 1.0m) and consists of freely draining sandy loam. This material will be removed by scrapers and stockpiled for progressive rehabilitation purposes (Figure 2-27).



Figure 2-27: Topsoil at ML Campoona Shaft

Below the topsoil at Campoona Shaft is a thin (~5 m) clay-rich, highly graphitic zone, which passes into highly weathered, porous quartz + graphite + kaolin + tourmaline ± iron oxides (goethite and hematite). All feldspar has been converted to kaolin ± illite. Thin clay-rich zones occur; probably as cavity fill rather than discrete horizons.

Assay data from 64 drillcores at Campoona were provided by Pirie Resources. Gneiss was the dominant lithology (51%) followed by graphite (19%) and schist (4%). The schist recorded a median value of 0.21% Sulphur, which is 0.01% higher than the number adopted to indicate the presence of potentially acid forming (PAF) materials. Static testing concluded that the geological setting, sulphur contents and volumes of materials on site, the likelihood of acid and metalliferous drainage (AMD) is low. Further, the drainage quality from the site is likely to be non-acid metalliferous drainage. A conceptual acid and metalliferous drainage management plan discusses management measures (Appendix O). The Sugarloaf site is located in the Cleve EA. The area is characterised by gently sloping sandy plains and footslopes with some dunes. From the results of the borehole investigation it can be interpreted that there are two dominant material layers below the Sugarloaf site. Under the thin topsoil layer, there exists a sandy clay layer with a thickness of which varies across the site from 5 – 12 m. The sandy clay overlies weathered schist.

The land around the proposed pipeline between the Sugarloaf processing facility and Pindari bore runs through the Hambridge EA. This is an extensive area of linear dune fields with occasional inselbergs (isolated abruptly rising outcrops or ridges within flat or gently sloping plains). The pipeline leads into the Messenger EA at Pindari, characterised by an undulating plain and isolated dunes, with some narrow strike ranges on outcropping quartzite (Laut *et al.* 1977).



2.12 Heritage

Protection of indigenous and non-indigenous heritage is a core consideration in Project Development. This section provides an assessment of the potential for areas of heritage interest to exist in the Project location. The interests of the local peoples, the Barngarla who have a strong link to country are a key consideration in the assessment.

Past studies have shown that watercourses and topographic features such as prominent outcrops and hills are often of particular anthropological concern to Indigenous people. Sites that may be of non-indigenous heritage significance may include heritage buildings and remnant vegetation.

2.12.1 Legislative context

Legal protection of heritage sites is afforded under specific legislation both at the state and commonwealth level, as follows:

- *Aboriginal Heritage Act 1988* (State)
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth)
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
- *Native Title Act 1993* (Commonwealth)
- *Heritage Places Act 1993* (State)
- *Development Act 1993* (State).

2.12.2 Indigenous cultural heritage

Aboriginal tribes with different traditions, language and stories historically occupied different parts of the land. A study of the indigenous history and culture was completed for the Project area (Appendix H).

The study showed that there are no previously recorded sites of significance to Indigenous archaeology, anthropology, history or tradition in the project area and the majority of the project footprint has minimal predictive archaeological sensitivity. Some areas are predicted to have potentially higher sensitivity for undocumented sites. For example, watercourses and topographic features such as prominent outcrops and hills are more likely to be of particular interest to the local Barngarla people and thus the Campoona Hill and Sugarloaf Hill may be of significance. The uncleared or vegetated area of these features is outside the area of proposed disturbance by the Project.

Management plans under the PEPR for the project will include procedures to manage any unexpected discoveries that may occur during the project.

2.12.3 Non-indigenous cultural heritage

The European or non- Indigenous cultural heritage of the region was also assessed including searches of:

- Libraries archives and documentary materials.
- SA State Heritage Register.
- Register of the National Estate.
- Cleve District Council Development Plan and Plan amendment reports.
- Data obtained from the Australia Heritage Places Inventory (2011).

The history of the area shows the transition from traditionally owned land, to settlement and the emergence of pastoral and mining activities that continue on the Peninsula today.

No Heritage sites are within the Project sites and no additional locations were evident upon review of mapping for the area.



Four Heritage Sites are listed, and a further 20 are provided in a Danvers Architects publication (1987) that is referred to by the Cleve District Council for the broader area (Table 2-13).

Table 2-13: List of local and state heritage places in the Cleve District

	ID	Detail	Listing
1.	HSA16534	JC Darke Memorial & Grave, item has been digitised as it doesn't exist in a DCDB parcel	State
2.	HSA16535	Dwelling ('Yeldulknie Cottage'), Building footprint	State
3.	HSA16536	Yeldulknie Weir, Building footprint	State
4.	HSA16537	Sims Farm Homestead, Building footprint	State
5.	CLE:007	"Blackwood", house	Local
6.	CLE:005	"Railway Dam"	Local
7.	CLE:003	Cottage	Local
8.	CLE:004	Yadnarie Tank and Well	Local
9.	CLE:006	St John Lutheran Church	Local
10.	CLE:049	House	Local
11.	CLE:050	Ruin	Local
12.	CLE:009	Cottage	Local
13.	CLE:011	Darke Peak Primary School	Local
14.	CLE:012	Darke Peak Institute	Local
15.	CLE:008	"Sands of Carappee" cottage	Local
16.	CLE:001	"Poonaroo" homestead	Local
17.	CLE:002	Two monuments	Local
18.	CLE:014	Cleve Uniting Church	Local
19.	CLE:015	National Trust Museum	Local
20.	CLE:016	St Michael and All Angels Anglican Church	Local
21.	CLE:034	CWA Rooms	Local
22.	CLE:034	Cottage	Local
23.	CLE:048	Poonana Mine	Local
24.	CLE:038	"Windittie" cottage	Local

Management plans under the PEPR for the project will however include procedures to manage any unexpected discoveries that may occur such early European heritage places as related to early settlement, pastoral development and historic mining and water infrastructure.

2.12.4 Geological heritage

A search for these sites in the area using the online database indicated that there are no geological monuments/ Geological Heritage Sites within the project area. The closest site is Scapolite within the Hutchinson Group, which is located near Cowell, approximately 27 km south-east of the Campoona Shaft.

2.13 Proximity to conservation areas

The Hambridge and Hincks Conservation Parks occupy a large area and are located in the north western and south western part of the central Eyre Peninsula. Other smaller conservation parks are located in the Yeldulknie, Darke Peak and Rudall districts and are known as the Carappee and Rudall Conservation Parks. According to the Cleve Development Plan (2013), the desired character for the parks is to ensure their ongoing protection and conservation as significant environmental assets in the region.

2.13.1 Proximity to gazetted parks

Carappee Hill Conservation Park is the closest gazetted park to any of the project areas and is approximately 4 km from the proposed MPLs at Sugarloaf and Pindari (Figure 2-28).



2.13.2 Proximity to heritage agreement scheme areas

The closest Heritage Scheme Agreement (HA 569) to any of the project areas is adjacent to the Pindari pipeline alignment between Jamieson Tank Road and Carappee Hill Road.

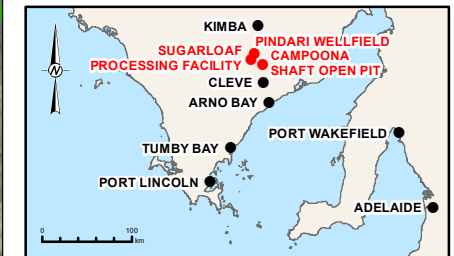
Another heritage agreement areas lies to the east of the eastern end of Jamieson Tank Road pipeline route (south of the road at Jamieson Tank, HA 877). The pipeline construction route will avoid these areas.



CAMPOONA PROJECT MINING LEASE PROPOSAL

HERITAGE AREAS – GAZETTED PARKS AND HERITAGE PLACES

LOCATION MAP



LEGEND

- Conservation Park
- Approximate Heritage Agreement Boundary
- Approximate Water MPL
- Approximate Sugarloaf MPL
- Campoona Mineral Claim Boundary

NOTES

- Township data sourced from MapInfo StreetPro.
- Conservation Park data sourced from DEWNR, Department of Environment, Water and Natural Resources, South Australian Government.

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REFERENCE SCALE: 1:225,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: BMC
APPROVED: LVC

**FIGURE
2.28**





2.14 Pre-existing site contamination and disturbance

A search request was made to the Environment Protection Authority under Section 7 of the *Land and Business (Sale and Conveyancing) Act 1994* for the following parcels of land:

Table 2-14: Section 7 requests

	Title Reference	Address
1.	CT Volume 5520 Folio 584	Section 8, 636 Carapsee Hill Road, JAMIESON SA 5640
2.	CT Volume 5934 Folio 679	Section 5, Carapsee Hill Road, JAMIESON SA 5640
3.	CT Volume 5828 Folio 505	Allotment 302, Carapsee Hill Road, JAMIESON SA 5640
4.	CT Volume 5828 Folio 501	Allotment 301 (F 178713), Carapsee Hill Road, JAMIESON SA 5640
5.	CT Volume 6112 Folio 331	Sections 28 & 30, 825 Jamieson Tank Road, CAMPOONA SA 5640

The search showed that none of the following are applicable to the above titles in relation to the *Environment Protection Act 1993*:

- **Enforcement orders:** Section 59 Environment performance agreement; Section 93 Environment Protection order; Section 99 Clean up order; Section 100 Clean up authorisation; Section 103H Site contamination assessment order; Section 103J Site remediation assessment order.
- **Notices:** Section 103N Notice of declaration of special management area (re site contamination); Section 103P Notation of site contamination audit report; Notice of prohibition of restriction on taking water affected by site contamination.
- **Licenses and exemptions:** Current or historic licence or exemption issued under Part 6 of the *Environment Protection Act 1993* or the repealed *Waste Management Act 1987* for a waste or recycling depot, activities producing listed waste or other prescribed activity.
- **Pollution and site contamination details and reports:** serious or material environmental harm including but not limited to section 83A notifications (threat or actual harm to underground water); environmental assessment report of a kind required to be recorded on the public register; site contamination audit report (including reports or audit terminations pre- 1 July 2009); Section 103E agreements or exclusions (site contamination); agreements or other details/reports for voluntary site contamination assessment (S 103I) or for voluntary site contamination remediation (S 103K); notification for commencement of site contamination audit (103Z(2)); records of waste deposition held by the former Waste Management Commission under repealed *Waste Management Act 1987*; and, reports prepared by SA Health Commissions under the repealed *South Australia Health Commission Act 1976*.

Copies of the letters of reply from the SA EPA in relation to the above information are included in Appendix I.

There is a potential for hazardous substances to have been used in the area as associated with general farm practice and chemical use, such as fuels and oils, fertilisers, herbicides and pesticides. Older farm buildings may contain hazardous building materials such as asbestos containing materials, lead based paints, mercury containing lights and synthetic mineral fibres. There are no chemicals stored and no naturally occurring hazardous materials known or expected to be present at the Project sites.

On the western side of Sugarloaf Hill is an onsite area used for deposition of disused farming equipment such as old sheets of iron, water tanks and general hard/inert waste. Given the slope of the land, the leading edge of the main dump is up to 30m high.



2.15 Traffic and transport

This section describes the current traffic in the area along with the traffic expected as a result of the construction and operation of the proposed mine and processing facility including access arrangements. A variety of existing background reports, traffic surveys, technical data and site visit observations were used for this study that was completed in July 2014 (Appendix J).

2.15.1 Roads

The local road network around the project sites includes the Elson-Campoona Road on which the Campoona Shaft will be located which runs west from the Kimba-Cleve Road. The Sugarloaf processing facility is accessible from Jamieson Tank Road, via the Kimba-Cleve Road or via Plane Road, Elson-Campoona Road then northward via Harris Road and Cut-Line Road (Figure 2-29). The Pindari Pipeline runs north from Jamieson Tank Road and then along Carappee Hill Road.



Figure 2-29: Road network adjacent to the Campoona and Sugarloaf project sites

The Kimba-Cleve Road is a sealed two-way arterial road managed by the Department of Planning Transport and Infrastructure (DPTI) and which carries around 180 vehicles each day. The road has approval for a DPTI 3A Performance Based Standard which allows approved vehicles including heavy vehicles which make up around 13 % of the traffic, up to 36.5 m road trains. The speed limit on this stretch of the Kimba-Cleve Road is 110 km/hr.

The Jamieson Tank Road is not sealed. It is a 6 m to 7 m wide two-way road with no speed limit posted and as such the default 100 km/hr limit would apply. Based on the likely use of the road, it is estimated that it would carry 50 vehicles each day. Jamieson Tank Road is managed by the District Council of Cleve (Figure 2-30).



Figure 2-30: Kimba-Cleve Road (L) and Jamieson Tank Road (R)

Elson-Campoona Road, Plane Road, Harris Road and Cut Line Road are also all unsealed and managed by the District Council of Cleve. These roads range from around 6 m to 9 m wide and are estimated to carry less than 50 vehicles per day based on surrounding land uses. There are no sign posted speed limits on these roads but the default rural speed limit of 100km/h would apply given the rural setting and unsealed nature of the road (Figure 2-31).

Each of these roads is permitted to carry up to 19.0 m General Access Vehicles (GAV), subject to road conditions. However, Restricted Access vehicles (RAV) are larger than GAV such as B-Doubles and DPTI approval is required for roads to carry RAVs. Of the roads surrounding the Project area, the Kimba-Cleve Road is approved for RAVs up to 53.5 m.



Figure 2-31: Elson Campoona Road (top L), Plane Road (top R), Harris Road (bottom L) and Cut Line Road (bottom R)



2.15.1.1 Traffic generation

To obtain sufficient product for the small-scale start-up phase of the operation (Years 1 – 3), a short-term excavation program at ML Campoona is envisaged (approximately one month), with minor site improvements at MPL Sugarloaf. The Sugarloaf site improvements are expected to include works within and adjacent to the existing shedding to install a modular processing facility capable of processing up to 10,000 tonnes of ore per annum.

The traffic generated by the improvements to the existing site and subsequent excavation at Campoona and transport for processing at Sugarloaf are expected to be minor.

For the fully-scaled construction and operation, limited traffic is also expected to be generated. During construction, there are expected to be a maximum of 50 people working on site at a time and during operation this will drop to around 10-20 staff (20 trips per day some personnel will share cars). Some deliveries may require oversize vehicles and applications for permits for these will be arranged as necessary.

The processing rates are expected to range as follows:

- up to 70,000 tpa (around 200 tonnes per day).
- up to 140,000 tpa (around 400 tonnes per day).

Once in production, the graphite ore will be transported by road between Campoona Shaft to Sugarloaf processing facility using B-Doubles and / or road train RAV vehicles:

- up to four two way trips per day for 70,000 tpa capacity.
- up to eight two way trips per day for 140,000 tpa capacity.

The estimated trips during construction and operation are shown in Table 2-15.

After processing, the product will be bagged in 20-25 kg dust proof bags or lined bulker bags. The packaged product will then be placed in a shipment container or pallet storage for subsequent transport to a port facility (most likely Port Adelaide). There is no dedicated port or shipping solution required for this Project.

Table 2-15: Predicted traffic at Campoona Shaft and Sugarloaf (Appendix J)

Site	Construction Trips per Day – Campoona (tpd)	Construction Trips per Day – Sugarloaf (tpd)	Operation Trips per Day – Both Sites (tpd)
Staff	40	60	20
Trucks	6	10	8
Delivery Vehicles	10	20	2
TOTAL	56	90	30

The staff would generate an extra 10 vehicles on the roads during the morning and afternoon peak hours. Operational vehicles would be expected to increase the local traffic by around 30 trips per day. This level of traffic is not expected to compromise the safe operation of the local road network based on predicted existing road volumes. The preferred route for this Project can be found in Table 2-16.



GRAPHITE PROJECT MLP AND MPS

Table 2-16: Preferred route

Roads	Paving	Length	Description	Additional requirements
Jamieson Tank Road	unsealed	8.2 km	Straight road providing good general visibility through predominantly farmland; there are no dwellings along the route until Sugarloaf itself. Width varies from 5m to 8 m, with vegetation encroaching in some areas due to low traffic and maintenance. Some undulating short steep crests and dips. Minimal road side vegetation. Although the road is unsealed the surface has reasonable rubble present. Sealed on the approach to Cleve-Kimba Rd.	RAV route approval of DPTI required Appropriate maintenance required for increased traffic volumes.
Cleve-Kimba Road	sealed	11.5 km	A number of bends between relatively flat straight sections. Haul trucks may need to reduce speed around some bends. There are several passing bays along the route.	No specific requirements.
Elson-Campoona Road	unsealed	1.9 km	Wide (one bend) and flat. Clay with minimal rubble and deep tyre ruts visible. This may cause issues in the wet. Native vegetation along the verges and a minor creek crossing (with floodway sign) between the site access point and the Kimba-Cleve Road. Upgrade may be required for all weather access. Relatively straight, 8 m.	Appropriate maintenance required for increased traffic volumes.

The Sugarloaf access track is straight with good visibility and a rocky surface which is in relatively good condition.

At full production the concentrated product (up to 10,000 tpa) will be bagged in 20-25 kg dust proof bags or in lined bulker bags and transported or placed into shipping containers and transported via road to Port Adelaide in GAV (or where necessary, up to B Doubles on approved roads) on average around once each day on weekdays (varying between two to six times per week depending on production capacity).

2.15.1.2 Road and traffic management

The *Unsealed Roads Manual – Guidelines to Good Practice* (2009 ARRB Group) provides criteria for functionality and maintenance of unsealed roads to ensure a robust and economic use of resources in unsealed road management.

The unsealed sections of routes identified in this report fall into Road Classification 4B which function is to be “for connection between local centres of population and links to the primary road network”. These roads would typically carry between 50 to 150 vehicles per day. Thus, not considering conditions of roads, the capacity envisaged for such roads is appropriate for the expected traffic. However, Jamieson Tank Road will be paved with a compacted gravel surface. Targeted geotechnical pavement investigations will confirm existing conditions and upgrade requirements. The Elson-Campoona Road to the Campoona mine entrance will be sealed or sheeted with coarse gravel by Pirie Resources if the graphite project proceeds. In addition, truck movements will also be restricted during school pick-up and drop-off times to minimise potential interactions with peak local traffic times and pedestrians.

2.15.2 Rail

The Cummins to Buckleboo railway line runs in a general north-south direction about 6 km west of the Campoona Shaft site. There is no requirement for rail access for the operation of the Campoona or Sugarloaf processing facility as the project will use road haulage for transport of the product to Port Adelaide.



2.15.3 Port

The Port of Adelaide is located approximately 540 km by road from the Sugarloaf processing facility, around 14 km from the Adelaide city centre. It is operated by Flinders ports and is the main service point for container shipping in SA.

In 2012 / 2013 10.37 million tonnes of a total 15.17 million tonnes of cargo handled through the Port of Adelaide was imported / exported to overseas markets. Overseas markets serviced by the Port of Adelaide include the Middle East, North Asia and South East Asia and imports are mainly received from the USA, North Asia and South East Asia. Mineral sands and Mineral Concentrates are among the export commodities already handled at the Port along with other commodities such as petroleum, livestock, vehicles, agricultural products and iron and steel.

The ship exchanges operate between 6 am and 2 pm, 2 pm and 10 pm and 10 pm and 6 am, with deliveries received between the hours of 6 am and 10 pm Monday to Friday (Flinders Ports not dated).

The small-scale start-up phase of the operation is expected to produce ~1,000 tonnes of product each year, bagged into 20-25 kg dust proof bags or into one tonne bulka bags and shipped to potential customers.

During full-scale production, packaged products are to be delivered to the Port of Adelaide on average around once per day on week days or less, for up to 200 deliveries (50 tonnes each) per annum (totalling 10,000 tpa) for over 13 years. Of the total cargo handled by the Port each year, this would represent an increase of less than 0.1%.



3.0 DESCRIPTION OF THE PROPOSED MINING OPERATIONS

3.1 General description of operations

Pirie Resources is proposing to mine graphite (and its derivative graphene) from the Campoona Shaft site located around 20 km north of the town of Cleve on the Eyre Peninsula. The total area of the Mining Lease for Campoona Shaft is approximately 68 ha. Pirie Resources has a binding Heads of Agreement covering the purchase of the land required at Campoona Shaft to accommodate the mining operation.

Pirie Resources owns the 561 ha Sugarloaf property which will host the Sugarloaf processing facility and the tailings storage facility (TSF; MPL Sugarloaf). Sugarloaf is located 15 kilometres to the northwest of the Campoona Shaft mine site. The processing facility and TSF will be covered by a 499 ha MPL within the greater Sugarloaf property (Figure 3-1).

Water for the project will be provided by a combination from the Pindari Wellfield and Jamieson Tank (MPL Water). There will be substantial recycling of water on site once processing activities commence.

The project criteria are provided in Table 3-1. The mine and associated infrastructure are described in the proceeding sections and layout plans are provided in Figure 3-1.

During the small-scale start-up phase of the operation mining will extract 10,000 tonnes of ore per annum to produce up to 1,000 tonnes of graphite concentrate. Part of this production will be used for ongoing product accreditation needed to secure a client base prior to full-scaled mining and processing. During the full-scaled stages, mining is planned to occur on a campaign basis during autumn and spring. Ore will be stockpiled and transported to MPL (Sugarloaf) for processing. The Sugarloaf mineral processing facility will operate on a continuous basis.

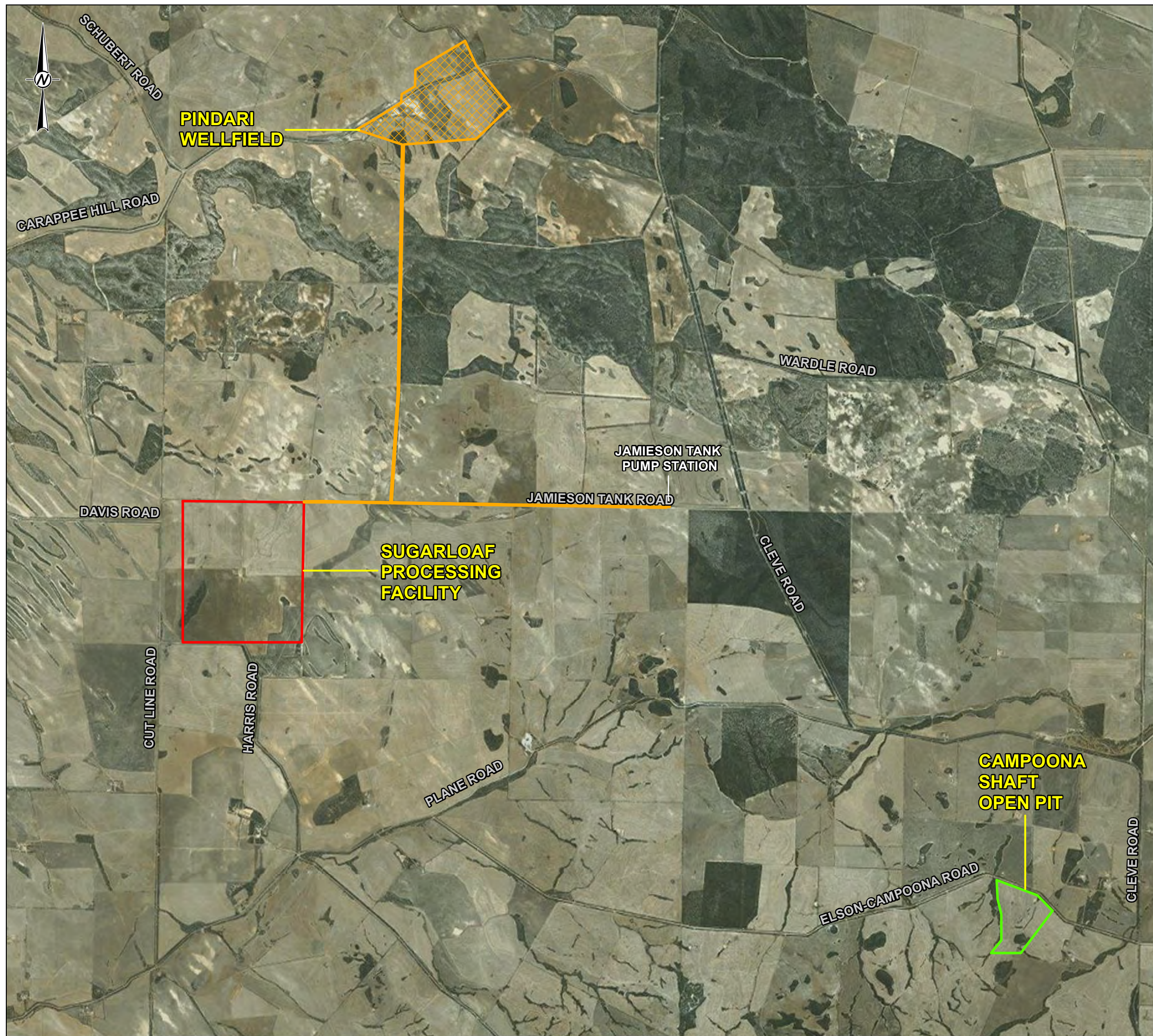
Table 3-1: Project outline

Item	Description
Location	Approximately 20 km north of Cleve, Eyre Peninsula, South Australia
<i>Campoona Shaft (ML Campoona Shaft)</i>	109 Elson-Campoona Road, Campoona CT 5414/498 Lot 18 Plan/Parcel H 530500/18 Primary Production Zone
<i>Sugarloaf Processing Facility (MPL Sugarloaf)</i>	825 Jamieson Tank Rd Campoona CT 6112/331 Lot 30 Plan/Parcel community plan 530500/30 Primary Production Zone
<i>Pindari Wellfield and Jamieson Tank (MPL Water)</i>	The wellfield is close to Ross Ramsay and Carappee Hill Road. Jamieson Tank is on Jamieson Tank Road.
Council Area	District Council of Cleve
Exploration licences	EL5804 Wildhorse plain – Campoona Shaft EL4861 Carappee Hill – Sugarloaf Hill EL5815 Waddikkee - Pindari
Mining stages	
<i>Small-scale start-up</i>	0 – 3 years to allow potential customers to test graphite and graphene and secure sales 10 kt graphite ore produced annually
<i>Stage 1</i>	4 – 6 years 2,008 kt graphite ore produced
<i>Stage 2</i>	7 – 11 years 5,320 kt graphite ore produced
<i>Stage 3</i>	12 – 16 years 2,972 kt graphite ore produced
Mining Lease area	
<i>ML Campoona Shaft</i>	68.9 ha



GRAPHITE PROJECT MLP AND MPS

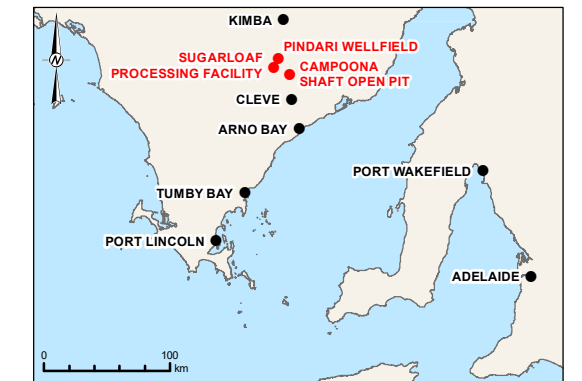
Item	Description
<i>Application MC 4393</i>	
Miscellaneous Purposes Licence areas	
<i>MPL Sugarloaf Application T 03006</i>	499 ha
<i>MPL Water Application T 03012</i>	241.1 ha
<i>Mining inventory</i>	1.65 Mt (Measured: 0.32 Mt; Indicated: 0.78 Mt; Inferred 0.55 Mt)
<i>Mine life</i>	16 years (assuming a small-scale start-up period of 3 years), to a pit depth of 100m
<i>Mining / Processing rate</i>	Initially 10,000tpa rising subject to securing sales to full scale production of 140,000 tpa
<i>Production</i>	Initially 1,000 tpa rising to 10,000 tpa graphite concentrate at full scale production (total 130 kt over life of mine). Initially up to 100tpa graphene rising to ~ 2,000tpa (or more) depending on market development
<i>Production method</i>	Crushing, milling, flotation, leaching screening, drying and bagging before transport
Small-scale start-up	
<i>ML Campoona Shaft</i>	One short campaign each year for less than one month involving an excavator and truck; daylight operations only
<i>MLP Sugarloaf</i>	Small-scale start-up may include staged processing
Tailings storage	During the small-scale start-up phase a mini-TSF will be built within the final TSF footprint and capable of storing up to 9,000tpa
<i>Electricity</i>	Initial electricity supplied from grid and augmented if needed with diesel generation
<i>Water</i>	Process water required is initially approximately 10 ML per year
Stage 1 – 3: Full-scale operation	
<i>ML Campoona Shaft</i>	Up to 3-4 month-long campaigns, twice per year nominally in autumn and/or spring during daytime hours (7am to 7pm), 6 days per week. Final pit depth will be 100 m.
<i>MLP Sugarloaf</i>	Full scale production operating a continuous 24 hrs, 7 days (haulage day shift only) operation
Tailings storage	Tailings rising to 130,000 tonnes per year at full production
Ore and Concentrate Haulage	- Route between mine and processing facility via Elson-Campoona Road, Kimba-Cleve Road and Jamieson Tank Road - Product to an appropriate Port, such as Port Adelaide, for distribution to market
Electricity transmission	- Connected with an extension to the existing 11 kV transmission line from the Darke Peak Water Treatment Facility, 2.6km to the Jamieson Tank-Cut Line Road intersection, then 800m south along the Cut Line Road to the Sugarloaf Processing facility access road and then 1.3km to the Sugarloaf processing site 132 kV single circuit overhead line between Whyalla and Port Lincoln, crossing Kimba-Cleve Road approximately 20 km from Sugarloaf - Alternative supply may be via diesel generators on site
Electricity demand at processing plant	At full production approximately 7,350 MWhr per annum at full scale production
Water sources	- Potable water from Jamieson Tank under agreement from SA Water (MPL Water) - Pindari wells providing high salinity process water (MPL Water) - Onsite rainwater - Recycled water from the TSF
Water requirements	Process water required is initially approximately 10 ML per year approximately rising to 100 ML per year water at full scale production rates with up to 40 ML of that coming from recovered decant water from the TSF on a seasonal basis
Workforce	- Construction: approximately 60 - Operation: approximately 18 miners, 15 operators and 6 supervising personnel
Capital expenditure	Capital cost of the project could vary and is dependent on product output. Capital estimates vary from \$10 million for 2,500 tpa output rising to \$36 million if output reaches 10,000 tpa. Small-scale start-up is expected to be achieved at a capital cost of < \$5 million.



CAMPOONA PROJECT
MINING LEASE PROPOSAL

**MINING LEASE FOR CAMPOONA
SHAFT AND MISCELLANEOUS
PURPOSES LICENCES LOCALITY**

LOCATION MAP



LEGEND

- Approximate Water MPL
- Approximate Sugarloaf MPL
- Campoona Mineral Claim Boundary

NOTES

- Township data sourced from MapInfo StreetPro.

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1. World Imagery - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 250 500 1,000 1,500 2,000
Metres

REFERENCE SCALE: 1:60,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

**FIGURE
3.1**





3.1.1 Elements of the proposed operation

3.1.1.1 Mining

The proposed ML for Campoona Shaft covers an area of approximately 68 ha for mining and stockpiling in the existing grazing and crop land. The open pit covers an area of approximately 10 ha.

The graphite deposit is approximately 20 m to 50 m wide, 600 m long and dips steeply to the west. The deposit has a thin veneer of soil cover usually less than 2 metres in thickness. The deposit has undergone complete oxidation to depths of approximately 60 m bgl meaning that mining to that depth will be largely free-dig. The deposit is open at depth and based on current graphite prices can be economically mined to depths of approximately 100 m bgl. Accordingly, the depth of pit will be 100 m bgl, although this could be extended under favourable economic circumstances.

The initial small-scale start-up phase of the operation would include stripping the topsoil (50 m × 25 m area) followed by an excavating of a 10 m deep trench. This would occur over a nominal four-week period, with the ore stockpiled adjacent to the trench, and material trucked to Sugarloaf to maintain a process ore stockpile of around 1,000 tonnes.

Full-scale mining is proposed to occur in campaigns during autumn and spring during daytime hours only, although processing will occur year round. It is expected that the pit will be conducted as a free dig operation as the rock is relatively soft, although becomes more competent with depth. Should blasting be required, it will be at a depth congruent with increasing competency of the mineralization (refer to Section 3.5.3) (estimated to be approximately 60 m bgl). Harder 'transition' rock may be encountered above this depth where blasting may also be required.

Overburden material will be stored adjacent to the pit in an eastern and western Waste Rock Storage Facility (WRSF) which will also provide amenity screening (refer to Section 3.5.7).

The mined graphite ore will be stored on the ROM stockpile at Campoona Shaft prior to being transported in B-Double trucks to the processing facility at MPL (Sugarloaf).

Further information on the operation of the mining activities is provided in Sections 3.4, 3.5 and 3.6.

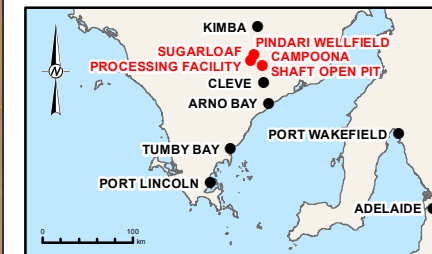
A mine site layout plan is shown in Figure 3-2 and concept of the benched open cut mine profile. The supporting mine site surface infrastructure is described in Section 3.10.



CAMPOONA PROJECT MINING LEASE PROPOSAL

MINE SITE LAYOUT

LOCATION MAP



NOTES

1. Township data sourced from MapInfo StreetPro.
2. Site plans sourced from AMC, 2015

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1. Aerial image sourced from Mapland, Department of Environment, Water and Natural Resources, South Australian Government.



REFERENCE SCALE: 1:7,500 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: AL
APPROVED: LVC

**FIGURE
3.2**





3.1.1.2 Processing

The small-scale start-up processing facility will be of modular design that would be largely constructed off-site and placed in position near the existing storage shed.

The processing facility layout plan and a conceptual diagram of the proposed processing plant layout for full scale production at Sugarloaf is provided in Figure 3-3. A detailed process chart showing the stages and equipment is provided in Section 3.8 and a diagram of process water flows Sugarloaf is also provided in Section 3.8.4.

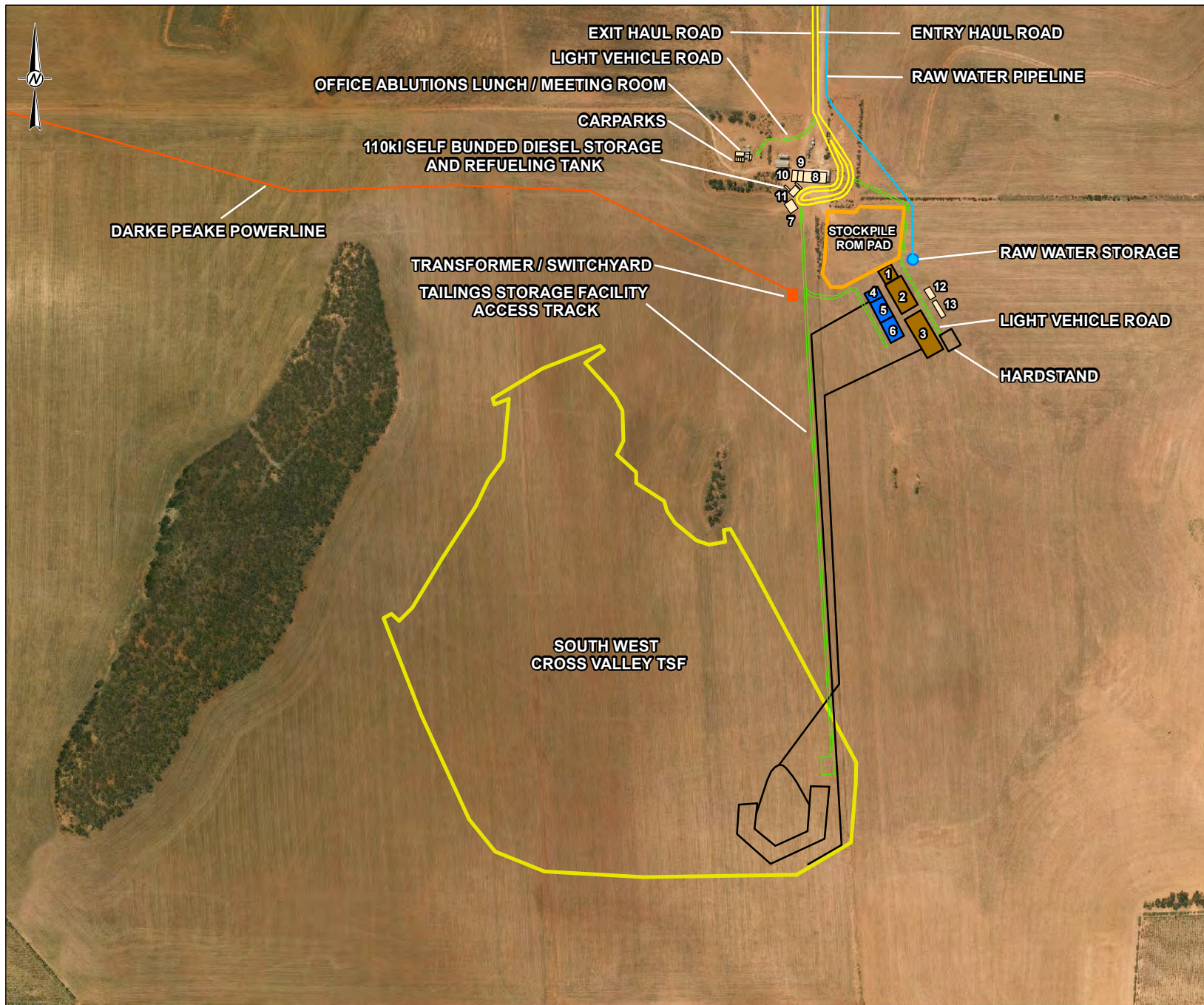
The graphite concentrate production process is summarised below:

- Reclaim plant feed from the blended ore stockpiled on the ROM stockpile.
- Feed the crushing circuit with tyre loader via a dump hopper. The double roller breaks the ore to (nominally) less than 32 mm.
- Water is added to the crushed ore to produce a slurry as part of the crushing and washing circuit; remove oversize materials.
- Transfer the slurry to the flotation circuit.
 - The first stage is a flash float to produce a concentrate that is directed to the milling and thence to cleaning cells
 - Roughing flotation units recover the majority of the graphite.
 - Scavenger flotation recovers further graphite from the rougher tailings.
 - The combined and densified coarse concentrate from the flash, rougher and scavenger flotation cells are passed through the concentrate mill and then to the cleaning circuits.
 - A multi-stage cleaning flotation process further removes gangue minerals from the concentrate. The tailings from the cleaners are redirected to the rougher feed.
- Concentrate and tailings are separately thickened to increase solid content. Sedimentation forms thick slurry, with recovered water flowing to the process water pond for recycling.
- The concentrate thickening process is followed by further densification and washing of the slurry in a centrifuge and then an acid leaching process to produce a greater purity graphite concentrate (refer Appendix K).
 - The thickened concentrate is processed in a centrifuge to reduce the moisture content to around 30%. Multi-stage thickening or decantation may be an alternative route for concentrate washing.
 - The solids are then repulped to achieve a solids content of around 22% using a leach liquor of weak hydrofluoric acid. The leachate train acid dosing will achieve a hydrofluoric acid (HF) concentration of around 8% prior to the reaction taking place. The acid increases recovery of graphite to produce a purer form.
 - The leach liquor and slurry are heated using immersion heaters to achieve a temperature of around 95°C and remain in tanks for a residence time of about 1-2 hours, and then the slurry is pumped to a heat exchanger using process water to cool to around 40°C.
 - Spent liquor is recycled to the leach feed repulp tank. Remaining acid in spent leach liquor is neutralised with limestone and/or lime before it is mixed with thickened flotation tails discharged to the TSF.
 - Vapours from the leach circuit are treated via scrubbers to capture, filter and clean vent gas by passing it through hydrated lime slurry, removing acid from the vapour and hence release to the atmosphere.



GRAPHITE PROJECT MLP AND MPS

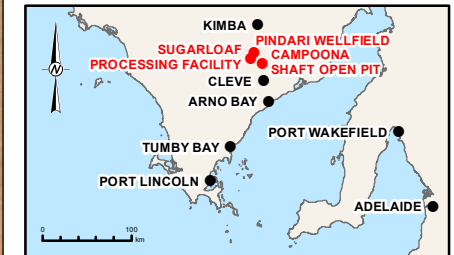
- Thickened tailings slurry and neutral leach discharge are mixed and directed to the TSF.
- The solids spread in thin layers within the TSF to form beaches, decant water is collected and the water is recycled to the process water pond.
- Following the leach process, the thickened concentrate is transferred to a centrifuge for washing and densification and then to dryers to remove the remaining water content.
- The graphite concentrate product is stored in silos for bagging and transport to market.
- The tailings are stored in the TSF where water is either returned to the processing facility or during the dry summer months evaporates.



CAMPOONA PROJECT MINING LEASE PROPOSAL

SUGARLOAF LAYOUT PLAN

LOCATION MAP



LEGEND

1 Crushing Plant	Existing Shed
2 Flotation Plant	8 warehouse and
Hardstand	Product Storage
3 Dewatering Plant	9 Workshop (LV
Hardstand	Workshop)
4 Sedimentation Pond	10 Emergency Vehicles
5 Stormwater Pond	11 Bunded Apron
6 Mill Pond	12 Plant Workshop
7 Reagent Store	13 Plant Laydown Yard

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Site plans sourced from AMC, 2015

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1. Aerial image sourced from Mapland, Department of Environment, Water and Natural Resources, South Australian Government.

0 25 50 100 150 200
Metres

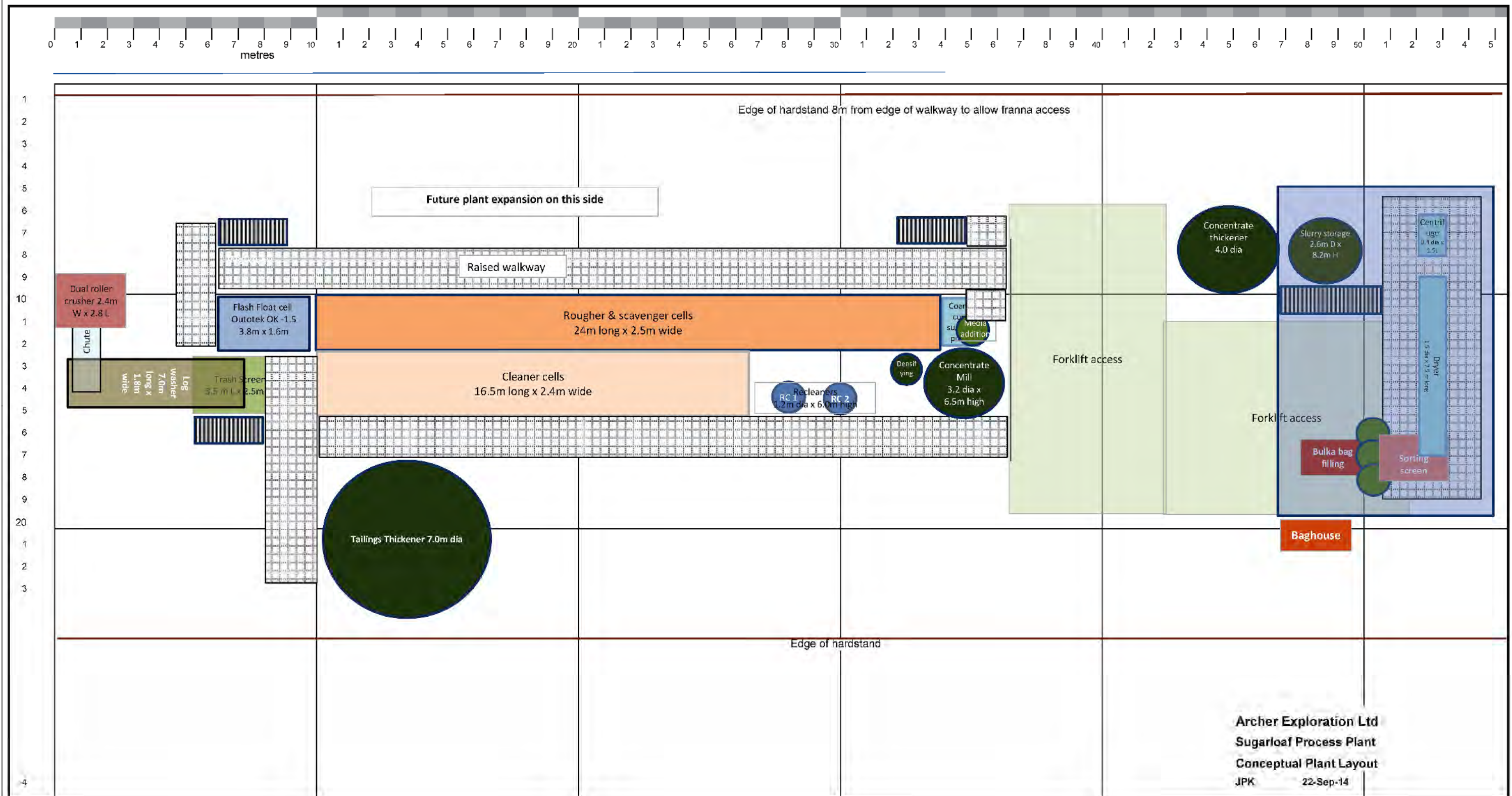
REFERENCE SCALE: 1:7,500 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: AL
APPROVED: LVC

**FIGURE
3.3**





CAMPOONA PROJECT
MINING LEASE PROPOSAL

**CONCEPTUAL PLAN OF
SUGARLOAF PLANT LAYOUT**

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: AL
APPROVED: LVC

**FIGURE
3.4**





3.1.1.3 Waste management

No overburden or internal waste rock is anticipated in Years 1 – 3 during the small-scale start-up phase of the operation. No noise attenuation is needed for the small-scale trenching program as trenching will be conducted mid-slope on the western side of the ridge where the ridge elevation will provide a natural noise attenuation barrier.

During full scale production benign overburden rock will be used to construct the WRSFs which will function as amenity screening mounds (refer to Section 3.9). Where suitable, overburden may also be used on site to construct the base to the ROM stockpile or other hardstand storage areas.

Process tailings will be stored in the TSF located at the Sugarloaf site (refer to section 3.9.2).

Other wastes expected to be generated during operation are managed as described in Section 3.9.3.

3.2 Reserves, products and markets

3.2.1 Geological environment

3.2.1.1 Geology of the area

A hydrogeological report completed for the project from which information in this section is drawn is provided in Appendix D. The Eyre Peninsula's basement geology has rocks belonging to the Gawler Craton province under the much younger sedimentary material in basins and thin sheet deposits. The geology and structure of the basement formations, along with erosion, has resulted in the formation of hills and gullies/valleys of the Cleve Uplands. The fault lines near Cowell (observable at the surface by prominent fault scarps) divide the hard basement rock in the Cleve Uplands from the Tertiary/Quaternary sedimentary basin on the Cowell flats. The Lincoln Fault defines the eastern edge of the broader upland area that includes the Cleve Hills and runs the length of the eastern coast of the Eyre Peninsula. The hills include the folded Lincoln Complex granitoids and the Hutchinson Group sediments which are some of the oldest exposed rocks on the Peninsula.

The age of the rocks on the Eyre Peninsula comprise predominantly Pre-Cambrian (2,700 to 2,300 million years ago (mya)) rocks overlain by Tertiary / Quaternary age sediments (34 to 0.01 mya). The oldest rocks on the Eyre Peninsula are located in the Project area (Cleve Uplands) and in the Lincoln Uplands, consisting of rocks belonging to the Sleaford Complex. Specifically, the Sleaford Complex has paragneisses, gneissic granites and granitic gneisses. These rocks are overlain by the Hutchison Group Metamorphics. The Hutchison Group consists of iron-bearing sedimentary layers that were metamorphosed into schists, quartzites, dolomites and jaspilites. The proto-gneisses are derived from mostly clastic marine sediments of Palaeoproterozoic age where methane (CH₄), possibly from sub-marine volcanic activity was encapsulated into the sediments from which the carbon component converted into crystalline graphite as a result of upper amphibolite-facies metamorphism.

Sediments from the Permian age (around 252 to 298 mya) and Jurassic age (around 145 to 201 mya) on the Eyre Peninsula are generally limited to the deeper sections of the Poldia Trough, west of the study area. However, sediments of this age have not been mapped at or near the study area. Younger Tertiary age sediments (around 2.58 to 66 mya) that overlie the fractured rock basement of the Gawler Craton and the Permian/Jurassic sediments are mostly fine-grained to gravelly fluvial sands (deposited by rivers and streams), interbedded with clay layers of various thicknesses. The Tertiary sediment cover ranges from a lateritised cover (red coloured residual soil rich in aluminium and iron) in the hills to thicker sedimentary layers in the lowlands. The Tertiary sediments are overlain by a thin layer (less than 5.0 m thick) of Quaternary calcareous sediments (around 0.005 to 2.58 mya) and include sand dune deposits, sand spreads and numerous calcrete (cemented carbonate) horizons. During a relatively recent arid period, large amounts of salt from the ocean along with calcareous fine dust including material containing boron minerals were blown in and accumulated in the landscape over time.



3.2.1.2 *The graphite deposit*

The Campoona Shaft graphite deposit extends along a 600 m north-easterly strike and dips steeply to the northwest. The graphite occurs beneath a thin veneer of topsoil, is around 20-50m thick and the overall vertical depth is at least 100 m, with no signs of thinning. The upper 5 m is a highly graphitic clay-rich weathered zone.

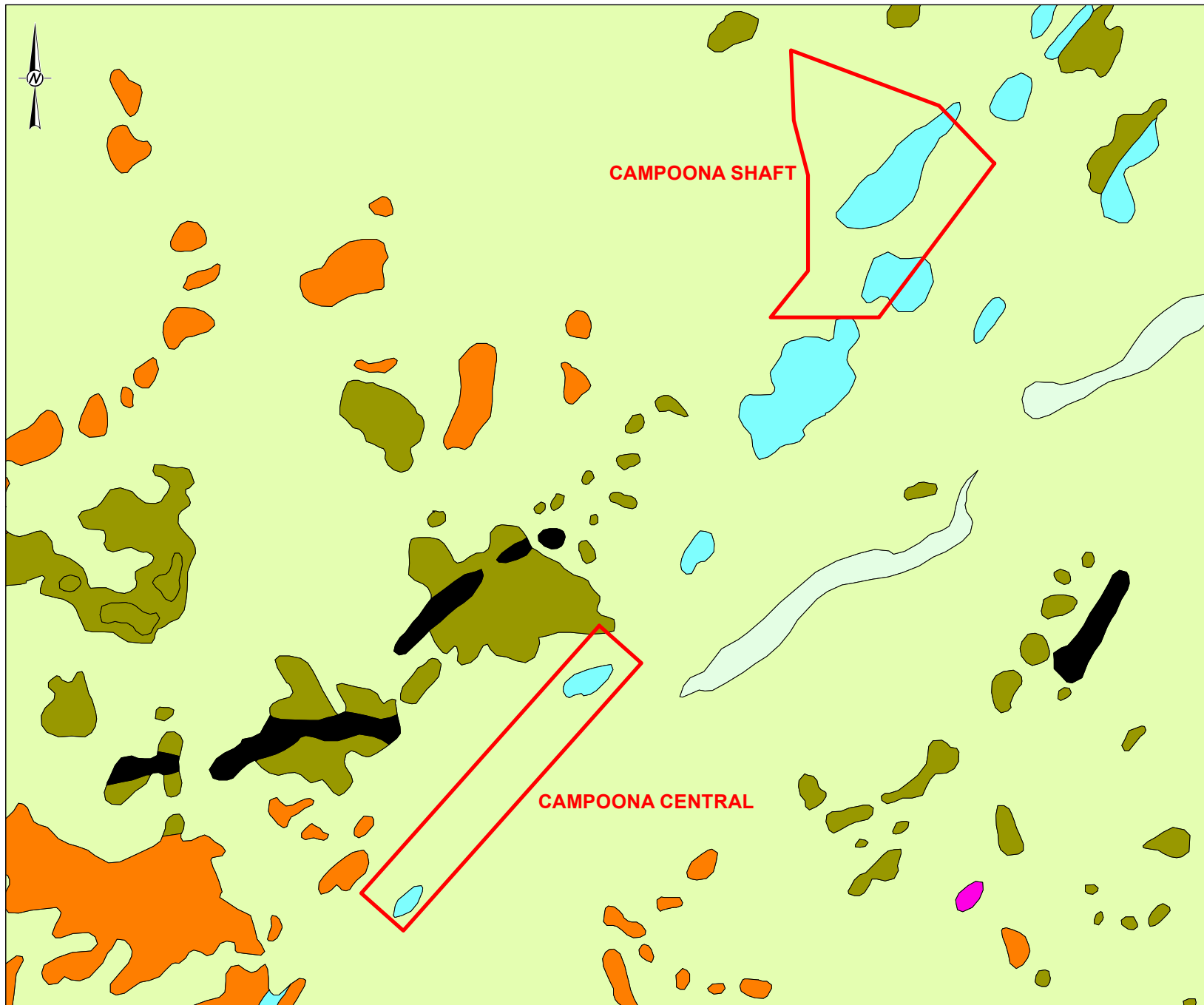
The greater Campoona graphite mineralisation occurs as discrete pods over some 6 km of strike. These pods, including Central Campoona, will be the subject of future ML applications.

3.2.1.3 *Composition of mined rock and overburden*

The graphite deposit found within the proposed ML Campoona Shaft are within the Mount Shannon Formation or Upper Middleback Jaspilite unit, which is part of the Hutchison Group (Figure 3-5). The graphite horizon is segmented due to cross faulting, which is often associated with amphibolite intrusions.

The highly graphitic zone passes into highly weathered, porous quartz, graphite, kaolin, tourmaline, and may also include iron oxides (goethite and hematite), where all feldspar has been converted to kaolin with or without illite. The graphitic schist becomes more competent with depth; however, strong weathering persists to at least 100 m bgl. Sulphide in the form of pyrite occurs irregularly in trace quantities and the likelihood of encountering potential acid forming material is low.

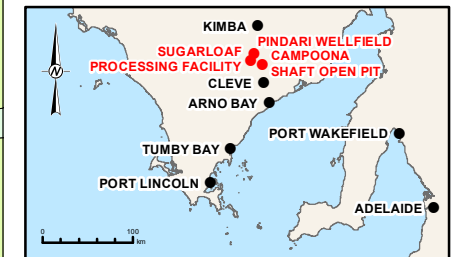
During mining there will be a program to test the trace quantities of sulphur when the mine depth reaches the base of total oxidation (60 m depth). This will be done by using blast holes in waste to geologically assess sulphur content ahead of mining. Should results indicate PAF, that waste material will be encapsulated in the W-WRSF. Conservative allowances for PAF encapsulation have been included in planning the design of the W-WRSF.



CAMPOONA PROJECT MINING LEASE PROPOSAL

GEOLOGICAL MAP OF THE REGION

LOCATION MAP



LEGEND

Qha1 - Fluvial gravelly clay, sand, silt and clay	Li - Lincoln Complex - Gneissic granite; granodiorite; adamellite. Veins of pegmatite and apilite
Qpap - POORAKA FORMATION: Colluvial and fluvial dark brown and mottled green gravelly silt, silt and clay	Liu - Upper Middleback Jaspilite - Jaspilite
Lhy1 - Quartz-sericite metasilstone; minor quartz-magnetite gneiss. Based on Prot-hyp on KIMBA	Lhw - Warrow Quartzite - Quartzite, massive, rarely cross-bedded, conglomeratic, pelitic; gneiss; nephrite
Lic - Cook Gap Schist - Schist, medium-grained, biotite-garnet-sillimanite quartzo-feldspathic, grading to gneiss, migmatized in high-grade area, locally graphitic	qz - Quartz veins/bodies, undifferentiated
Lik - Katunga Dolomite - Marble, white to pale grey, dolomitic, layered with serpentine, with calcite-diopside-tremolite banding	Tlhw/Lic - Cook Gap Schist - Schist, medium-grained, biotite-garnet-sillimanite quartzo-feldspathic, grading to gneiss, migmatized in high-grade area, locally graphitic

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Geology data sourced from PIRSA, South Australian Government.

0 100 200 400 600 800 1,000
Metres

REFERENCE SCALE: 1:25,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: AL
APPROVED: LVC

**FIGURE
3.5**





Figure 3-6 is a conceptual cross section showing a simplified geological profile across the Cleve Uplands. Figure 3-7 is a schematic of the geology of the Campoona Shaft resource.

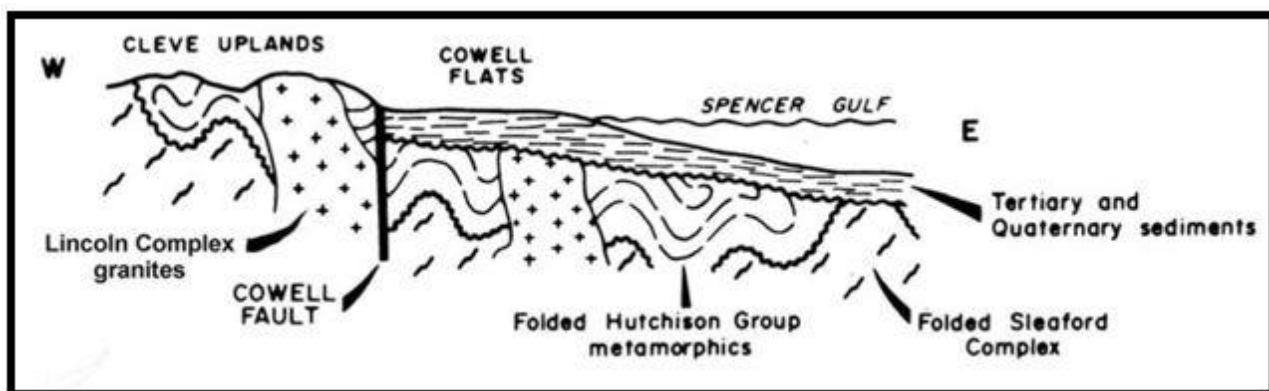


Figure 3-6: Geological cross-section of the Cleve Uplands (Twidale et al. 1985)

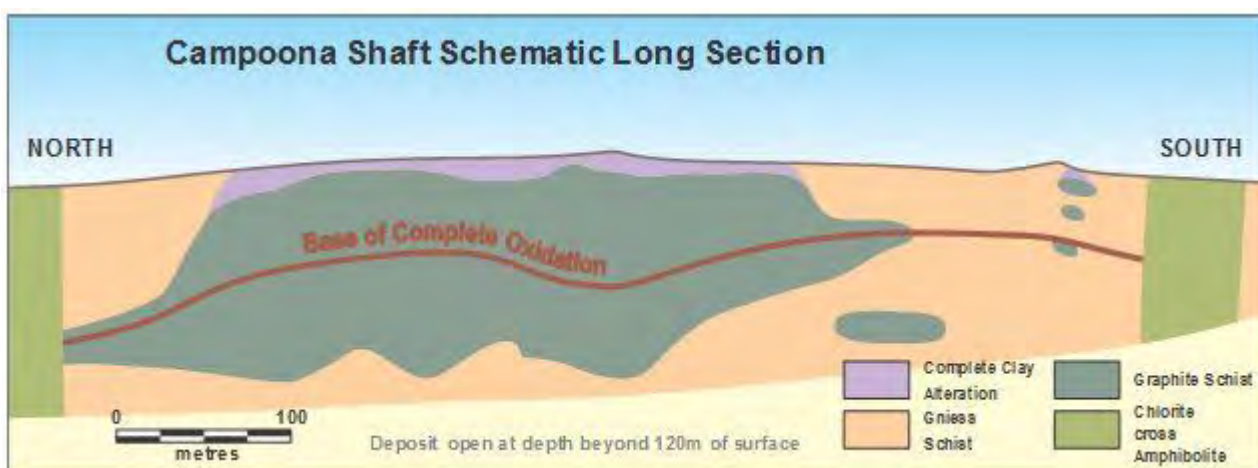


Figure 3-7: Campoona Shaft schematic of ore body geology

3.2.1.4 Pit optimisation and strip ratio

The following table describes the pit optimisation results and expected waste to ore ratios. Information from the geotechnical report provided in the Campoona Shaft Mine Plan (AMC 2015) was used – refer to Appendix L – to determine batter slopes and berm widths for the pit design. The pit was optimised using Whittle Four-X and the Lerchs-Grossmann algorithm to ascribe a value to each particular block of the Resource Model to determine if it could be economically mined. To produce the pit optimisation results, a range of base data as provided in the Mine Plan was also used to work out the maximum net present value. This occurred at pit shell 21. Pit 21 was selected for the design of the final stage pit and pits 6 and 15 were selected for intermediate design stages as they represent approximately 1/3 and 2/3 of the pit 21 life respectively.



Table 3-2: Mining production and pit optimisation summary

Pit Shell	Total Material Excavated (Mt)	Plant Feed (Mt)	Concentrate (kt)	Waste: Ore Ratio	Life (years)	Mine Production Rates			
						Mining kt/a	Waste kt/a	Process kt/a	Concentrate kt/a
4	0.26	0.17	15.3	0.57	1.66	156.7	56.7	100.0	9.3
6	1.07	0.45	42.8	1.41	4.04	265.7	155.4	110.3	1.6
9	1.88	0.67	64.1	1.80	5.67	332.3	213.5	118.8	11.3
11	2.55	0.82	78.1	2.11	6.75	378.3	256.6	121.7	11.6
15	4.43	1.25	113.3	2.55	9.83	450.8	323.9	126.9	11.5
21	8.74	1.78	161.8	3.90	13.69	638.4	508.1	130.2	11.8
24	9.54	1.88	169.6	4.08	14.36	664.0	533.3	130.7	11.8
26	10.99	2.06	183.7	4.34	15.65	702.5	571.0	131.5	11.7
29	12.26	2.16	192.9	4.67	16.39	748.1	616.2	131.9	11.8

3.2.1.5 Pit design

Five pit design scenarios were assessed based on the pit optimisation study (refer to Section 3.2.1.4 and Appendix L). The different scenarios look at varying slopes and ramp design requirements based on truck usage which affect the stripping ratio. It should be noted that the stripping ratio may change after the final design is completed due to changes in parameters such as graphite price, foreign exchange fluctuations and due to any operational modifications such as adding access ramps and the practical layout of the mine. The five designs were compared to the optimum pit shell 21. Subsequently, two redesigns with a single land ramp (12.5 m wide) were made and design SL3 selected as it focussing on the maximising the plant feed and offered a low stripping ratio of 4.66. The design comparisons are provided in Appendix L.

Design SL3 had the parameter settings as shown in Table 3-3.

Table 3-3: Selected design parameters

Parameter	Selected Design SL3	Parameter	Selected Design SL3
Rock	10,327,000 t	Bench height east (weathered, above 50m)	10 m
Plant feed	1,619,000 t	Bench height east (unweathered, below 50 m)	15 m
Waste	8,708,000 t	Bench height west (weathered, above 50m)	10 m
Stripping ratio	4.66	Bench height west (unweathered, below 50 m)	15 m
Concentrate	129,600 t	Berm width east (weathered, above 50m)	7 m
Revenue	(Note)	Berm width east (unweathered, below 50 m)	6 m
Mining cost	(Note)	Berm width west (weathered, above 50m)	7 m
Processing cost	(Note)	Berm width west (unweathered, below 50 m)	6 m
Benching	Double	Overall slope angle east (weathered, above 50m)	38°
Batter angle east (weathered, above 50m)	60°	Overall slope angle east (unweathered, below 50 m)	49°
Batter angle east (unweathered, below 50 m)	65°	Overall slope angle west (weathered, above 50m)	38°
Batter angle west (weathered, above 50m)	60°	Overall slope angle west (unweathered, below 50 m)	49°
Batter angle west (unweathered, below 50 m)	65°	Final pit depth	100 m
		CAPEX	\$36M

Note: commercial information redacted



The northern edge of the pit is designed to be 40 m from the Elson-Campoona Road to ensure a sufficient buffer whilst allowing for a side slope of 27°, which is below the natural angle of repose of loose rock of 38° in the oxidized zone and 49° for the transition and fresh zones of the mine, as assessed in the geotechnical study (Appendix L).

The ultimate pit size at the completion of mining is approximately:

- 600 m at the longest point
- 300 m at the widest point
- 100 m at the deepest point.

3.2.2 Resources

Pirie Resources proposes to mine graphite ore and process that ore to produce and sell graphite concentrates.

A number of graphite resources have been identified by Pirie Resources. The combined JORC 2012 Resources for Campoona Shaft, Central Campoona and Wilco South is 8.55 Mt @ 9.0 % Cg, providing 770,800 t of contained graphite (5% Cg lower cut-off)

Table 3-4 summarises the Campoona Shaft JORC Resource only as it is this Resource that is the subject of this MLP, shown 5% total graphitic carbon (TGC) lower cut-off grade.

Table 3-4: Campoona Shaft JORC resource

Resource Category	Tonnes (Mt)	Graphite (% TGC)	Contained Graphite (t)	Density (t/m ³)
5% TGC lower cut-off grade				
Measured	0.32	12.7	40,600	2.00
Indicated	0.78	8.2	64,00	2.08
Inferred	0.55	8.5	46,800	2.10
TOTAL (>5% TGC)	1.65	9.2	151,400	2.08

3.2.3 Production rate and products

3.2.3.1 Production rates

The raw graphite ore from the Campoona Shaft will be processed at the MPL Sugarloaf processing facility. Mining during the small-scale start-up operation will involve the mining of up to 10,000 tonnes of ore per year for up to three years.

Depending on marketing, production could eventually expand to 140,000 tpa. At full production capacity, nominally around 10,000 tpa of graphite concentrate product will be produced. Test work completed by Pirie Resources has consistently produced concentrates with >98.5% Cg (graphitic carbon).

Run-of-mine graphitic ore will be trucked from the Campoona Shaft site to the Sugarloaf processing facility. Graphite concentrate product will be transported from the site to market via the road network to a port most likely Port Adelaide due to its ability to handle containerised cargo.

Extractive minerals (as defined in the *Mining Act 1971*), will not form part of the materials/products leaving the site.

A summary of material movements is provided in Figure 3-8 below.

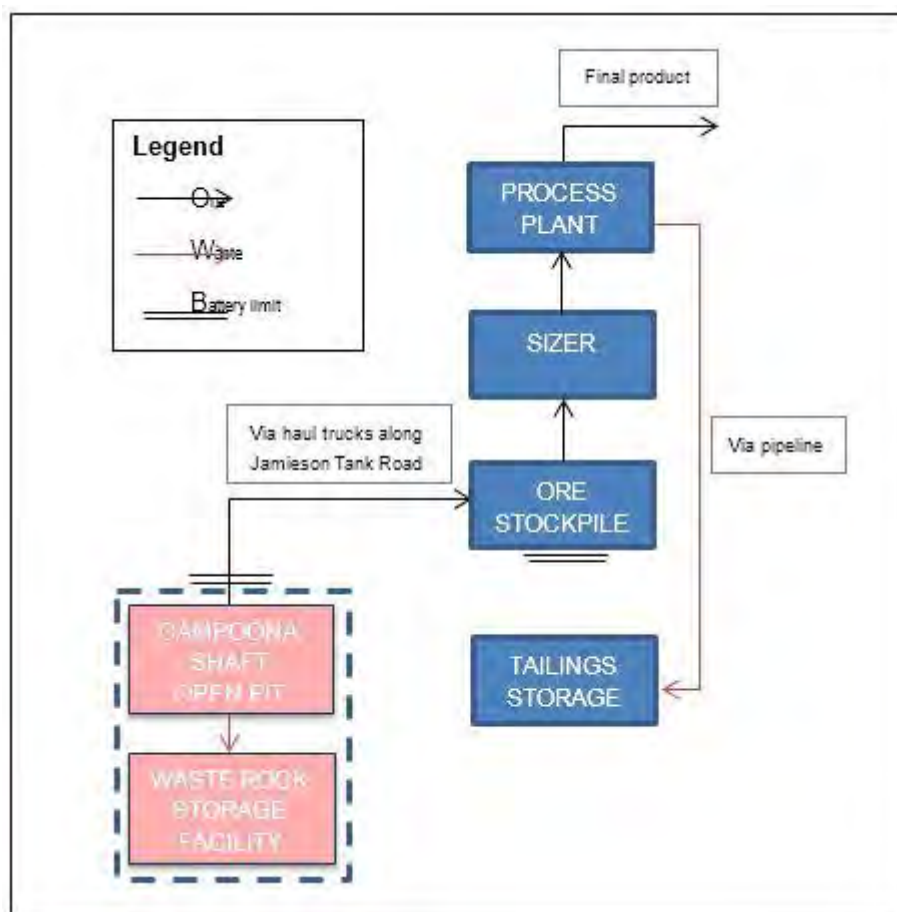


Figure 3-8: Material movements

3.2.3.2 Products

Graphite has a number of properties that make it attractive, in areas including the emerging green initiatives such as lithium-ion batteries, fuel cells, solar energy, semi-conductors, and nuclear energy (Figure 3-9). Graphite is also used in basic industrial applications and in high technology applications such as in mobile phones, cameras and laptop computers. Having energy storage applications, graphite can also be used in fuel cells at wastewater treatment plants and landfills to increase green energy by converting the methane into electricity, rather than emitting it into atmosphere.

On average, around 2 kg to 10 kg of graphite is used in hybrid vehicles and 25 kg to 50 kg in electric vehicles. Its strength and light weight, as well as natural lubricity make it a vital component for vehicle parts such as in gaskets, cylinder heads, clutches, brakes, exhaust systems and reinforced carbon fibre.

The ore is also suitable for making graphene, which is another valuable and versatile product. It is extremely thin and is 200 times stronger than steel. Graphene has a range of applications such as a highly efficient replacement for silicon in semi-conductors, in electronic devices and touch screens and LCD's, as an additive or coating to plastics to enable them to conduct electricity and for strengthening materials used for example in wind turbines and aircraft.

Pirie Resources has entered into a two-year research agreement with Adelaide University to focus on new product opportunities for Pirie Resources specific graphite/graphene agricultural and environmental remediation products with a view to commercialisation. Early work is showing promising "proof of concept" for agricultural applications.



The high end graphite product markets targeted include:

- Dry cell, alkaline and lithium-ion batteries
- Brake pads
- Carbon brushes
- Lubricants and greases
- Recarburation of steel (where the carbon graphite can be used to increase the carbon content to produce a hard, heat- and wear-resistant layer).

Graphene is one of the lightest and strongest materials with an ability to conduct heat and electricity better than other materials. Emerging applications include electronics, energy storage, paints, corrosion control and filtration (Figure 3-9).

3.3 Exploration activities

3.3.1 Existing exploration activities

To date, Pirie Resources' exploration drilling has focused on the Campoona Shaft graphite deposit with lesser drilling at Central Campoona (south of Campoona Shaft).

In 2012, Pirie Resources undertook an exploration drilling campaign at the Campoona Shaft. Most holes intersected significant graphite which occurs as intense graphitic schist. Drilling at Campoona Shaft has shown that the graphite is high grade with flake sizes averaging up to 100 microns.

Assessments to date show that the base of complete oxidation of the deposit is at approximately 60 m bgl. Below 60 m depth, the schists become progressively more competent but strong oxidation persists to at least 100 m depth.

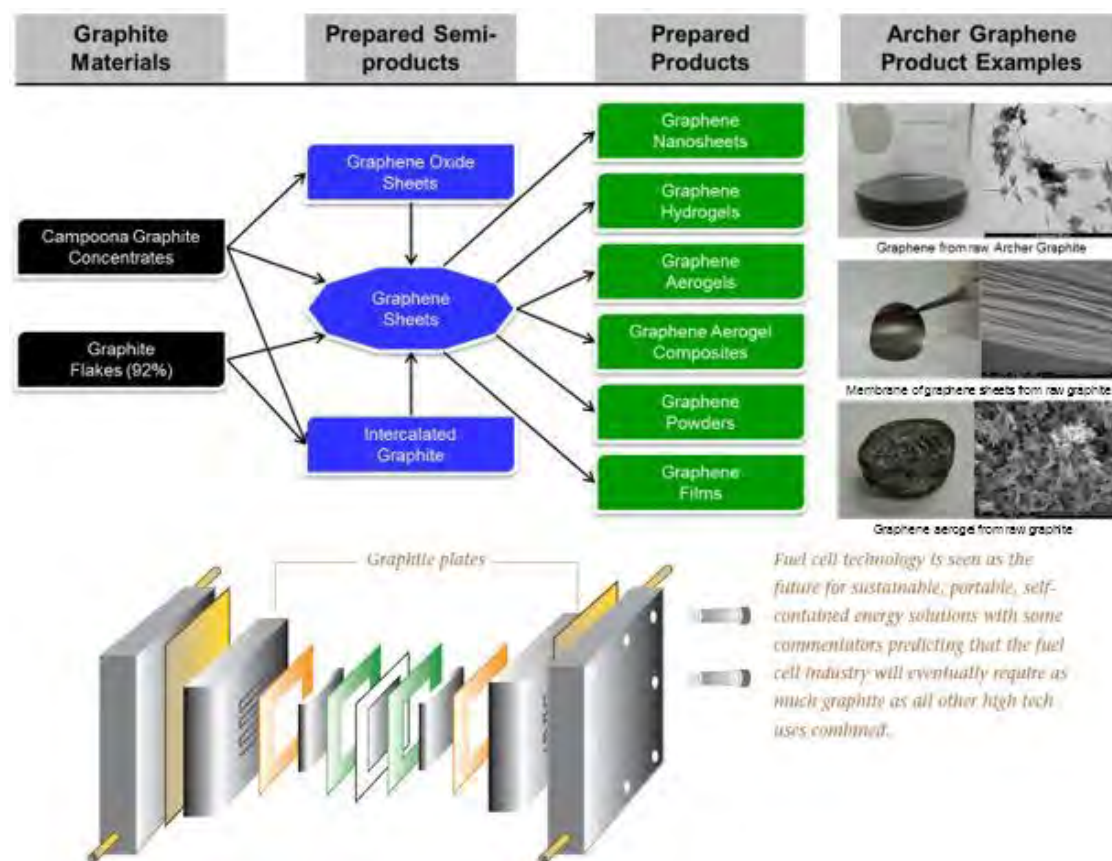


Figure 3-9: Graphite products



Table 3-5 shows results of initial petrology analysis of samples obtained from exploration drilling at Campoona Shaft.

Table 3-5: Petrology of Campoona Shaft drilling samples

Drill Hole ID	Depth Below Ground (m)	Flake Size Range (microns)	Average Flake Size (microns)	TGC (%)
CSRC12_006*	49-50	30-250	120	16.00
CSRC12_006*	52-53	30-300	185	15.90
CSRC12_007	28-29	30-200	100	0.15
CSRC12_007	72-73	30-300	120	16.90
CSRC12_007	84-85	30-350	180	13.40

Source: Archer AXE Graphite, Archer's exploration portfolio (n.d.) * The metallurgical evaluation of Drillhole CSRC12_006 samples showed that there was 93% TGC concentrate and 92% recovery rate.

3.3.2 Proposed exploration activities

No further exploration is planned at Campoona Shaft.

It is likely that Pirie Resources will continue exploration at Central Campoona under its existing exploration licenses. With historical drill holes and an underlying EM signature, Pirie Resources may further explore at Sugarloaf, however exploration is not considered in the foreseeable future.

Currently, the ore at Sugarloaf is being assessed for its ability to condition soils and improve the growth rate of cereal crops. No further material is required for testing, and as such, no management measures for exploration will be discussed. Should the circumstances for exploration at Sugarloaf change, Pirie Resources will apply for an Exploration Work Approval (EWA) and include specific management controls in the application.

The location of the TSF has been positioned so as to not sterilize the potential future resource (Figure 3-10).

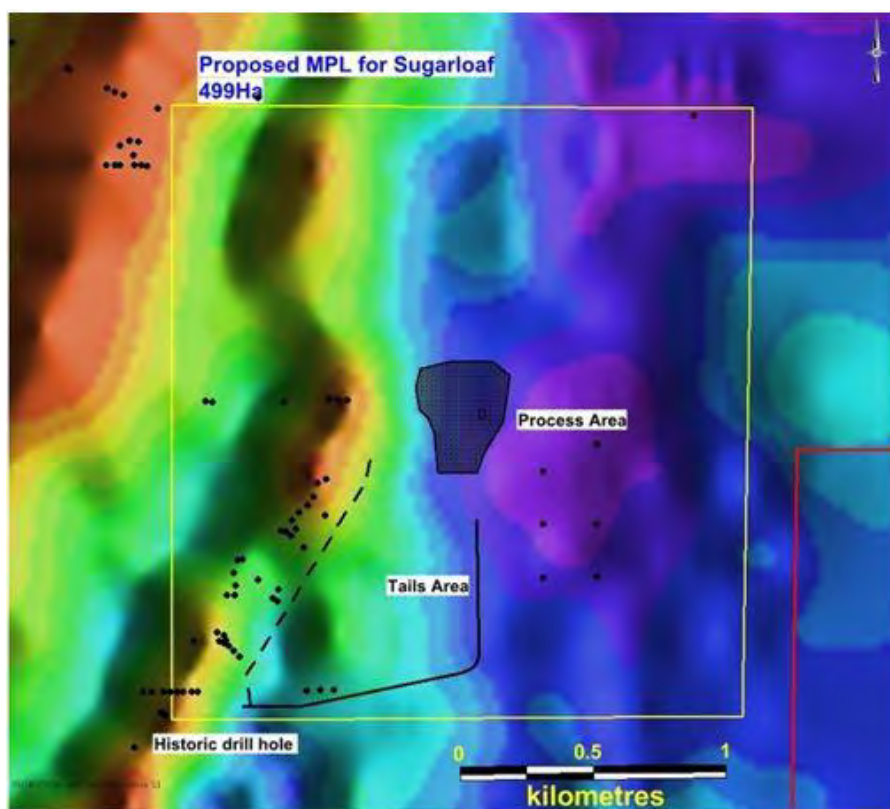


Figure 3-10: The EM signature and drill holes from Sugarloaf showing the position of the TSF and processing area



GRAPHITE PROJECT MLP AND MPS

Pirie Resources has also commenced exploration at Wilco South and has identified deposits near Sugarloaf (Carapsee Hill; Figure 3-11) the latter of which has an identified Exploration Target of 37-70 Mt grading of 10-12% total carbon. These form part of Pirie Resources' future exploration plans but are not part of the current proposed project (Figure 3-12).

Pirie Resources has acquired Waddikee EL5815 which lies to the north of Sugarloaf and which has a strong likelihood for resource growth, with around 20 km of conductive bodies identified by EM, including seven known graphite prospects (Figure 3-13). It is also likely that the current contained resource will grow appreciably with further drilling.

In addition to graphite deposits and prospects, Pirie Resources has a range of other exploration prospects in SA including magnesite, gold, copper and manganese.

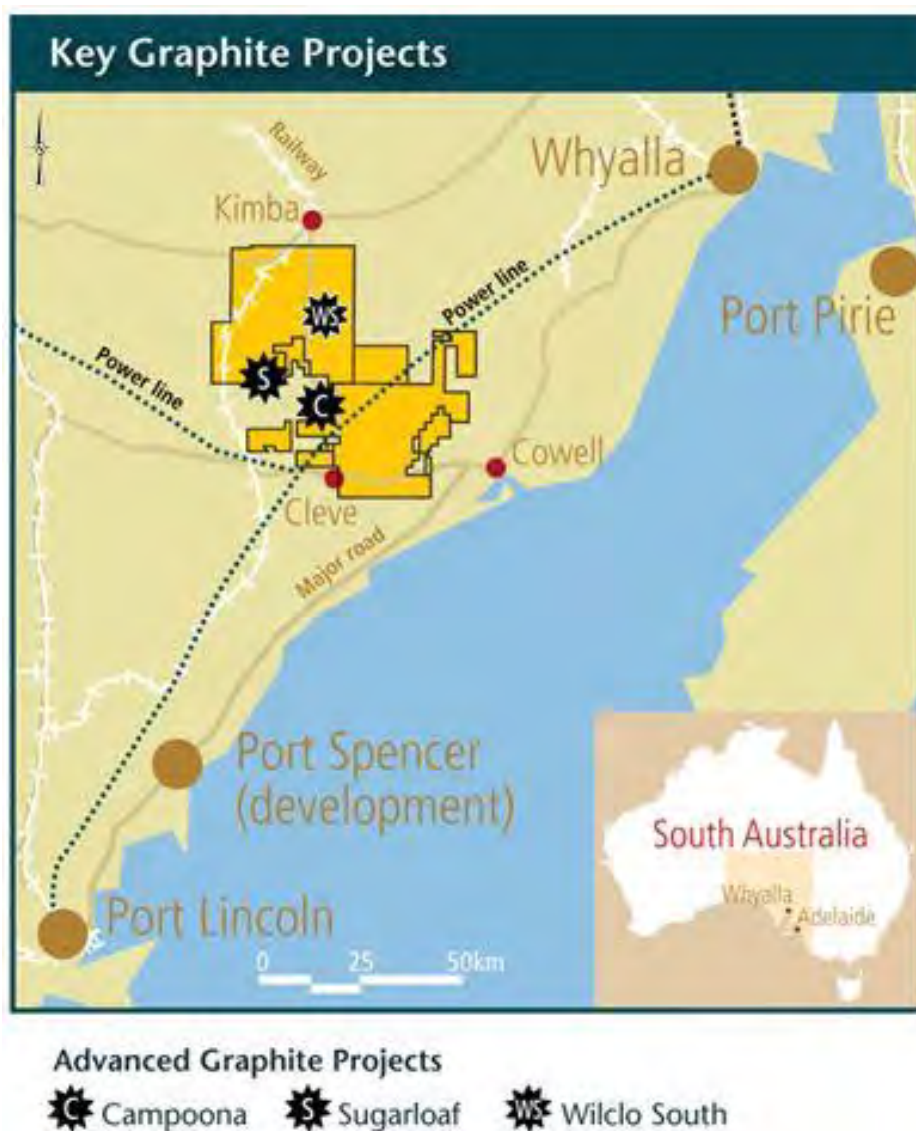


Figure 3-11: Graphite projects



GRAPHITE PROJECT MLP AND MPS

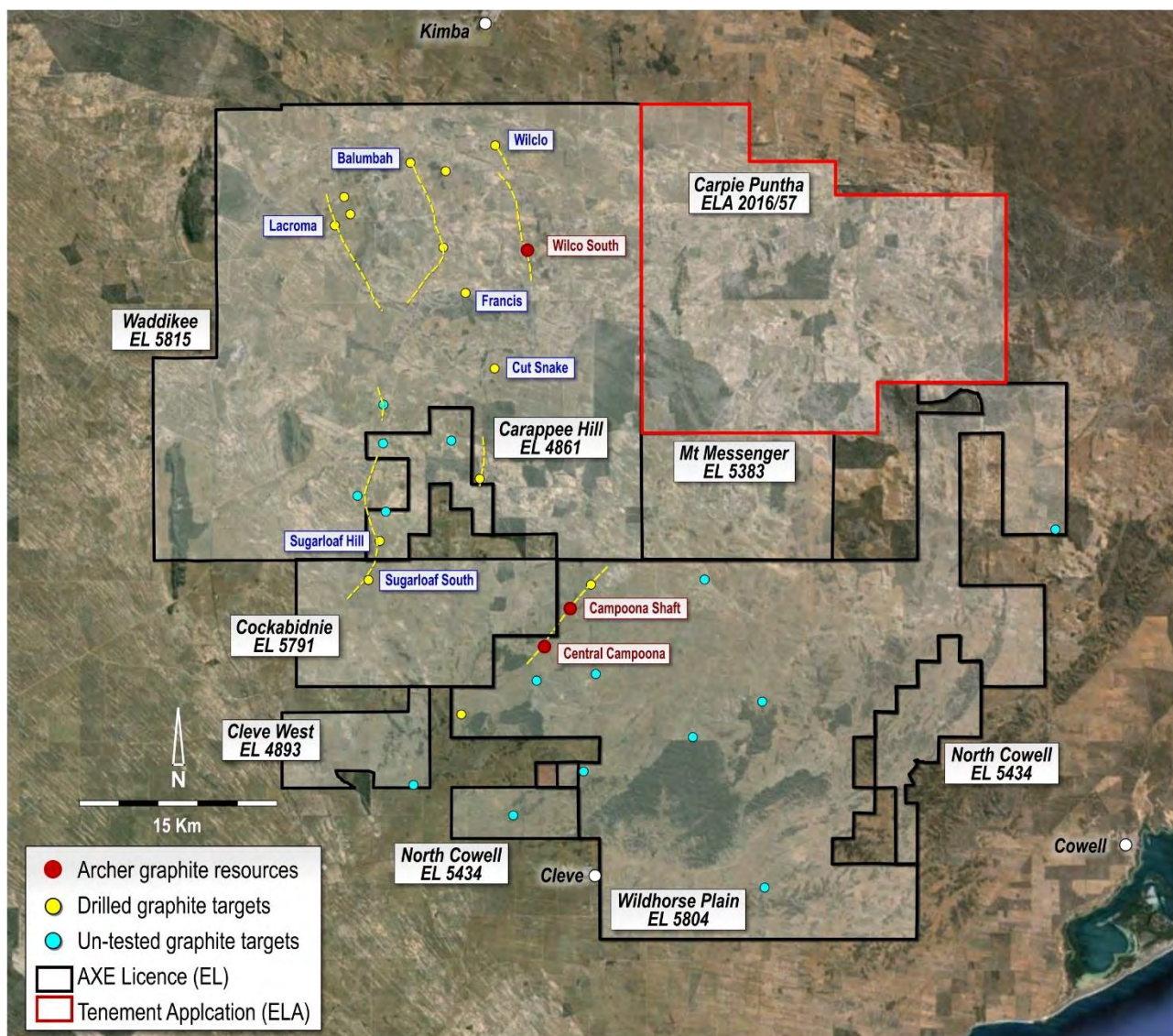
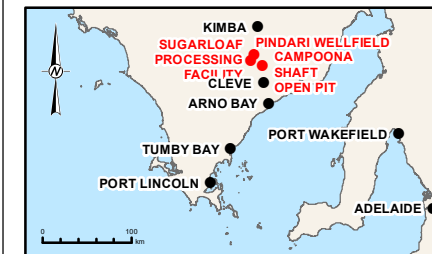


Figure 3-12: Resource locations

CAMPOONA PROJECT MINING LEASE PROPOSAL

WADDIKEE RESOURCE LOCATIONS AND ELECTROMAGNETIC RADIATION INDICATIONS

LOCATION MAP



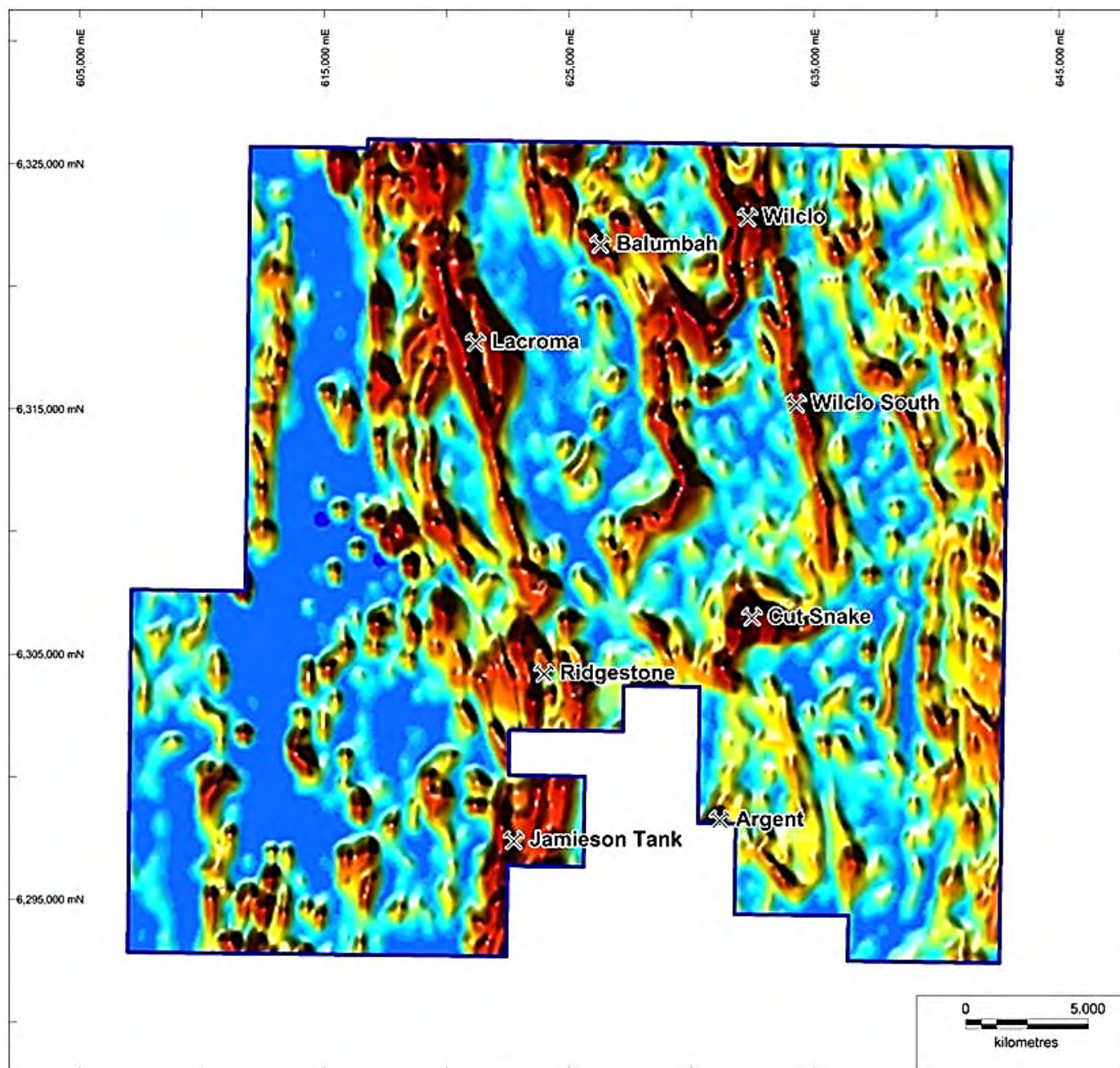
NOTES

1. Township data sourced from MapInfo StreetPro.
2. Base image sourced from Archer Exploration.

REFERENCE SCALE: NOT TO SCALE
PROJECTION: Not to Scale

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: AL
APPROVED: LVC

**FIGURE
3.13**





3.4 Mining plan

3.4.1 Types of mining operation to be carried out

The proposed ML pit will be an open cut benched mine to be developed using conventional trucks and excavators. It is anticipated that free digging techniques will be able to be used to the base of oxidation (around 60 m bgl). Below this depth, the material becomes progressively more competent and blasting may be required, and possibly shallower if harder 'transition' materials are encountered above this zone. It is expected that by the end of mining, the pit depth will reach 100 m and be 600 m in length and 300 m in width.

Mining is planned to occur in campaigns nominally in autumn (March to May) and spring (September to November). Excavated ore material will be stored at the Campoona mine shaft ROM stockpile with a capacity of 26 kt as well as a smaller ROM stockpile located at the Sugarloaf processing facility.

Mining campaigns may either be shortened or lengthened to ensure continuous supply of graphite ore for processing but will continue to be operated on a day-shift only basis six days per week. Processing (as described in Section 3.8) will utilise both physical and chemical beneficiation techniques to obtain high purity graphite concentrate averaging >98.5% TGC, including crushing, flotation, milling and leaching techniques.

3.4.2 Sequence of mining and progressive rehabilitation operations

The life of the Campoona shaft graphite mine is expected to be 16 years. The mining and rehabilitation schedules are based on three overlapping stages of mining, however Pirie Resources may accelerate mining stages if required:

- Small-scale start-up: nominally 1 – 3 years, with 10 ktpa of graphite ore excavated from a 10 m deep trench:
 - Graphite ore to be stockpiled adjacent to the trench and transported as needed to Sugarloaf for processing.
 - No waste rock is anticipated from this phase.
- Stage 1: nominally years 4-6, with a total of 2,008 kt of rock mined:
 - Overburden will be used to construct the eastern Waste Rock Storage Facility (E-WRSF; capacity of 1.72 Mt) first to act as a noise bund and amenity screen for the adjoining residents.
 - The E-WRSF will be battered and rehabilitated with vegetation progressively.
- Stage 2: nominally years 7-11, with a total of 5,320 kt of rock mined:
 - Overburden will be used to construct the western Waste Rock Storage Facility (W-WRSF) progressively built from the east to west enabling battering and rehabilitated with vegetation as it is constructed.
 - A PAF cell will be constructed within the W-WRSF, enabling encapsulation for the life of the project using waste rock generated through Stage 2 and Stage 3 of the project.
- Stage 3: nominally years 12-16, with a total of 2,972 kt of rock mined:
 - Overburden will be used to construct the southern end of the western Waste Rock Storage Facility (total capacity of 4.83 Mt) progressively built from the east to west enabling battering and rehabilitated with vegetation as it is constructed.

Topsoil will be stored in two stockpiles (TSSS-SP1 and TSSS-SP2) over the life of the project and used during rehabilitation. Topsoil will be borrowed from the footprints of the pit and WRSFs. These stockpiles will have a maximum height of 4 m and a slope angle of 35 degrees.



The WRSFs will be initially built with 35 degree sloping batter angles and 30.5 m wide berms. Once the finalise design for each stage is achieved, the batter angles will be reduced by dozer push to an angle of 20°, leaving 5m berms in between. Re-sloping will be conducted in conjunction with ongoing geotechnical and environmental monitoring to ensure that slope stability, sediment control and water quality objectives are met.

Revegetation of the plateau and the berms of the WRSFs will be undertaken as the areas become available and conditions allow after they are filled with waste rock, allowed to settle and are covered with topsoil. This will ensure that the minimum amount of ground is exposed at any one time thus reducing the potential for dust and erosion. The steeper slopes (>10 degrees) will be vegetated with local native vegetation species while plateaus will be re-spread with a mix of grasses and native vegetation to enhance their ability to be reused for either grazing or arable land.

Due to the nature of the steeply dipping orebody, the pit will progress mainly in a vertical direction. As such progressive rehabilitation of the pit will not be possible.

The pit stages are shown in figure 3-14, Figure 3-15 and figure 3-16. The initial trenching is not shown as it only occupies a very small portion of Pit Stage 1.

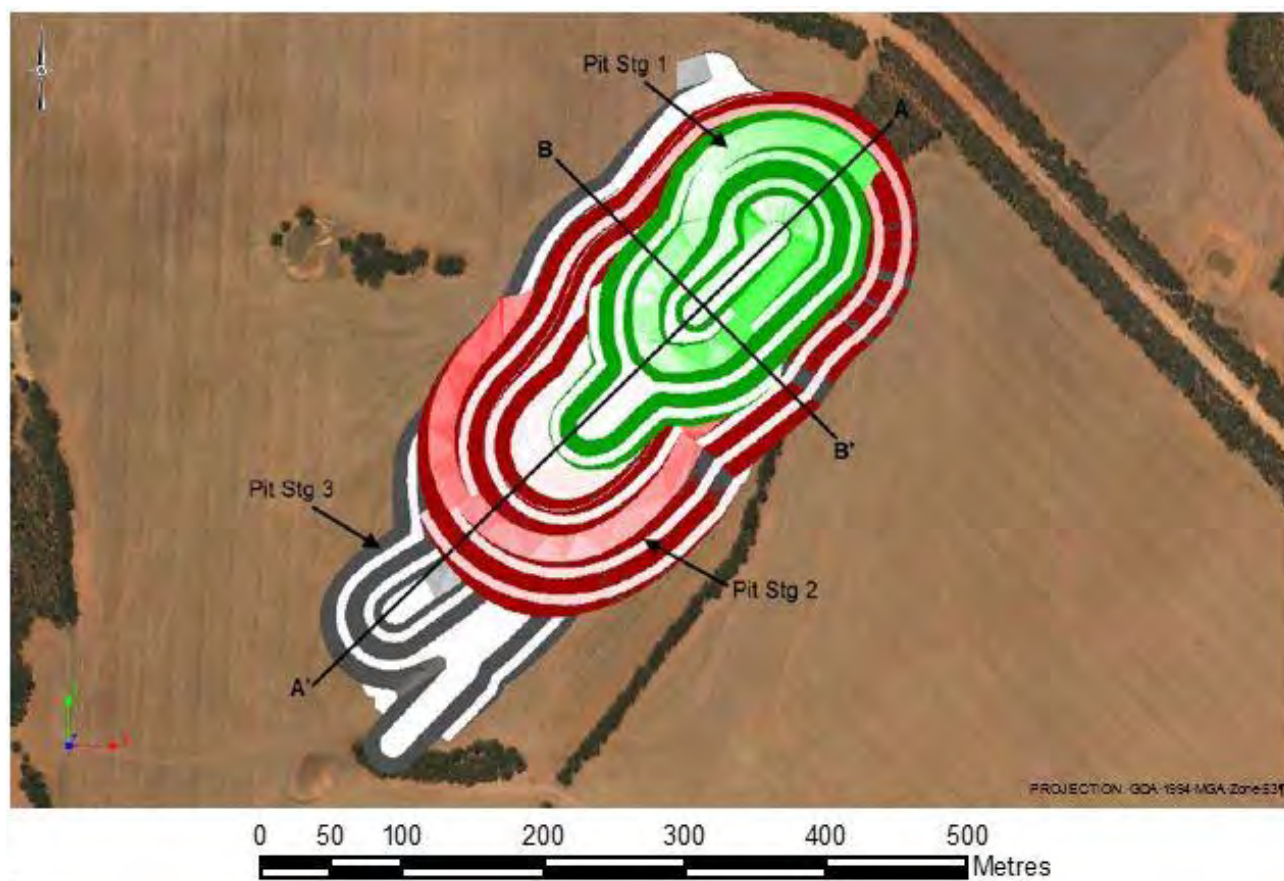


Figure 3-14: Plan view of Campoona Shaft pit stages during Year's 4- 16 (AMC 2015)



GRAPHITE PROJECT MLP AND MPS

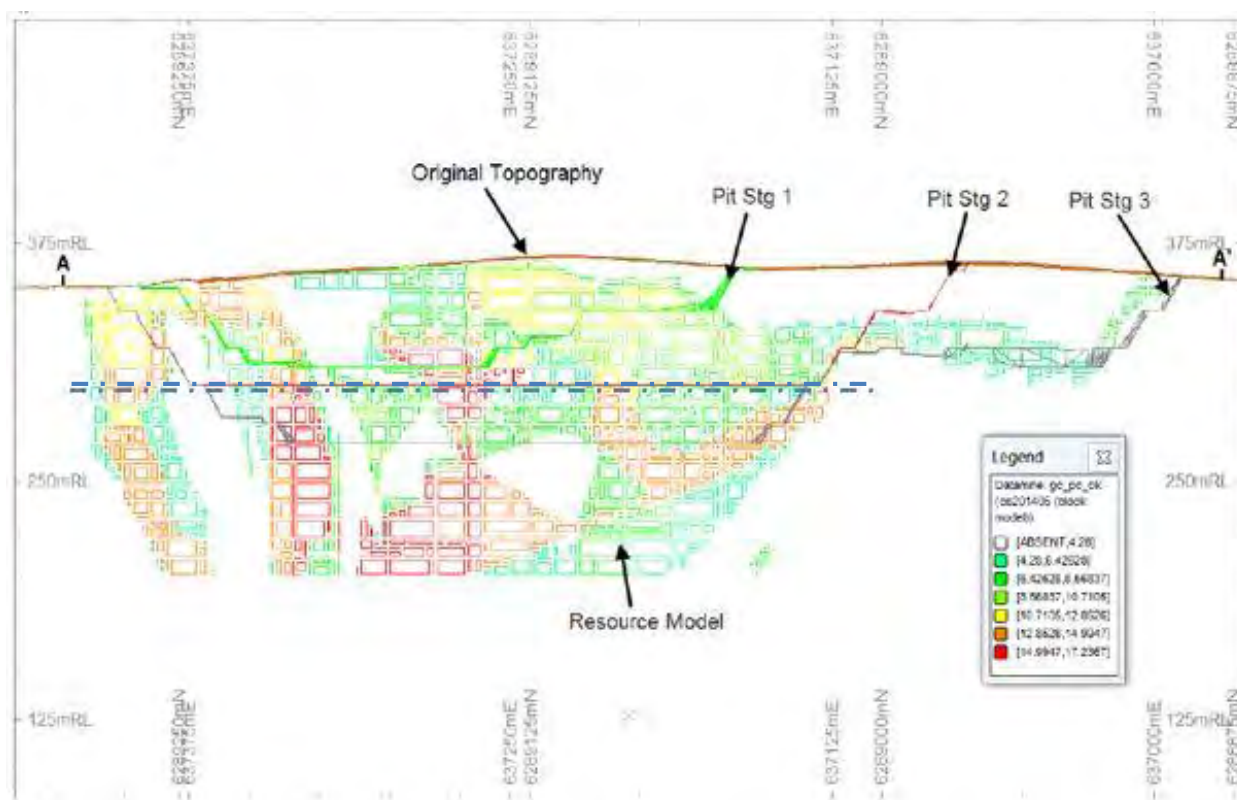


Figure 3-15: Campoona Shaft pit stages - long section looking South East (AMC 2015). The base of oxidation, inferred by Pirie Resources, is shown in a hashed blue line. Note - mRL are equivalent to AHD

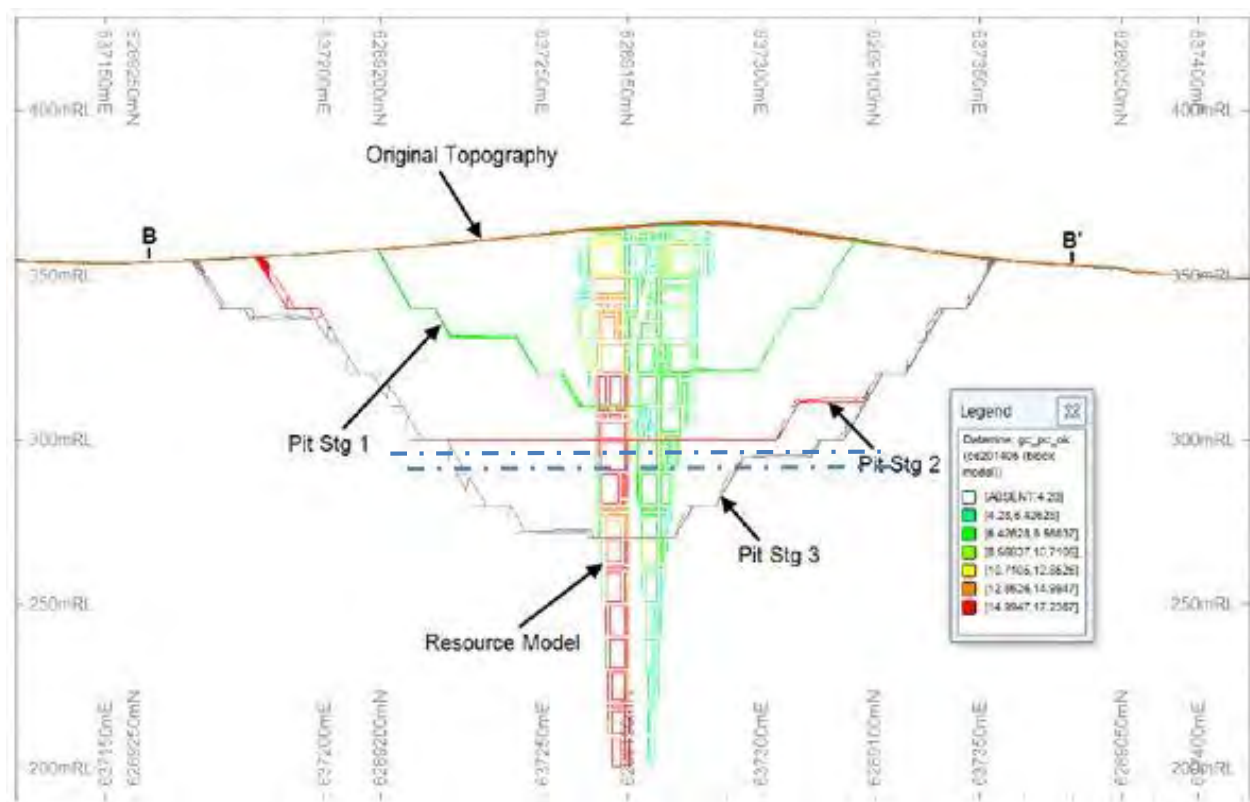


Figure 3-16: Campoona Shaft pit stages - cross section looking NE (AMC 2015). The base of oxidation, inferred by Pirie Resources, is shown in a hashed blue line. Note - mRL are equivalent to AHD



A detailed production schedule is provided in the mine plan in Appendix L and summarised in Table 3-6.

Table 3-6: Estimated production schedule

Stage	Bench (mRL)	Total Rock Mined (kt)	Total Plant Feed Mined (kt)	Years 0-3		Years 4-6		Years 7-11		Years 12-16	
				Rock	Plant Feed	Rock	Plant Feed	Rock	Plant Feed	Rock	Plant Feed
Trenching	370-360	30	30	0	30						
1	370-310	2,008	479			1,369	297	639	182	0	0
2	370-300	5,320	475			19	3	4,615	472	686	144
3	370-270	2,972	490			0	0	622	46	2,350	444
All	370-270	10,330	1,474		30	1,388	300	5,876	700	3,036	588

3.5 Mining operations at proposed ML Campoona Shaft

3.5.1 Modes and hours of operation

During the small-scale start-up phase the 10,000tpa of graphite ore will be excavated over some 4 weeks per year using minimal mining equipment consisting of one excavator and a truck working during daylight hours.

Due to the small scale nature of the whole operation, including Stages 1-3 which achieves full production of 140,000tpa, only discrete mining campaigns, around three months at a time during spring and autumn are required. This avoids the very dry summer months and wetter conditions of winter. Ore would be stockpiled at the Campoona Shaft mine site and transported to the processing plant at Sugarloaf throughout the year, including when the seasonal mining campaigns have been completed.

Mining activities at the Campoona Shaft are proposed to be carried out during daylight hours, nominally 7am – 7pm Monday to Saturday over the two campaigns. This equates to around 1,118 hours per annum.

Key factors that will influence mining campaigns include:

- Market conditions (economic risk factors).
- Wet winter weather (affects accessibility and road safety).
- Fire risk (safety risk) during summer.

At full scale production the tonnage expected for each campaign is between 35,000 and 75,000 tonnes to provide up to 140,000tpa of ore for processing to produce up 10,000 tonnes of graphite concentrate per annum.

The Campoona site will be actively managed throughout the year, including when the seasonal mining campaigns have been completed to:

- Transport ore to the processing facility.
- Undertake rehabilitation and environmental activities.

3.5.2 Mining workforce

Given the small size of the mining operation and the campaign nature of the operations, local mining contractors will be used to undertake the work on a contract basis. The mining workforce is proposed to use local resources where possible; no fly-in fly-out facilities are planned. At full scale operation, the estimated mining and haulage workforce will number up to 18 personnel. Further details on employment during construction and operation of the processing facility are provided in Section 3.11.1 and a discussion on employment is provided in 4.1.1.

Between 21 and 25 employees will be on site during operation of the full scale mine and a further 15 to 18 personnel associated with the processing plant and around 5 in administration tasks.



3.5.3 Use of explosives

The lithology at Campoona Shaft is relatively soft but becomes more competent with depth.

It is expected that for the target depth the use of free digging techniques will be suitable to approximately 60 m bgl. However, it is possible, that as the mine deepens or where harder 'transition' rock is encountered, explosives such as ANFO (ammonium nitrate 94%, fuel oil 6%) may be required. ANFO can be used as the pit will be dry during operation. The following is based on peak capacity and assumes weekly blasts once the pit reaches depths below 60 m when blasting might be necessary for excavation:

- 50 kt of rock broken per blast (24,200 m³).
- 146 holes on average per blast (127 mm diameter x 10.35 m long, drilled at 15 degrees from vertical).
- Powder Factor (the ratio of the mass of explosive in kg to volume of rock blasted in m³) of 0.52.
- 12.6 t of ANFO explosive per blast.

Where explosive use is required, guidelines for purchase, storage, carriage boxes, use, airblast overpressure noise and ground vibration will be followed. SafeWork SA is the responsible regulator for the use of explosives in South Australia.

A blast management and monitoring plan will be developed that details the frequency of blasting and to ensure that:

- All potentially affected residents will be notified in advance of the specific blasting times.
- A blasting exclusion zone will be enforced in consultation with all landholders (including the District Council of Cleve).
- Noise and vibration limits are not exceeded at sensitive receptors.

It is expected that for safety purposes, temporary road closures may be required for the duration of blasting activity plus up to 20 minutes before and after. As blasting will not be required in weathered rock, there is sufficient in-pit distance that estimates fly-rock risks do not encroach on private land (Appendix L) and no formal evacuations will be required.

Fly-rock risks will be managed through proper blast design, ensuring all designed parameters are followed strictly. This includes directing the blasting movement towards free faces and the middle of the pit and therefore away from the pit perimeter. As blasting is not expected until 60 m below the ground surface, additional buffer from fly rock is provided by the pit. Pit walls will be presplit to control blast energy. Stemming length and types with delayed timing will be in accordance with manufacturer's recommendations to avoid fly rock.

Additional appropriately trained and experienced specialist personnel would be brought in to manage any explosives related activities.

3.5.3.1 Magazine

Storage of explosives and accessories will be above ground approved and licensed steel or modular steel or concrete magazines including portable if required, meeting the requirement as set out in the AS 2187.1. These will be located to meet the requirements of Schedule T – *Tables of safety distance for magazines* in the *Explosives Regulations 1996* and AS 2187.1, including requirements for separation from specified protected and unprotected works, receptors and infrastructure. The confirmed location will be advised to the Chief Inspector (the Director under the *Explosives Act 1936*) as required.

The proposed magazine area is shown as part of the pit mining and infrastructure stages shown in figure 3-17, Figure 3-18 and Figure 3-19, adjacent to the West WRSF which will provide additional protection. In this location, up to 30,000 kg net explosive quantity could be stored based on required separation distances from Elson-Campoona Road. It is proposed that for the Campoona Shaft operation, that two small huts will be constructed for the magazine; one to store 300 detonators and accessories and another to store up to 300 boosters.



A two week supply of ammonium nitrate prill (22 t stored bulk bags) will be stored in a sheltered yard near the magazine.

3.5.4 Ore Stockpile and pad

At full production haul trucks will stockpile ore at the pad near the process plant before it enters the crushing circuit. Blended ore will be reclaimed from the stockpile via a front end loader, the pad has a nominal size of 80 m x 30 m and is comprised of a level hardstand, with a capacity to store 26 kt of material (12 kt stockpile on the tip head platform and two 7 kt stockpiles on each of two 'fingers').

A buffer stockpile with a capacity of around 10 kt will also be built on the northeast side of the pit. This buffer along with the main ROM stockpiles will be used as feed for the Sugarloaf processing facility between campaigns for which around 35 kt of material is required.

A stockpile cover or the use of sprinklers at the ROM will be considered to minimise losses to dust.

3.5.5 Type of equipment

The type and indicative numbers of equipment that is likely to be used at the proposed ML Campoona Shaft and MPLs at Sugarloaf and Pindari Wellfield is outlined in Table 3-7, noting general power tools and hand tools may also be used during construction activities.

Table 3-7: Indicative Campoona and Sugarloaf construction equipment

Equipment	Sound Power Level dB(A)	Campoona	Pindari Bore and Pipeline	Potential Ignition Sources
Bulldozers	113	1	1	Diesel
Excavators	109	1	1	Diesel
Haul Trucks	120	1	2	Diesel
Prime movers (B Double)	111	1	1	Diesel
Graders	110	1	1	Diesel
Front end loaders	113	1	1	Diesel
Compaction rollers	108	1	1	Diesel
Cranes	105	3	1	Electrics
Forklifts	106	1		Diesel
Concrete mixer trucks	109	1	1	Diesel
Generator	119	1	1	Diesel
Generator for welding	113	2	1	Diesel
Drill rigs	115	-	1	Diesel
Large side booms	-	-	2	

Potential ignition sources include exhaust from the vehicles listed above and in particular, welding operations and electrical equipment listed below for the operational phase. All vehicles, where possible, will operate via diesel fuel to minimise risks.

The main equipment that is likely to be used during operation of the works at the Campoona Mine (daytime only) is outlined in Table 3-8, noting general power tools and hand tools may also be used at times for maintenance purposes.



Table 3-8: Campoona operational equipment

Equipment	Sound Power Level dB(A)	Campoona	Potential Ignition Sources
100 kVA Diesel Genset, Enclosure with treated exhaust	112	1	Diesel
Excavator (70 tonne)	107	1	Diesel
Excavator (35 tonne)	105*	2	Diesel
Excavator (55 tonne)	106#	2	Diesel
Bulldozer	109	1	Diesel
Prime movers (B Double	111	2	Diesel
Haul / Dump truck (40 tonne)	105-107	3-5	Diesel
Front end loader	108	1	Diesel
Grader	110	1	Diesel
Water truck	105	1	Diesel
Drill rig (if needed for blasting)	115	2	Diesel
Work trucks	< 74 (< 80km / hr) [∞]	4	4

Source: * <http://s7d2.scene7.com/is/content/Caterpillar/C434911> accessed 23 April 2015.

<http://s7d2.scene7.com/is/content/Caterpillar/C434911> accessed 23 April 2015

∞ <http://www.motoring.com.au/reviews/2014/comparison/toyota/hilux/toyota-hilux-4wd-dual-cab-ute-comparison-2014-45228> accessed 23 April 2015

3.5.6 Mine dewatering

Based on the drilling conducted to date, it is not expected that any significant groundwater will be encountered and as such mine dewatering of groundwater will not be required. Of 64 holes drilled, 48 were greater than 50 m deep and of these only three encountered moisture at depth, which were all outside the mine area.

In rainfall events that may generate the potential for pooling, dewatering will be conducted using in-pit sumps and pumps to remove water from the pit.

3.5.7 Stockpiles

Waste Rock Storage Facility stockpiles are addressed in Section 3.9.1.

During full production the ore stockpile at Campoona Shaft will have capacity to store 26 kt of material. A tip head platform will have a 12 kt capacity in addition to two fingers each with a 7 kt capacity. These will be built by direct tip-head dumping from the tip head platform using mine trucks. A 10 kt buffer stockpile will be built near the end of a campaign to the NE of the pit

Each mine stockpile will be up to 4 m in height and will have slopes less than 35 degrees. The stockpile will be continually refreshed and utilised through the life of the mine. A drainage line with silt trap will be constructed around the stockpile to limit erosion and siltation runoff. Specific stabilisation control measures such as using a hydro mulch (or similar product) will be applied if they are not planned to be used or added to within 30 days.

An ore stockpile at Sugarloaf, will be built to store a maximum of around two week's feedstock supply at any one time.

Two soil stockpiles will be constructed for rehabilitation purposes. Soil stockpiles will be constructed using mining trucks. Soil stockpile will be no greater than 4 m in height and will have slopes less than 35°. Drainage will divert runoff to the east and west sumps located on the down gradient side of the waste rock storage facilities. These will be stabilised using a hydro mulch (or similar product) if they are not planned to be used or added to within 30 days.

The pit stages and associated infrastructure are shown in Figure 3-17, Figure 3-18 and Figure 3-19.



GRAPHITE PROJECT MLP AND MPS

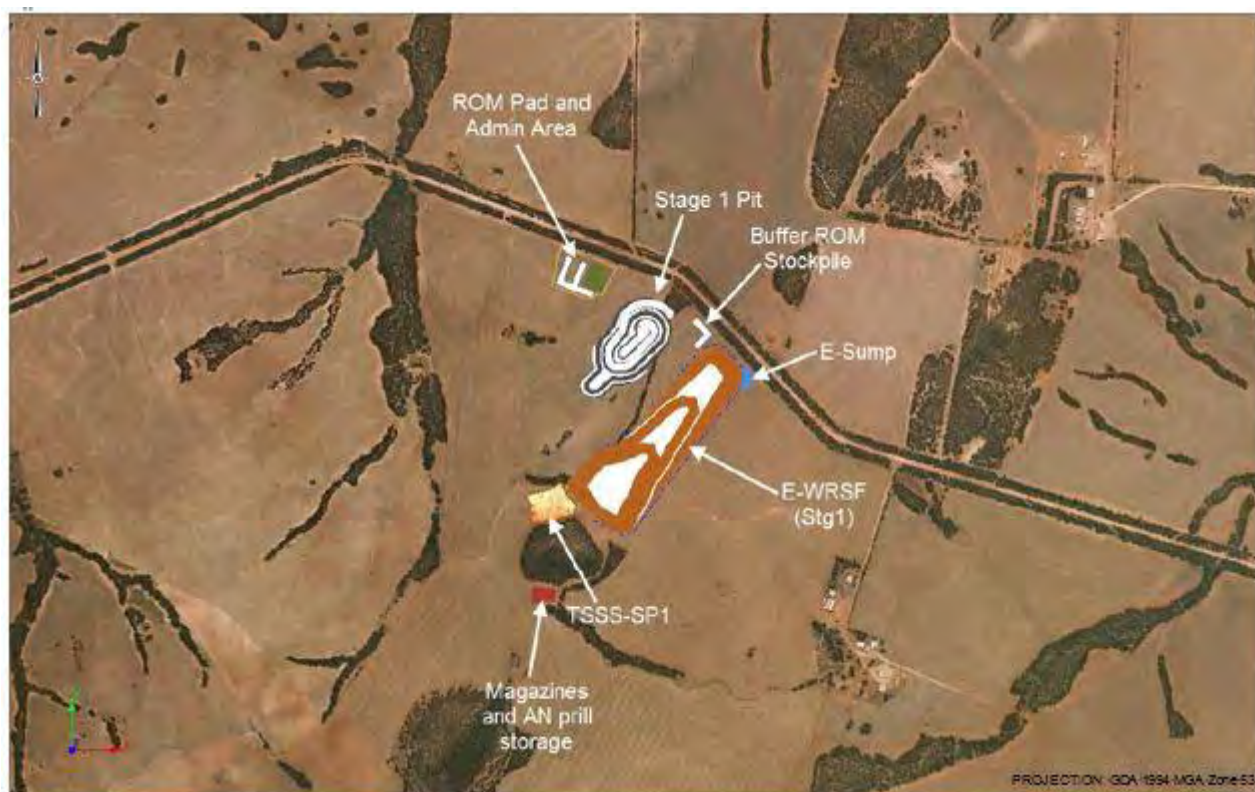


Figure 3-17: Pit and mining infrastructure - Stage 1 (AMC 2015)



Figure 3-18: Pit and mining infrastructure - Stage 2 (AMC 2015)



Figure 3-19: Pit and mining infrastructure - Stage 3 (AMC 2015)

3.6 Mine completion

The closure strategy at the completion of mining, as well as closure and rehabilitation of the processing facility and other infrastructure is addressed in Section 3.12.

3.7 Underground workings

The mine is proposed to be operated as an open cut mine and as such, underground works do not form part of the project.

3.8 Crushing, processing and product transport

There is no crushing or processing proposed at ML Campoona. Instead, ore will be mined (free dig) during spring and autumn months to 60 m depth (then dug with the assistance of explosives to a pit depth of 100 m) and stockpiled. Ore from the Campoona Shaft open pit will be stored on the ROM stockpile at Campoona before transfer to the Sugarloaf processing facility.

Initially during the small-scale start-up stage 10,000tpa of ore will be mined from a trench and transported as needed to the small modular processing facility (akin to a pilot-scale plant) at Sugarloaf.

At full scale operations, up to 140,000 tpa of ore will be transported via road from the stockpile at the ML Campoona Shaft to the processing facility at MPL Sugarloaf. The ore will be treated to produce concentrate graphite via milling flotation and leaching.

The Sugarloaf processing area (layout as described in Figure 3-2) consists of:

- Ore crushing (Section 3.8.1).
- Flotation plant on hardstand, including cleaner/re-cleaner flotation (Section 3.8.2).
- Concentrate thickener/dewatering plant hardstand including product slurry storage tank, plus centrifuge, fi and dryer (Section 3.8.2).



- Concentrate Leaching.
- Product screening, storage and bagging (Section 3.8.2).
- Tails thickening and spigotting.

Other infrastructure required at Sugarloaf comprises the following:

- TSF (see Section 3.9.2).
- Plant hardstand areas.
- Sedimentation basin planned for the far south-east corner of the Sugarloaf plant site.
- Water storages including surface water diversions, raw water storage, stormwater pond, mill pond and potable water tank.
- Heavy vehicle access roads and other roads and tracks.
- Ore stockpile.

3.8.1 Crushing plant

Crushing will occur at the processing facility on a 24-hour basis. The crushing plant is expected to be housed in a new facility, shown as No.1 on Figure 3.3.

The crushing plant at Sugarloaf is a potential source of noise generation; however, graphite by its nature is very soft and highly lubricious meaning noise generation during crushing will be low. Noise levels and ignition sources for equipment used during the operation of the processing facility, including the crushing plant is provided in Table 3-10.

Up to 80% of the particle size is expected to be less than 25 mm after crushing. Dust from the crushing plant was not considered to be problematic for sensitive receptors (Appendix S).

Two geochemical reports were completed for the project (Appendix M). These indicate that the *in situ* material (and hence potential dust from the crushing plant) is comprised from gneiss, oxidized gneiss, graphite and schist rocks, which showed the chemical composition as shown in Figure 3-20.

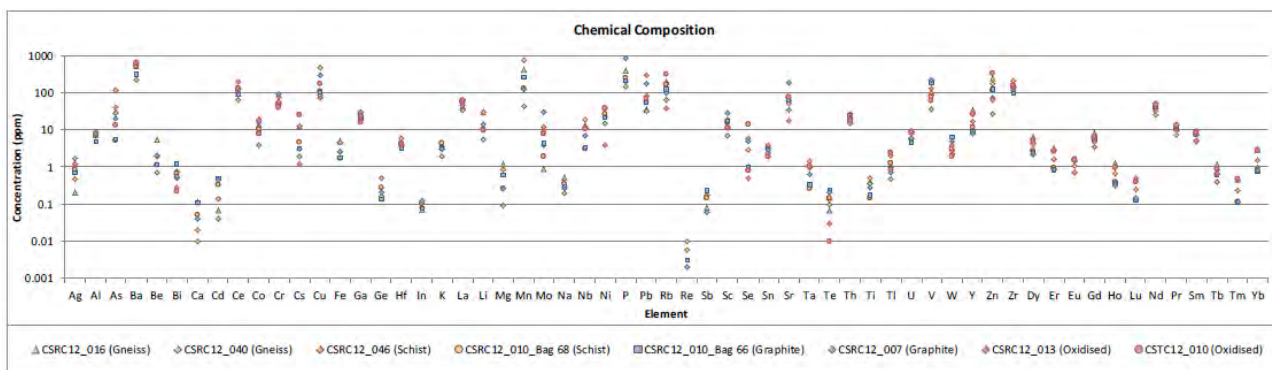


Figure 3-20: Chemical composition of *in-situ* Gneiss, Schist and Graphite minerals from Campoona Shaft

3.8.2 Processing plant

Both the small-scale start-up processing circuit and the full scale processing circuit will have the same processing elements.

Crushed ore will be gravity fed from a dump hopper to a dual roll crusher. Water is added in a blunging machine to form a slurry. In this process, the ore is disaggregated in particle size 80% passing 180 μm . There is no additional grinding on site required. The crushed and screened slurry will then be transferred to the flotation cell circuit and a regrind mill to release the minerals in the concentrate.



The processing plant operation after crushing comprises milling, flotation and thickening, before leaching drying and bagging:

- **Flotation:** Float cells fitted with agitators will recover low grade concentrate. The combined concentrate from the rougher and scavenger cells will be milled and pumped to the cleaner/re-cleaner flotation processes to produce higher grade concentrate. Cleaner tailings are directed back to the rougher flotation cells. Small amounts of diesel and kerosene, as well as small amounts of frother are used to collect the graphite. These chemicals are predominantly carried into the concentrate. Assaying of the tailings components record hydrocarbon levels within the tailings solids at levels below detection. Hydrocarbons within the decant water are around 0.5 ppm with TSF operations continuously recycling decant water back into the processing plant (see Appendix N).
- **Concentrate dewatering:** The concentrate thickener received concentrate from the cleaner flotation process. The graphite concentrate is further processed in cleaner and re-cleaner flotation cells before dewatering the slurry via a thickener centrifuge and a filter press to around 30% moisture.
- **Concentrate leaching:** The leach liquor and slurry, consisting of weak (8%) hydrofluoric acid and graphite concentrate, are heated using immersion heaters to achieve a temperature of around 95°C and remain in tanks for a residence time of about 1 to 2 hours. The slurry is pumped to a heat exchanger using process water to cool to around 40°C. Spent liquor is recycled to the leach feed repulp tank. Remaining acid in spent leach liquor is neutralised with limestone and/or lime before it is mixed with thickened flotation tails discharged to the TSF. Vapours from the leach circuit are ducted then treated via scrubbers to capture, filter and clean vent gas by passing it through hydrated lime slurry, removing acid from the vapour and hence release to the atmosphere. The vapour will have no odour (odour threshold for HF is around 0.1 mg/m³).
- **Storage and drying:** A storage tank will be used to store the slurry and will have extra unused capacity for unplanned events. The concentrate slurry is then sent via a screw feeder to dryer. The dewatering centrifuge and dryer and bagging processes will be run on a 12-hour daytime basis and a dust collection system will be implemented.
- **Campoona high grade graphite** can be exfoliated to produce >99.9% purity 2-3 layer graphene. The process is based on a direct liquid phase mechanical exfoliation method which avoids the use hazardous chemicals.

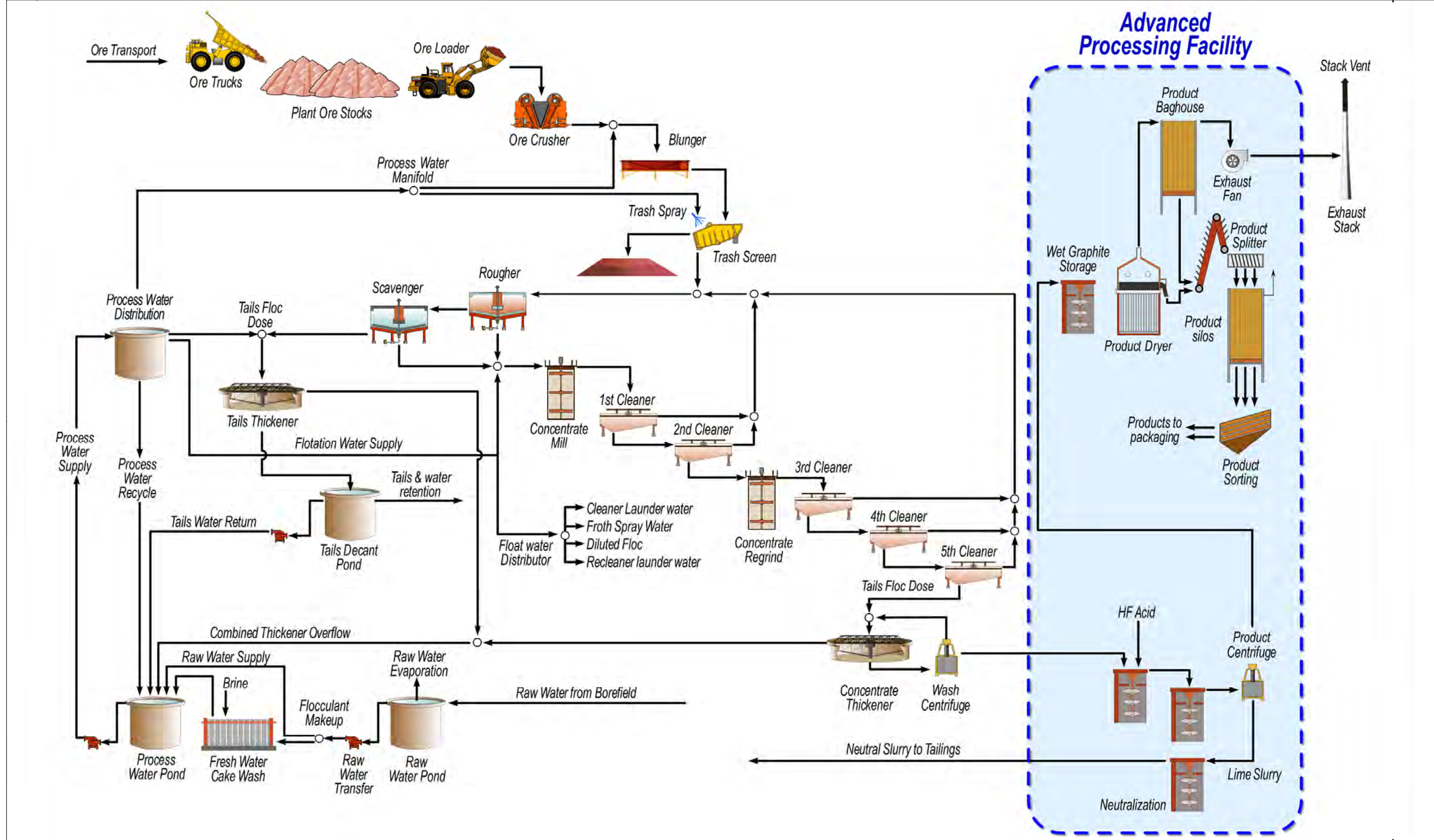
Highly concentrated graphite in the form of powder or slurry is delivered into reactor for the first step of processing to make graphene. Acid solution (sulfuric or phosphoric) is added into reactor with mixing and required reaction time. The reaction product is filtered and rinsed with water followed by neutralisation of waste water.

The product is moved into a mixer where shear mixing and sonication is used to exfoliate graphene in the form of a well-dispersed solution. The graphene dispersion is moved into dryer and dried to produce graphene in powder form ready for packaging. Alternatively, the produced graphene dispersion is diluted and adjusted into required concentration and packed as graphene liquid dispersion.

- **Packaging:** The graphite product will be split into different grades or sizes using a screw conveyor for subsequent storage in silos before bagging the product using an air injected bag filling station. The product will be stored at the warehouse before transport offsite for export to market.

The leaching waste and thickened flotation tails are mixed and pumped to the TSF. Reclaimed water from the thickener and the tailings decant are sent to the process water pond. The tailings pond is described in Section 3.9.2.

Figure 3-3 shows the Sugarloaf processing facility layout plan and Figure 3-21 shows each processing stage and the relevant plant at Sugarloaf.



CAMPOONA PROJECT
MINING LEASE PROPOSAL

SUGARLOAF PROCESSING PLANT FLOW CHART

PROJECT: 127663057
DATE: 2016-10-05
PREPARED: KB
REVIEW: LVC
APPROVED: JW

FIGURE
3.21





Noise and ignition sources of operational equipment at Sugarloaf are provided in Table 3-10.

The potential sources of dust are mainly associated with traffic on the stockpile and to a lesser extent the crusher operations given that graphite is naturally soft and highly lubricious. The composition of this dust will have the chemical composition measured from *in situ* samples of the gneiss, graphite and schist rock (see Figure 3-20).

No adverse odour is expected to be emitted from the site.

Beneficiation chemicals and their fate in relation to tailings are described in Section 3.9.2.4 and Section 3.9.2.5.

The impact assessment and mitigation measures associated with activities at Sugarloaf are provided in Section 6.

3.8.3 Process water balance

Potable water use is estimated up to 15 ML per annum. Initially during Years 1-3 of the operation, potable water will be sourced from site capture using the existing shed rainwater storage tanks augmented by trucking potable water to Sugarloaf from nearby Jamieson Tank.

At full production up to 0.25 ML will be maintained in site storage. Pirie Resources has a Supply Agreement with SA Water for the supply 40 ML per year rising to 80 ML per year, at Pirie Resources' election. Potable water will be sourced from mains water supplies via Jamieson Tank. The pumping restrictions on the mains supply (1.67 L s^{-1}) will be adequate to meet operational needs. Potable water will also be used for the offices and ablutions and for site rehabilitation activities.

Saline (around 22,500 mg/L TDS) raw bore water will be sourced from the proposed Pindari Wellfield. This saline raw water will be stored in a pond and used to supply up to 0.012 ML/h process water demand (approximately 100 ML per year). The water will be continuously pumped to a holding tank and then via a transfer pump which operates 12 hours a day to a 0.75 ML pond at the processing facility. The process water pond will also include treated water from an oil-water interceptor trap from the warehouse, workshop and stores. Up to 90% of the tailings slurry water will be available for reuse in the processing facility.

Note that the water balance shown in Figure 3-22 indicates 126 ML of water going from the process plant to the TSF with only 100 ML of feed water from Pindari. The 126 ML of process water will be supplemented by 85 ML of return water from the TSF during full scale operation and the rest made up by water from the Pindari Wellfield. The volume of process water required at start up is smaller, so a maximum of 100 ML [er year from the Pindari Wellfield would be sufficient to build up water in the system during the start-up phase.

Runoff water will contribute a small volume of water to processing. The sedimentation basin will supply water return from treatable used potable water (the portion used in workshops and warehouse) which is expected to be significantly less than 15 ML.

The pumps and holding tanks will be secured against unauthorised access.

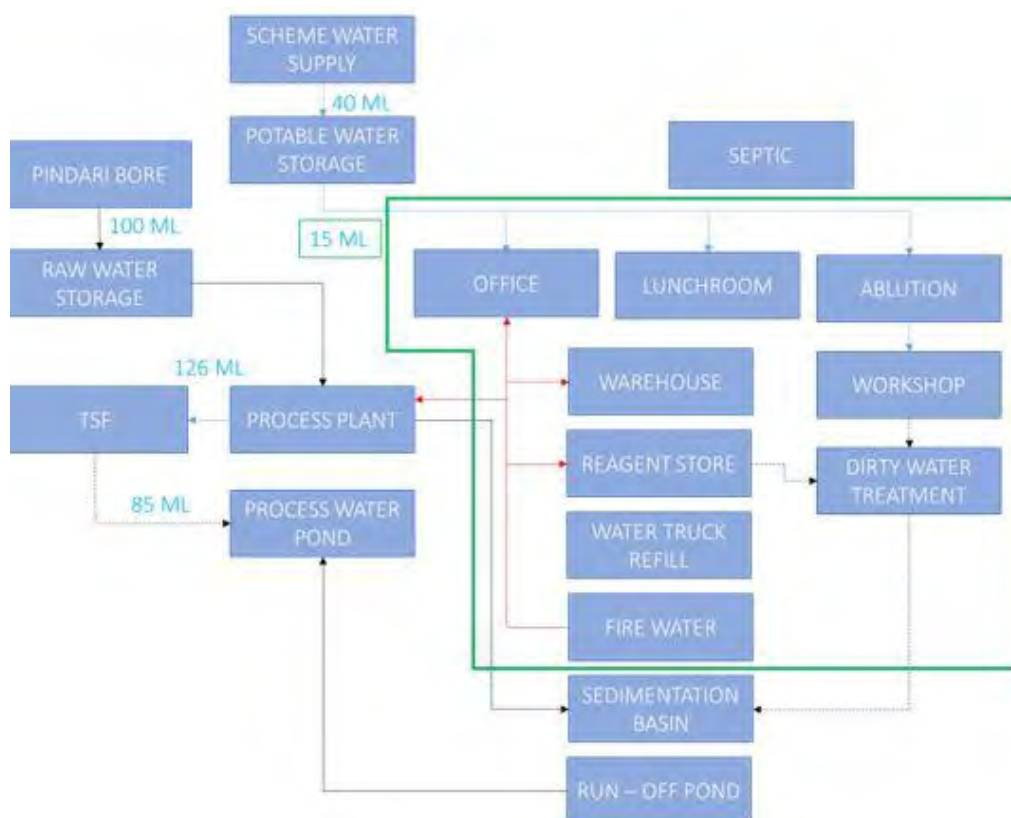


Figure 3-22: Water distribution at MLP Sugarloaf

3.8.4 Hours of operation

Initially due to very low throughput rates (1 – 1.5 tphr) the Sugarloaf small-scale start-up facility may be operated in campaigns. At higher production rates the Sugarloaf processing facility will operate year round with two 12 hour shifts each day; that is, 24 hours per day, and seven days per week.

3.8.5 Type of equipment

The mobile equipment envisaged to be used at the Sugarloaf Processing facility during the construction phase of the project is shown in Table 3-9, noting general power tools and hand tools may also be used.

Table 3-9: Sugarloaf construction equipment

Equipment	Sound Power Level dB(A)	Number	Potential Ignition Sources
Bulldozers	113	1	Diesel
Excavators	109	1	Diesel
Trucks	120	1	Diesel
Prime movers	111	1	Diesel
Graders	110	1	Diesel
Front end loaders	113	1	Diesel
Compaction rollers	108	1	Diesel
Cranes	105	3	Electrics
Forklifts	106	1	Diesel
Concrete mixer trucks	109	1	Diesel
Generator	119	1	Diesel
Generator for welding	113	2	Diesel



The main equipment that is likely to be used during operation of the Sugarloaf processing facility and which are considered the main sources of noise and ignition potential is outlined in Table 3-10. General power tools and hand tools may also be used at times for maintenance purposes.

Table 3-10: Sugarloaf operational equipment

Equipment		Sound Power Level dB(A)	Number	Potential Ignition Sources
Mobile equipment	Front end loader	108	1	Diesel
	Forklift	106	1	Diesel
	Water truck	105	1	Diesel
Crushing plant	Rolls breaker	117	1	Diesel
	Vibrating screen	116	6	Electrics
Processing plant	Regrind mill	117	2	Electrics
	Agitator	100	24	Electrics
	Air compressor	102	1	Electrics
	Rotary dryer	85	1	Electrics
	Dust collector fan	100	2	Electrics
	Blower	100	1	Electrics
Dewatering plant	Sump pumps (2), Vertical pumps (6), Horizontal pumps (2), Concentrate thickener pumps (2), Concentrate feed pumps (2), Tailings disposal pump (1), Tailings thickener pumps (2), water pumps (5)	85-95	22	Electrics

3.9 Wastes

The following sections describe the main wastes anticipated to be generated at:

- Campoona Shaft - overburden
- Sugarloaf processing facility - TSF.

Management of wastes generated during construction will be detailed in a construction environment management plan (CEMP). Section 6.19 describes the potential risks and proposed controls and management strategies.

3.9.1 Overburden

Overburden material will be generated between Stages 1 and 3. The overburden will be stored at two waste rock storage facilities to the east and west of the open pit mine at the proposed ML (Campoona Shaft) which will also act as amenity mounds.

Waste rock mined in conjunction with the graphitic ore will be excavated (overburden) and stored in two waste rock storage facilities adjacent the open pit.

- Western WRSF (25.7 ha) is located to the north west of the pit and surrounded by a drainage swale on its west and north boundaries. It will have a capacity for 4.83 Mt in Stage 1 (up to the middle of year 9) and 6.93 Mt in Stage 2 (middle of year 9 to year 13).
- Eastern WRSF (8.9 ha) will be to the south east of Campoona Shaft pit and surrounded by parallel drainage swales on its longitudinal boundaries and provides some amenity screening benefits in this location as well. It will have a capacity of 1.73 Mt, being built in years 1 to 4 and will act as a noise mound, particularly for the property located 750 m southeast of Campoona Shaft.



The ore body is overlain by a thin (<2m) soil horizon that will be removed and stored for progressive rehabilitation activities. Two topsoil/subsoil stockpiles are also planned. One permanent stockpile to the south of the Campoona Shaft will have a capacity of 37,600 m³ to store soil until the end of mine life when rehabilitation can progress and a temporary 223,800 m³ stockpile located south of the Western WRSF to be used for ongoing rehabilitation. Measures to control erosion from stockpiles are addressed in Section 6.

3.9.1.1 Overburden placement

Each level of the WRSFs will be built by placing waste rock in the paddocks using dump trucks and spread using a bulldozer until a 5 m high tip edge is formed. Waste rock will then be tipped over the edge of the platform until the stage design levels are achieved, and repeated until complete design height is reached. The Waste Rock Storage Facilities were designed to allow progressive rehabilitation at the site and once the final designs are reached, the faces can be battered from 35° slopes to 20° slopes, with a 5 m berm between design stages.

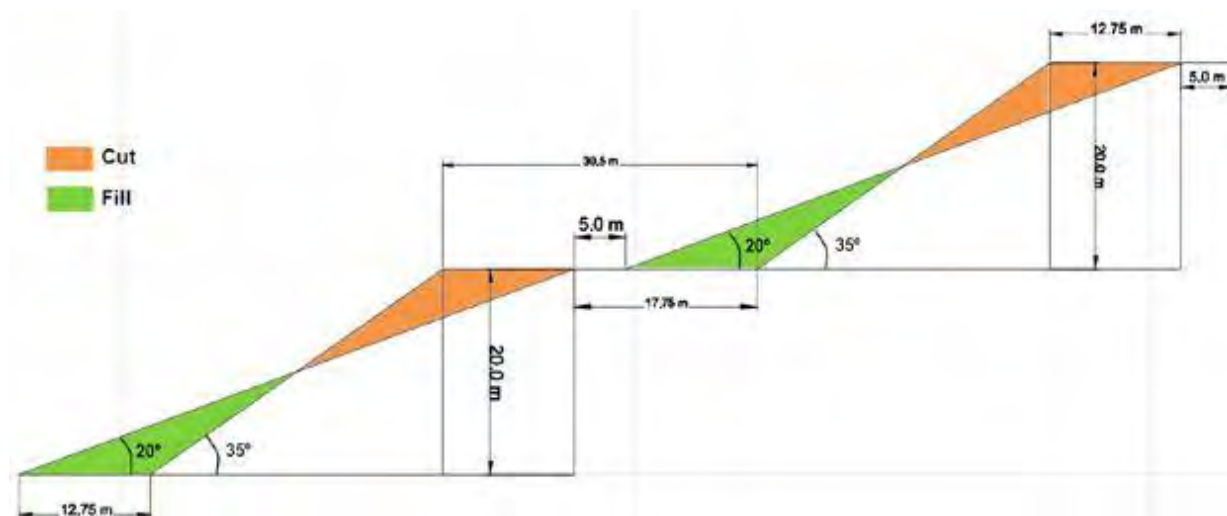


Figure 3-23: Build and rehabilitation angles for the Waste Rock Storage Facilities

Details on the cumulative volumes and placement in 10 m intervals of each of the WRSFs are provided in the Mine Plan in Appendix L.

3.9.1.2 Overburden stabilisation and erosion control

To minimise erosion, the berms of the WRSFs will have a slight -1% slope to promote surface runoff which will be directed to a series of drainage trenches and sumps. In the long term, battering down of slopes and shaping placed soil, along with revegetation, geotechnical and environmental monitoring and maintenance will help to ensure the stability, sediment control and water quality objectives are met. As the construction parameters allow lower benches to be battered down while leaving upper operational berms of 17.75 m wide, the WRSFs can be progressively rehabilitated each level is constructed.

- Perimeter drainage will be constructed before mining commences and the drainage systems for the western WRSF will be constructed in a progressive manner from east to west for stage 1 and to the south as the footprint area is cleared.
- The WRSFs will be hydro mulched as they progress to minimise erosion and dust-generating potential. Silt fences and other erosion control measures will be investigated to ensure water quality is maintained.
- Excavated material will be used to construct a bund on the down gradient side of the drains to provide an extra layer of protection.
- Sumps will be monitored and periodically cleaned to ensure continued drainage. Silt will be replaced in the WRSFs and water from sumps will be removed and reused on site including for dust suppression.

Rehabilitation diagrams are provided in the Mine Plan in Appendix L.



3.9.1.3 Overburden safety factors for slope stability

A stability assessment was completed for the WRSFs and is presented in the Mine Plan in Appendix L using RocScience's Phase² program. The model calculates the point at which critical strength and on set of slope instability. The factor of reduction in strength before instability occurs is the Factor of Safety. The factor of safety was calculated for the Western WRSF as it will be the greatest in height and slope planned for the site, using the geotechnical assessment completed for the site (Appendix L). Conservative material strength properties were assumed given the relatively deep weathering expected at the site and seismic data from 2012 considered to assess pseudo-static conditions.

The assessment showed that the calculated factors of safety for static conditions of 1.67 and for pseudo-static conditions of 1.41 are greater than the minimum required (1.5 and 1.3 respectively).

3.9.1.4 PAF material

Pirie Resources provided an estimate of possible PAF waste rock in relation to the waste tonnage expected, with a conservative estimate of waste rock being 0.2% PAF (Table 3-11).

Table 3-11: Campoona Shaft mine conservative PAF estimate (derived by Pirie Resources with no neutralising capacity assumed)

Bench	Number of Samples Within the Pit Having S Assays	Assays S>0.2%	Ore Samples (.2CG) with S >0.2%	Waste Samples > 2% Cg	Ore Tonnage ('000t)	Waste Tonnage ('000t)	Possible PAF Waste Rock ('000t)
370	37	3	3	0	13	31	0
360	141	0	0	0	95	593	0
350	122	2	1	1	204	1,593	2
340	94	0	0	0	220	1,808	0
330	84	0	0	0	207	1,352	0
320	76	0	0	0	201	1,173	0
310	51	5	5	0	190	774	0
300	32	4	3	1	147	618	24
290	12	0	0	0	123	398	0
280	12	7	7	0	114	279	0
270	12	7	7	0	92	90	0
Total Tonnes					1,608	8,709	26

A donut-shaped PAF cell within the western WRSF is scheduled for construction well before it will be encountered in Stage 3 of the mining schedule when mining progresses below the base of complete oxidation. There will be a void (average radius of 40m) generated in the middle of the WRSF, with initial rehabilitated to the west and north batters in stages 1a to 1c, then the east batter in stage 1d (see Figure 3-24).



Figure 3-24: PAF cell with 250,000 tonne capacity within the western WRSF

All PAF waste rock will be encapsulated in this cell, which can accommodate up to 250,000 tonnes, including capping. This is sized approximately ten times greater than the conservative estimate of PAF material.

3.9.1.5 Rehabilitation of Waste Rock Storage Facilities

Rehabilitation of the WRSF (and ML) and subsequent closure is addressed in Section 3.12.

3.9.2 Tailings

A full scale production Tailing Storage Facility (TSF) design was completed for the processing facility at MPL Sugarloaf, including an initial assessment to identify the preferred tailings management option (Appendix N). The options assessment was completed using environmental criteria and siting constraints analysis and with consideration of technical and cost project criteria. The selected option was placement of tailings slurry, following sedimentation thickening, in a cross-valley TSF to the south-west of the existing sheds at the Sugarloaf site. The reasons that are most attributable to selection of this option included:

- Smaller and fewer starter embankments required to be constructed and a smaller volume ultimate embankment.
- Improved visual amenity.

Inputs to the concept design report included:

- Analysis of the physical properties of tailings and natural soils.
- Assessment of seepage.
- Assessment of storage capacity over time.
- A consequence category analysis to assess the impacts of potential failures such as containment failure.
- A water management assessment to consider surface water runoff, water balance, water storage, decant, spillway and freeboard needs.



- A stability assessment and factor of safety analysis.
- A dam break risk assessment.
- A consolidation analysis.

The proposed TSF has been designed in accordance with the following industry accepted guidelines:

- Minerals Regulatory Guideline MG5 is designed to assist in meeting obligations under the Mining Act 1971 and the Environment Protection Act 1993 as they relate to TSFs.
- Environment Protection Authority (EPA) Wastewater Guidelines, Wastewater lagoon construction.
- Australian National Committee on Large Dams (ANCOLD) Guidelines on Tailings Dams, Planning, Design, Construction, Operation and Closure. These guidelines were issued by ANCOLD in May 2012 (ANCOLD, 2012) and are considered to represent 'leading industry practice'. The TSF has been designed in consideration of these guidelines.

As the proposed TSF has been designed using assumed parameters. Additional geotechnical investigation and laboratory testing is anticipated to be carried out as part of the next stage of the approvals process (program for environment protection and rehabilitation, or PEPR) to assess the borrow material proposed for use in the embankment construction. This would include further classification, compaction and strength testing.

The TSF design report including the supporting assessment reports is presented in Appendix N.

3.9.2.1 Tailing storage facility concept design

The tailings are proposed to be stored in a cross-valley TSF that uses the natural topography to direct and contain the tailings, as well as allow for a natural closure landform to be developed.

The TSF embankment will be constructed in seven stages, including a start-up stage, using borrow sourced from the TSF basin and immediate area.

Small Scale Start Up - Location and capacity

During the small-scale start-up phase, an allowance has been made to store tailings generated for up to three years. A small starter embankment will be constructed to store 27,000 m³ of tailings during this phase.

Stages 2 -4 Expansion and capacity

Tailings will be managed on a 24-hour basis at the TSF. The TSF will be accessible via a track from the main plant area and has been designed to take advantage of the natural topography to direct and contain the tailings in an open low lying cross-valley area to the south-west (downslope) of the processing plant. This will also allow for the closure landform to match the surrounding landscape by filling the valley to produce a gently undulating ridge.

The TSF (pond) will be able to store up to 1.6 Mm³ of thickened tailings with a solids concentration of 50% by weight, sufficient for around 13 years of production. Access to the deposition locations will be across the saddle embankment constructed at the northern end of the TSF. The access way will continue around the top of the TSF and link with the embankment access.

Deposition will be from one to five spigots at a time and rotated to manage the location of the pond around the decant and to provide time for the tailings to dry and reduce volumes of supernatant water for storage.

Starter Embankment

The start up TSF embankment is proposed to be constructed to RL 256 m, an average height of ~1.7 m and a maximum height of approximately 4 m above the surrounding topography. A minimum freeboard of approximately 1 m has been allowed for, after storage of 27,000 m³ of tailings. The embankment will be raised before the end of the third year for provide additional tailings storage capacity for the ramp-up period.



The freeboard of 1 m for the start-up phase has been provided for noting that water management systems are not planned to be constructed until Stages 1 – 3. Supernatant water from the tailings will be pumped back to the start-up process plant for re-use and to promote consolidation of the tailings.

Stage 1 – 3 Embankment expansion

The ramp-up embankment is proposed to be constructed to RL 257.5m, a height of approximately 5.2 m above the surrounding topography. The embankment is designed to have an upstream slope of 1V:2H, a downstream slope of 1V:3H and a crest of at least 6 m to provide one way light vehicle access and safety windrows.

The embankment is planned to be raised in a downstream direction to an elevation of RL 268.5 m, corresponding to a maximum height above the surrounding topography of ~ 16 m. The upstream and downstream slopes of the raises are designed to have consistent batter slopes and crest widths as with the starter embankment.

As the embankment has been designed to have water ponded against it, it has design features to manage the risks associated with:

- Wave action against the embankment.
- Piping erosion through the embankment.
- Elevated phreatic surface within the embankment.

This will be achieved by measures including maintaining as small a pond as practicable on the surface of the TSF by including a storage pond for supernatant water taken off the TSF. The embankment in contact with the supernatant pond area will be protected using a geo-composite liner or similar placed on the upstream face to protect the embankment against wave action, and reduce the likelihood of water movement into the embankment. The potential for leakage into the embankment will be monitored using a series of standpipe and vibrating wire piezometers. Additional design features such as flatter embankments and internal drains may need to be included in the final design to provide a stable embankment depending on the geotechnical suitability of the source material.

An assessment has been carried out to consider the stability of the proposed embankment at its ultimate height and for the closure landform. The minimum Factor of Safety (FoS) values adopted for the study are based on the guidelines provided by the Australian National Committee on Large Dams (ANCOLD, 2012) and leading engineering practice. These minimum values are consistent with other published values for earth dams.

■ Steady state static loading (no seismic)	FoS = 1.5
■ Maximum Design Earthquake (MDE)	FoS = 1.0
■ Maximum Credible Earthquake (MCE)	FoS = 1.0

Geotechnical stability of the embankment was analysed. The model indicates a FoS of 1.6 under static conditions and a FoS of 1.4 under pseudo-static loading, which meet minimum values above. Additional tests will be carried out on the sandy clay to confirm its strength. The potential for an elevated phreatic surface to develop will also be considered in more detail through calibration of the seepage model and monitoring (piezometers) during the operational stage.

A dam break risk assessment was also completed to consider the failure mechanisms that could lead to a dam break and release of tailings from the TSF. The results showed the risk of failure as rare or unlikely. Nevertheless, engineering controls have been put in place as part of the design, including suitable factors of safety liners on the upstream batter of the TSF embankment and a spillway (refer to the concept design report in Appendix N for details).



3.9.2.2 Tailing quantities

Table 3-12 presents the tailings production rates for the Campoona Graphite Project (Archer, 2014).

Table 3-12: Tailings production rates

Parameter	Value
Tailing generation rate	Years 0 – 3: 9,000 tonnes per year
	Years 4 - 6: 90,000 tonnes per year
	Years 7 onwards: 126,000 tonnes per year
Life of mine	16 years
Life of mine tailings	1 600 000 tonnes

3.9.2.3 Tailings quality based on ore processing

Tailings generated during ore processing will be thickened and pumped at a solids concentration of around 50% before being discharged via spigots into the TSF. Diluted HF from concentrate treatment will be neutralised with limestone slurry and mixed with tailings slurry prior to discharge to the TSF.

There are small quantities of kerosene and diesel added to the ore at a concentration of 134 mg/kg. Analytical assessments of hydrocarbons conducted by ALS Laboratories showed hydrocarbons concentrations within the tailings solids were below detection levels and hydrocarbons within tailings water were at levels of 0.5 ppm (Appendix N). This is explained further in Section 3.9.2.4.

The flotation reagents react with, but are absorbed by the graphite and are carried quantitatively through the concentrate. The dosage of flotation reagents is regulated in 'starvation' amounts so that the froth qualities are operationally manageable.

Other reagents are HF and limestone or lime. These reagents react during neutralisation of the leach discharge stream and reside as solid precipitates in the TSF. The residual acid from leaching of flotation concentrate is neutralised with lime. The neutralisation process is expected to result in negligible amounts of HF discharged to the TSF. Limestone will be added as a neutralisation agent in stoichiometric excess to the tailings from the concentrate upgrade facility (CUF) before they are blended with the tailings from the flotation concentrator and sent to the TSF. At full production, the flotation plant is expected to produce 15.5 tph of tailings at 50% solids. The discharge from the CUF is expected to be 0.6 tph so there is a dilution of around 25 times when these two streams are mixed prior to tailings deposition. The flotation concentrator tailings will be slightly alkaline (approx. pH 8-8.5), which will buffer any residual HF in both the tailings stream and the TSF (Appendix K).

The neutralisation reaction produces calcium fluoride, which has very low solubility (solubility in water is 15 mg/L water @ 18 deg C) (Appendix K). This assumes complete saturation and is considered to be a conservative value. As noted above, there will be a 25 times dilution of any free fluoride ions. This means that fluoride in tailings liquor will be at a similar concentration to natural occurrence in groundwater, likely to be within the 2 mg/L recommended water trigger value for livestock drinking water ((ANZECC 2000), Appendix K)).

In a source-pathway-receptor framework, the TSF can be viewed as a source of both hydrocarbons and calcium fluoride. However, as established in Section 2.9, groundwater is not a receptor due to its low value (both quantity and quality). In addition, the low permeability behaviour of the tailings and the lack of driving head owing to the gravity decant facility result in low volumes of seepage. Hence, there is a low risk of contaminants causing environmental harm.

Geotechnical properties of tailings samples were also tested and showed the tailings are expected to have the following properties:

- fine grained 'clay' with medium plasticity.
- low permeability ranging from 5×10^{-8} to 4×10^{-9} m/s



- adopted average stored dry density of 1 t/m³ and conservative beach slope of 0.5%, although a higher dry density of ~1.2 t/m³ may be achieved through consolidation (air drying and self-weight loading) which would increase the capacity of the TSF or the ultimate height of the confining embankment could be reduced.
- quartz is the dominant mineral composition.

Static testing of *in situ* materials was also completed (see Appendix M), including for sulphur. Those studies along with results of tailings analysis show that there is a low likelihood of acid metalliferous drainage (AMD) - if potentially acid forming (PAF) material is identified in the tailings during the ongoing monitoring and testing, management strategies (e.g. encapsulation) in accordance with the management plan (Appendix O) will be implemented.

Mineral testing of the tailings showed the following composition:

Table 3-13: Tailings mineral composition

Mineral Identified	Concentration (% by mass)
Clay mineral	< 1
Kandite group	20
Mica	9
Serpentine	8
K feldspar	4
Alpha quartz	52
Dolomite - ankerite	< 1
Alunite group	< 1
Goethite	1
Graphite	4

3.9.2.4 Fate of hydrocarbons

In a typical operating year, it is estimated that up to 17 t of hydrocarbons will be used in processing at the Campoona Graphite Mine, at a rate of 134 mg/kg (ppm) of ore processed. Golder has undertaken a preliminary assessment based on the behaviours of total petroleum hydrocarbons (TPH). The hydrocarbons are relatively insoluble (Chillcot, 1996), but solubility rates of 5 mg/L (ppm) have also been reported (ATSDR, 1995).

As part of the preliminary assessment, a flowchart has been developed that includes the following components:

- Kerosene used in processing.
- Kerosene components that stay with the product and that are distributed to the tailings.
- The proportion that remains with the water component of the tailings component (acknowledging that kerosene will float).
- The relative proportions that will be returned with decant water, volatilised or retained within the interstitial water within the TSF, based on the water balance.
- The proportion that may dissolve and be available to seep, based on the solubility rate of 5 mg/L.

A flow chart of the fate of the hydrocarbons for the tailings management system on an annual basis is presented in Figure 3-25. Based on this assessment, there is a low potential for hydrocarbons to be present in the seepage water. The assessment will be updated as part of the PEPR design, when additional information on the retention of hydrocarbons in the tailings water and the seepage rate is available.

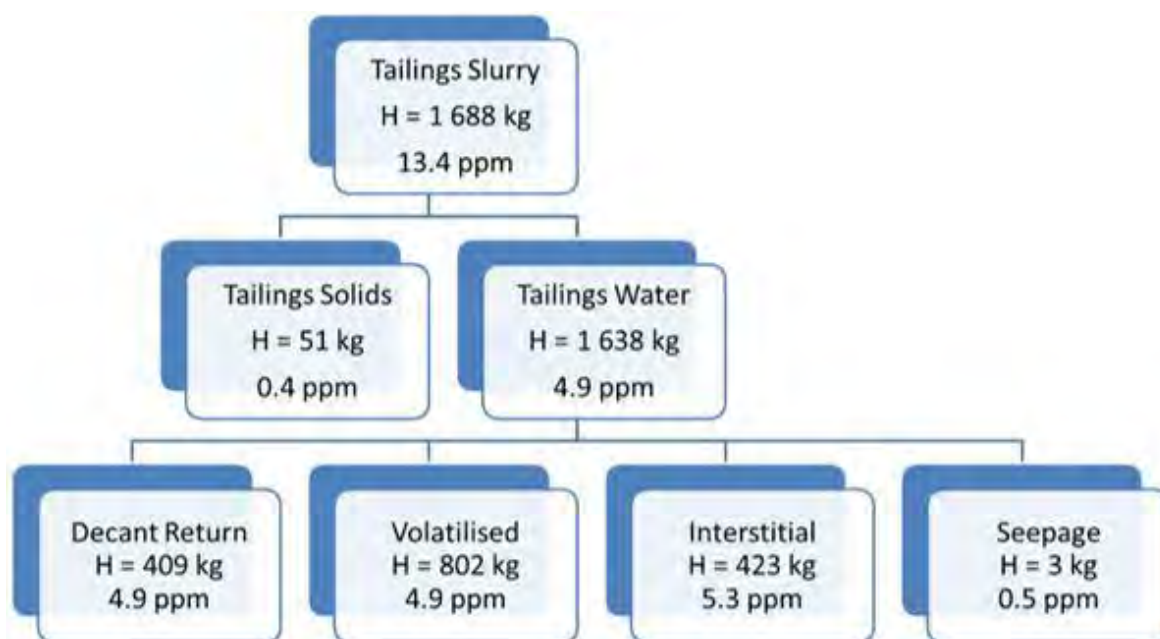


Figure 3-25: Flowchart of hydrocarbons in tailings on an annual basis

3.9.2.5 Fate of hydrofluoric acid

Tailings in the TSF will have low permeability (ranging from 5×10^{-8} to 4×10^{-9} ms⁻¹). A seepage assessment for the TSF estimated the potential seepage rates through the TSF in the order of 4% to 7% (around 0.2 L/s or 18 m³/day) of the process water transported to the TSF in the tailings slurry (refer Section 3.9.2.7).

There is no groundwater within at least 45 m of the base of the TSF and groundwater is not considered to be a receptor. Some mounding of seepage may occur as it is constrained by low permeability layers below. This will dissipate following the conclusion of mining.

Given the above, there is not considered to be a pathway for HF use to impact on the environment through seepage from the TSF.

Inadequate neutralisation of HF in the CUF could result in excessive discharge of HF to the TSF and emissions to air that impact on members of the public. As discussed above, this will be addressed through pH monitoring, sampling of tailings at least twice a day and through testing of lime and limestone used in neutralisation to ensure appropriate quantities are used. As a precaution, overdosing will be used.

3.9.2.6 Water balance

The results of a water balance model completed for the TSF at Sugarloaf (Appendix N), considering a full year of deposition, are summarised in Table 3-14.

Table 3-14: Yearly results of the water balance

Water Balance Components		Deposition Rate (tonnes/year)			
		90,000		126,000	
		m ³ /year	% total	m ³ /year	% total
Inflows	Process Water (50% by weight)	90,000	30	126,000	38
	Rainfall	208,853	70	208,853	62
Outflows	Evaporation	155,410	52	165,071	49
	Seepage*	5,361	2	5,361	2
	Retained Interstitial Water	56,667	19	79,333	24
	Decant Return	81,415	27	85,088	25

*Assumes the same pond size for both deposition rates



The decant return during the year varies from no decant return in the summer months to a peak decant return in June, with an estimated 67% to 90% of tailings slurry water available for reuse in the processing facility. Water will be returned to the process plant at a rate of up to 12 ML/hour.

A reverse osmosis plant is not required as Jamieson Tank has capacity to provide all freshwater needs.

3.9.2.7 Seepage management

A seepage assessment has been carried out to estimation the influence of seepage from the TSF on the groundwater system and to identify the extent of lateral seepage likely to emanate from the TSF during operations and post closure. To establish a baseline groundwater level, five boreholes were drilled around the Sugarloaf hill in the vicinity of the proposed location of the TSF to a maximum depth of 31 m bgl to 'fresh' rock. Each of the bores was observed to be dry and hence demonstrate that the water table is deeper than 31 m. Based on groundwater information provided by Pirie Resources (Archer, 2015), groundwater at the Sugarloaf processing facility site almost certainly is present (in fractured rock) but the water table would likely be between 50 to 100 m bgl. For the purposes of seepage modelling in the TSF area, a groundwater level at 45 m bgl was adopted to provide a realistic estimate of the groundwater response.

Laboratory testing of tailings indicate they will have low permeability, and once placed over the footprint area of the TSF, should inhibit seepage of water into the underlying natural soils. Nonetheless, underlying natural soils are likely to be of higher permeability than the tailings, and a low driving head from the pond is expected (reduced by the expected steep hydraulic gradient downwards through the tailings deposit).

Seepage parameters for the underlying soils and rock were adopted based on professional judgment and experience with similar materials. These parameters, combined with the proposed operating plan for the TSF, were used to develop an estimate of seepage through the base of the TSF, using a finite element numerical model developed using SEEP/W 7.03 (Geoslope International).

The results of the model indicate potential seepage rates through the TSF of up to 0.2 L/s (18 m³/day). The seepage is anticipated to result in an increase in the groundwater level to within ~10 m of the natural ground level (highest beneath the tailings storage) by the end of the tailings deposition.

After 20 years, the groundwater level beneath the tailings storage would dissipate to within 4 m of the original groundwater level and within 2 m after 50 years. The model also indicates that the extent of influence on the groundwater level during and after operations would be limited to approximately 500 m from the facility, indicating there would not adverse impact on groundwater levels in the vicinity of vegetation ~1 km downstream of the TSF.

It is planned that monitoring bores are to be installed around the TSF to observe the groundwater response to seepage. If the groundwater response is greater than expected, interception measures such as extraction bores or an interception trench may be required.

By staging the development of the TSF, Pirie Resources will be able to monitor seepage prior to building the full stage TSF, providing further assurances that environmental risks of tailing storage have been appropriately predicted and can be managed.

3.9.2.8 Surface water management

The catchment area of the TSF will be limited to the TSF basin. Supernatant and rainfall runoff will be recovered and directed to a storage pond from a gravity decant system constructed against the embankment. Concrete culvert with shutters will act like a weir to maintain the level above the adjacent tailings solids level. If the gravity decant becomes inoperable, or in extreme rainfall events, the spillway can direct overflow water away from the embankment and into the stormwater bund. The water will flow down the natural ground at the existing natural grade (maximum grade of 1V in 10H). Prior to the embankment being constructed to its ultimate height, a small bund has been included to direct tailings and supernatant water along the toe line of the embankment to the decant.



The pond has two cells:

- Cell 1 will collect and store 1 500 m³ of operational decant. This cell will be lined with geomembrane to reduce seepage. Particularly during the wetter months of the year, water will be regularly returned to the process plant. Cell 1 will be connected via a spillway to Cell 2.
- Cell 2 will store any overflow water from Cell 1 up to a 1:25 year, 24-hour rainfall event and has been sized at 42,900 m³. Cell 2 will be constructed from compacted sandy clay sourced on site. In the event of a storm greater than the design rainfall event, the water storage pond will fill and flow via a spillway into the down-gradient stormwater bund.

Sediment will be removed by a slurry pump or excavated during dry periods and reclaimed water from the tailings pond will be recycled back as process water.

Diversion bunds will be used to divert other catchments away from the TSF to follow the natural flow paths. The surface water drains have been sized to manage short term flooding events for up to the 1:100 average recurrence interval, 5-minute storm event.

3.9.2.9 Construction of the TSF

Borehole investigations completed at the site in 2014 and 2015 indicated two dominant material layers below the Sugarloaf processing facility site are a sandy clay layer with a variable thickness of between 5 m and 12 m overlying weathered rock (schist, pegmatite, gneiss and quartz). Testing of natural soils near to the proposed TSF to assess their potential for use in its construction, indicate that the near surface materials are clayey sand overlying generally firm clays with low to medium plasticity fines. The natural soils as tested are therefore expected to have the following properties:

- The mix of sand and clay is expected to be suitable for compaction to form an embankment.
- The plasticity and fines content indicate that once compacted, the natural soils would have a low permeability.
- The natural soils are unlikely to liquefy due to the plasticity.
- The soils may be susceptible to erosion due to dispersivity.

The borehole investigation indicates suitable material may be present. Additional geotechnical investigation and laboratory testing may be required to assess the borrow material proposed for use in the embankment construction. This would include further classification, compaction and strength testing.

Construction of the TSF will occur in six stages beyond the start-up embankment. The start-up embankment will be approximately 4 m high, raised by about 1.2 m for the initial ramp-up period, and then five subsequent raises of 2.5 m. The actual number and size of the raises will be identified from operational requirements. The design allows for construction to continue independent of operations, and continual construction of the embankment is an option. The TSF design includes a beach slope of 0.5% for starter and final storage. Prior to construction, the footprint of the TSF will need to be grubbed to remove and stockpiling topsoil (no trees or shrubs are present).

Table 3-15 presents the estimated quantities of material required for the construction of the TSF and associated infrastructure.



Table 3-15: Estimated construction quantities

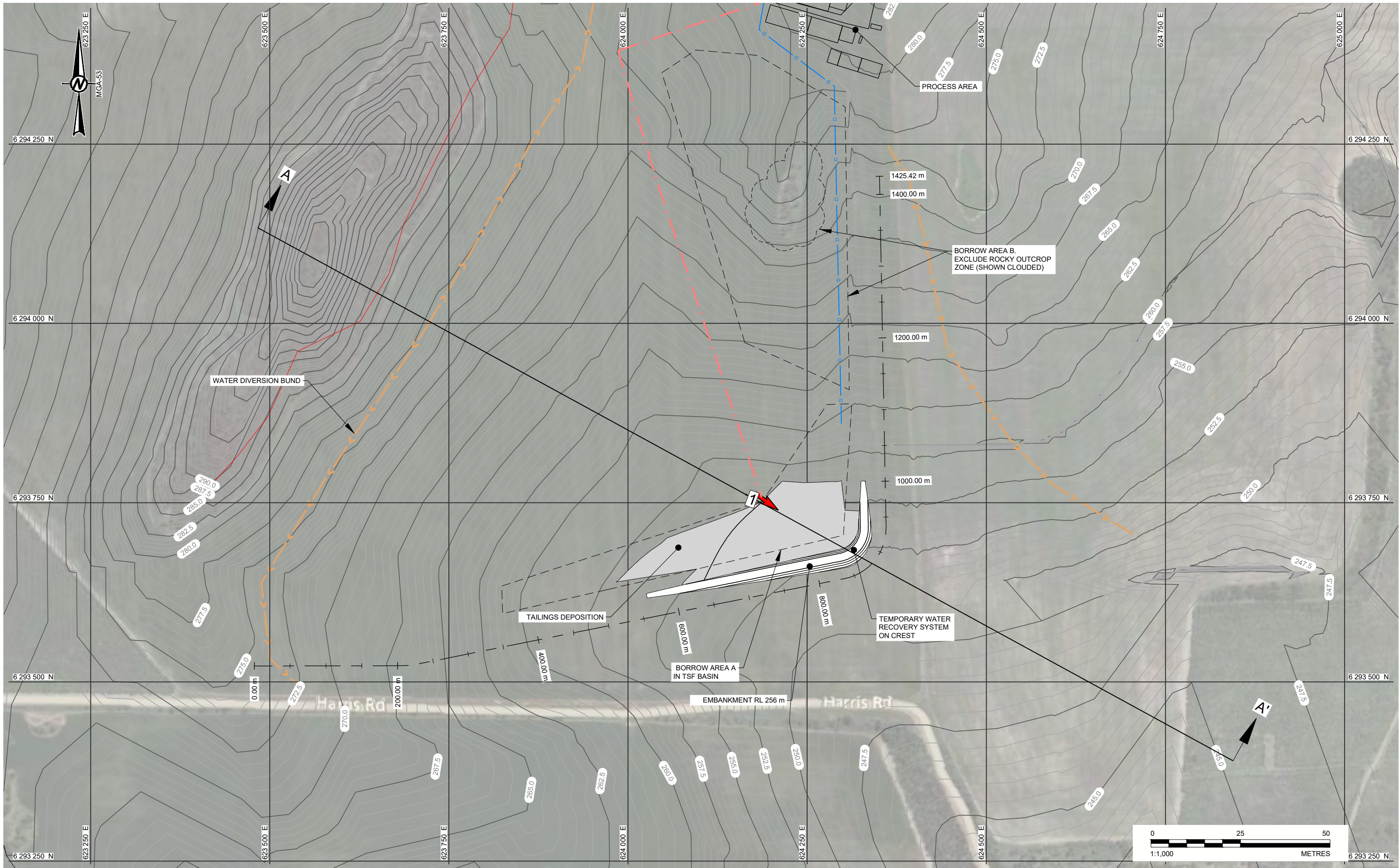
Component	Estimated Quantity
Start-up embankment	12,000 m ³
Ramp-up embankment	15,000 m ³ (in addition to the start up embankment)
Ultimate embankment	955,000 m ³
Saddle embankment	750 m ³
Water storage pond	39,100 m ³ cut 6,600 m ³ fill
Stormwater bund	16,800 m ³

The storage and settlement pond will be constructed predominantly in cut although some fill will be used to form the sides and create a uniform crest elevation. Extra fill will be used in construction of the stormwater bund and embankment along with borrow pit material if required.

Cell 1 of the water storage pond will be lined with a geomembrane. It is expected that the liner for Cell 2 will be constructed from ripping, conditioning and compacting the existing subsoil.

Conceptual construction diagrams for the TSF are provided in Figure 3-26.

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- LEGEND**
- GRAPHITE MINERALISATION BUFFER
 - WATER DIVERSION BUND
 - INDICATIVE TAILINGS DISTRIBUTION LINE
 - INDICATIVE SPIGOT LOCATIONS
 - SUPERNATANT WATER BUND AND DITCH
 - INDICATIVE SPILLWAY ALIGNMENT
 - RETURN WATER PIPELINE

NOTE(S)

1. SURVEY IS A COMBINATION OF 10m CONTOURS PROVIDED BY ARCHER IN FILE "Contours.shp" AND DTM POINTS PROVIDED IN "1401_Campoona_DTM_2014.xlsx"

CLIENT
ARCHER EXPLORATION PTY LTD

CONSULTANT



YYYY-MM-DD	2016-03-10
PREPARED	MMC
DESIGN	BT
REVIEW	PJC
APPROVED	PJC

PROJECT
CAMPOONA GRAPHITE PROJECT

TITLE
START-UP EMBANKMENT RL 256 m

PROJECT No.
127663057

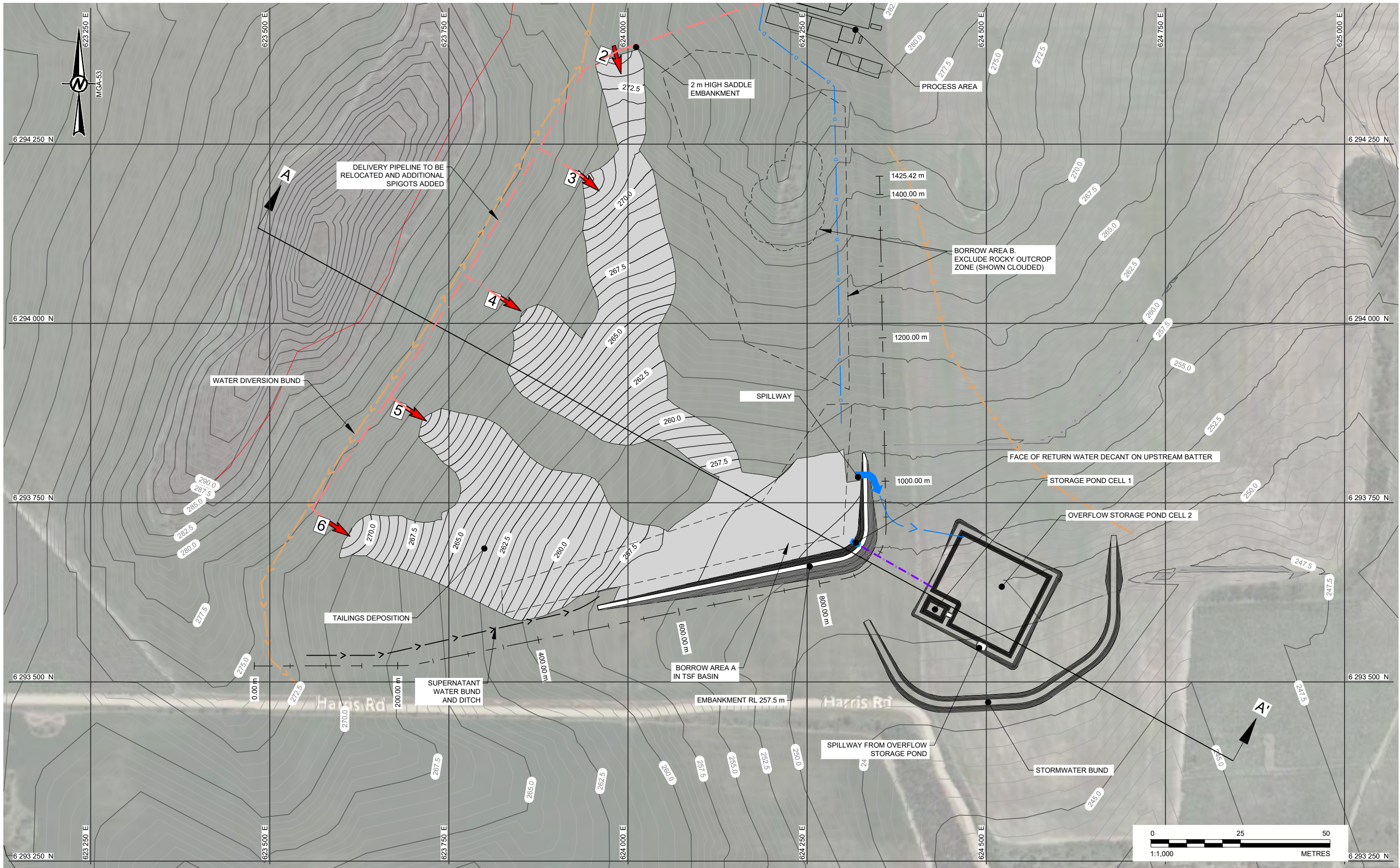
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FIGURE
001

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

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LEGEND

- GRAPHITE MINERALISATION BUFFER
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CLIENT
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YYYY-MM-DD	2016-03-10
PREPARED	MMC
DESIGN	BT
REVIEW	PJC
APPROVED	PJC

PROJECT
CAMPOONA GRAPHITE PROJECT

TITLE
YEARS 3 - 4.5 - EMBANKMENT 257.5

PROJECT No.
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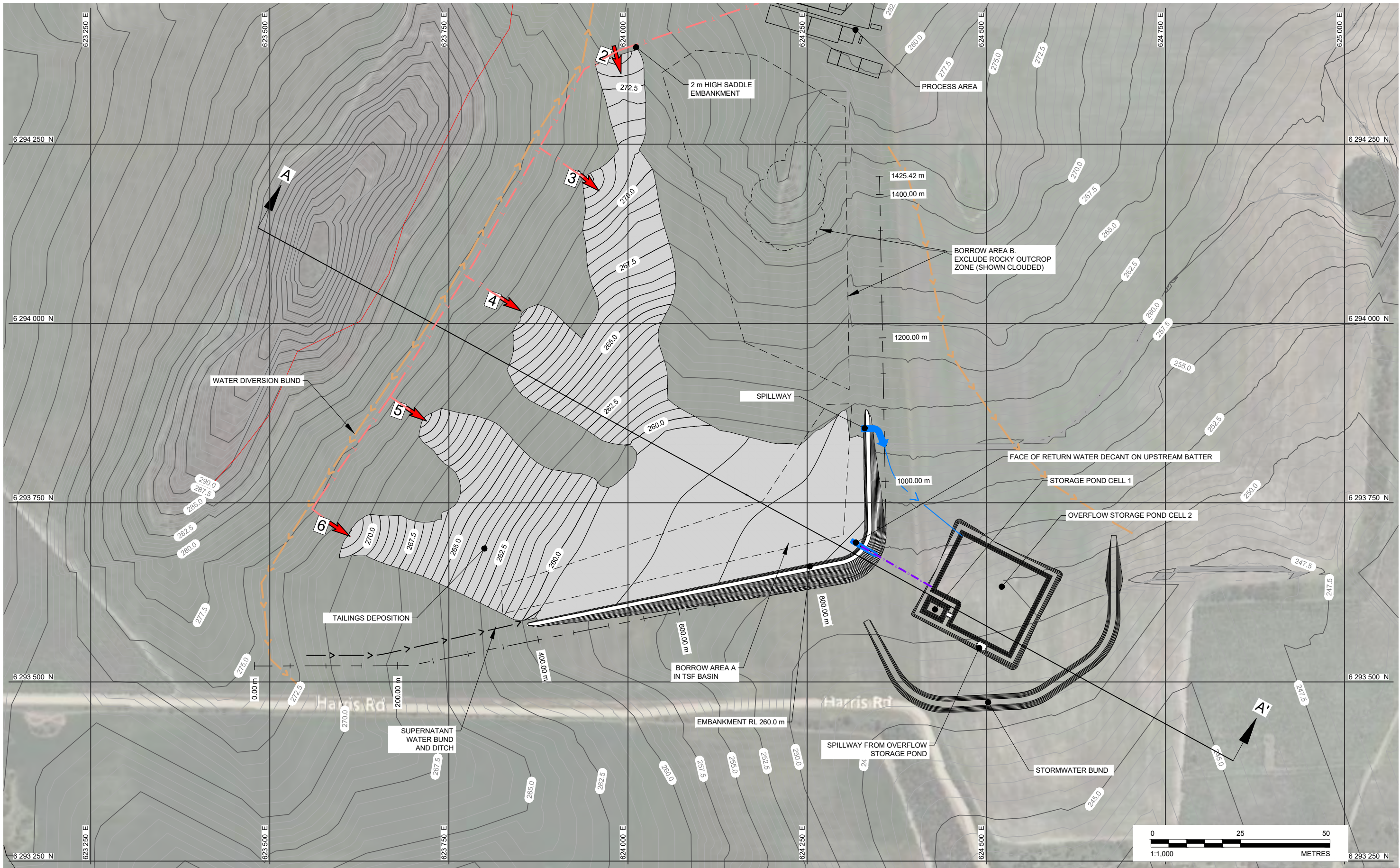
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FIGURE
002

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

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LEGEND

- GRAPHITE MINERALISATION BUFFER
- WATER DIVERSION BUND
- INDICATIVE TAILINGS DISTRIBUTION LINE
- INDICATIVE SPIGOT LOCATIONS
- SUPERNATANT WATER BUND AND DITCH
- INDICATIVE SPILLWAY ALIGNMENT
- RETURN WATER PIPELINE

NOTE(S)

- SURVEY IS A COMBINATION OF 10m CONTOURS PROVIDED BY ARCHER IN FILE "Contours.shp" AND DTM POINTS PROVIDED IN "1401_Campoona_DTM_2014.xlsx"

CLIENT
ARCHER EXPLORATION PTY LTD

CONSULTANT



YYYY-MM-DD	2016-03-10
PREPARED	MMC
DESIGN	BT
REVIEW	PJC
APPROVED	PJC

PROJECT
CAMPOONA GRAPHITE PROJECT

TITLE
YEARS 4.5 - 5.5 - EMBANKMENT 260

PROJECT No.
127663057

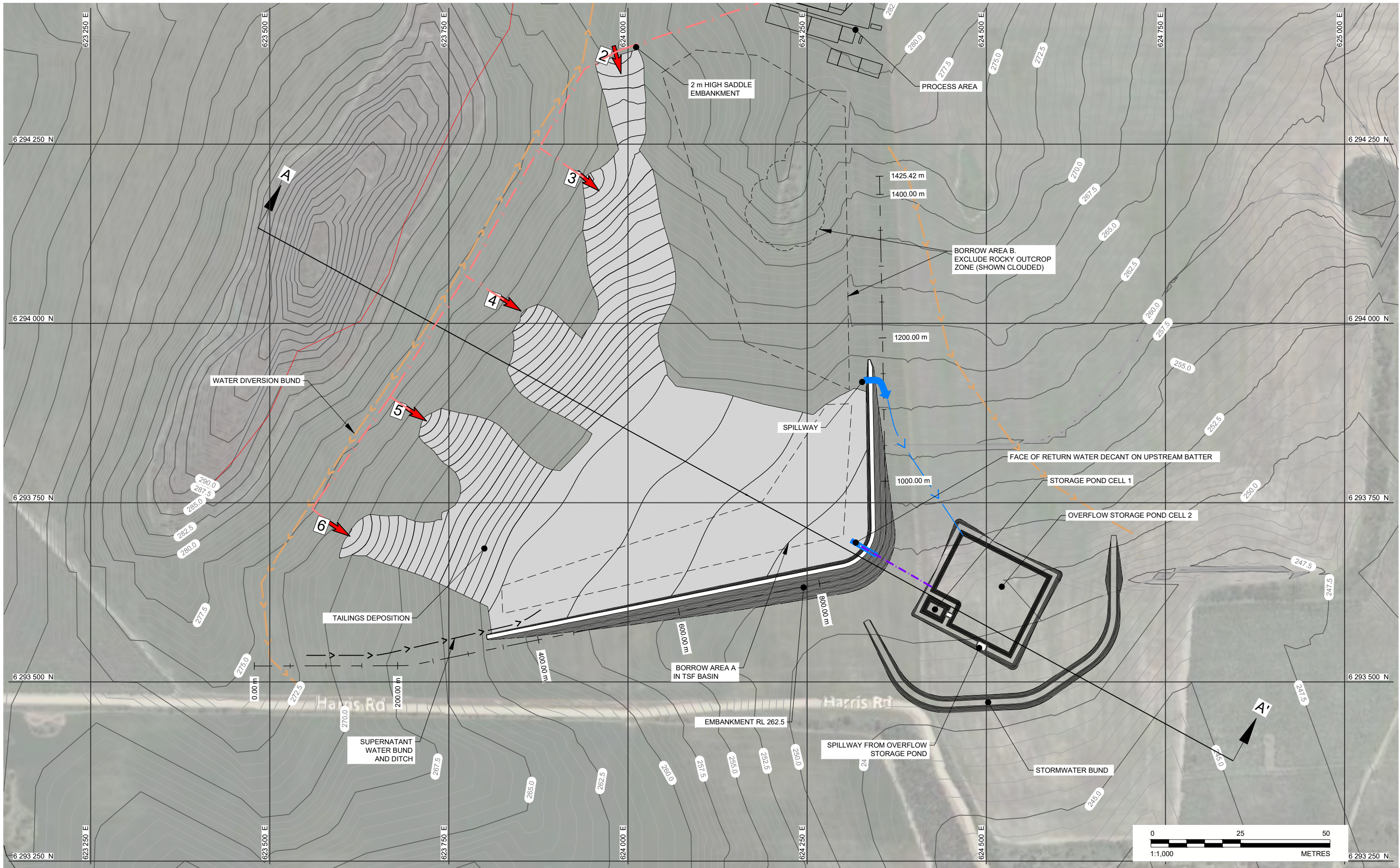
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FIGURE
003

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

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LEGEND

- GRAPHITE MINERALISATION BUFFER
- WATER DIVERSION BUND
- INDICATIVE TAILINGS DISTRIBUTION LINE
- INDICATIVE SPIGOT LOCATIONS
- SUPERNATANT WATER BUND AND DITCH
- INDICATIVE SPILLWAY ALIGNMENT
- RETURN WATER PIPELINE

NOTE(S)

- SURVEY IS A COMBINATION OF 10m CONTOURS PROVIDED BY ARCHER IN FILE "Contours.shp" AND DTM POINTS PROVIDED IN "1401_Campoona_DTM_2014.xlsx"

CLIENT
ARCHER EXPLORATION PTY LTD

CONSULTANT



YYYY-MM-DD	2016-03-10
PREPARED	MMC
DESIGN	BT
REVIEW	PJC
APPROVED	PJC

PROJECT
CAMPOONA GRAPHITE PROJECT

TITLE
YEARS 5.5 - 6.5 - EMBANKMENT 262.5

PROJECT No.
127663057

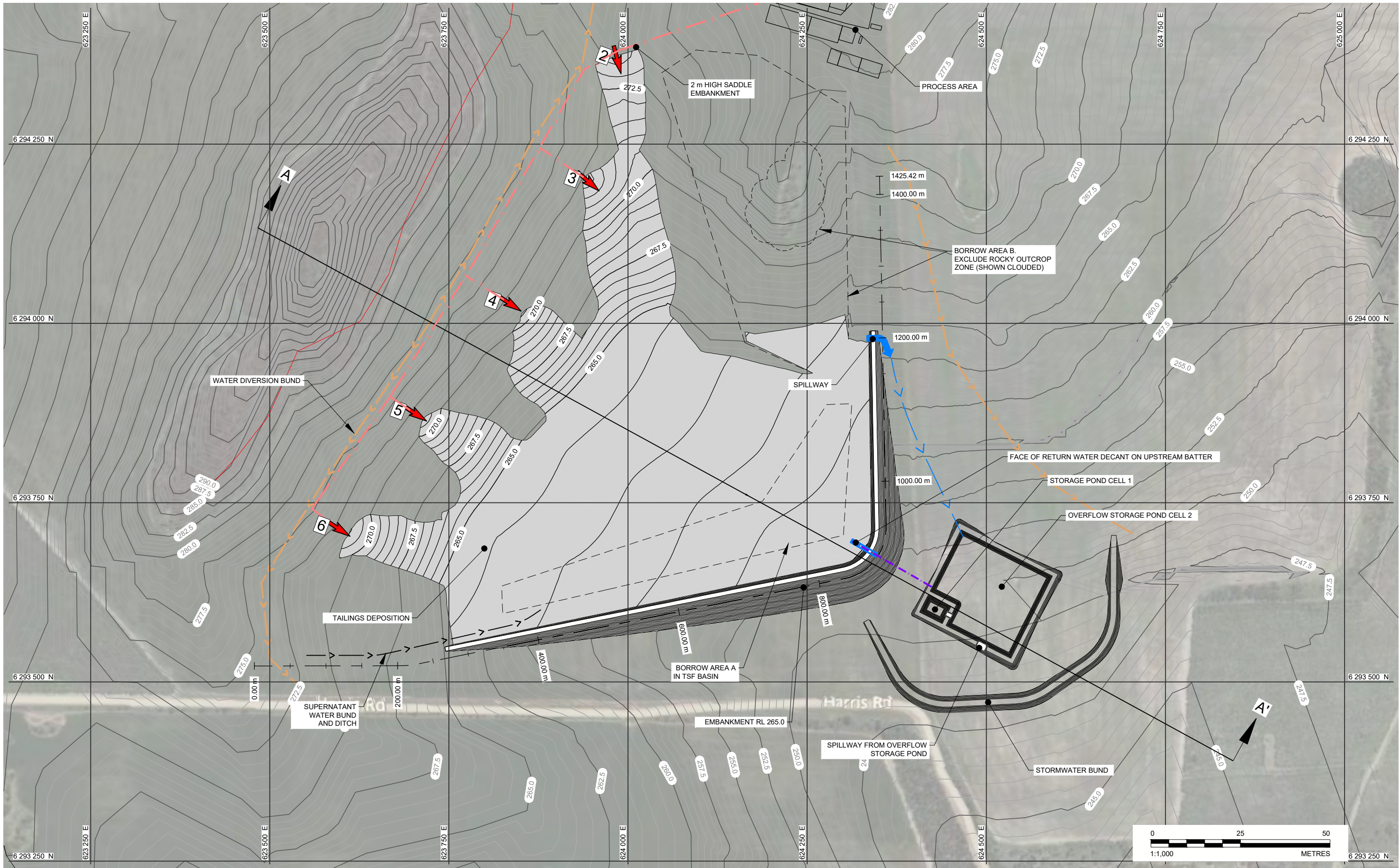
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FIGURE
004

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

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LEGEND

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- SUPERNATANT WATER BUND AND DITCH
- INDICATIVE SPILLWAY ALIGNMENT
- RETURN WATER PIPELINE

NOTE(S)

- SURVEY IS A COMBINATION OF 10m CONTOURS PROVIDED BY ARCHER IN FILE "Contours.shp" AND DTM POINTS PROVIDED IN "1401_Campoona_DTM_2014.xlsx"

CLIENT

ARCHER EXPLORATION PTY LTD

CONSULTANT



YYYY-MM-DD	2016-03-10
PREPARED	MMC
DESIGN	BT
REVIEW	PJC
APPROVED	PJC

PROJECT

CAMPOONA GRAPHITE PROJECT

TITLE

YEARS 6.5 - 9.5 - EMBANKMENT 265

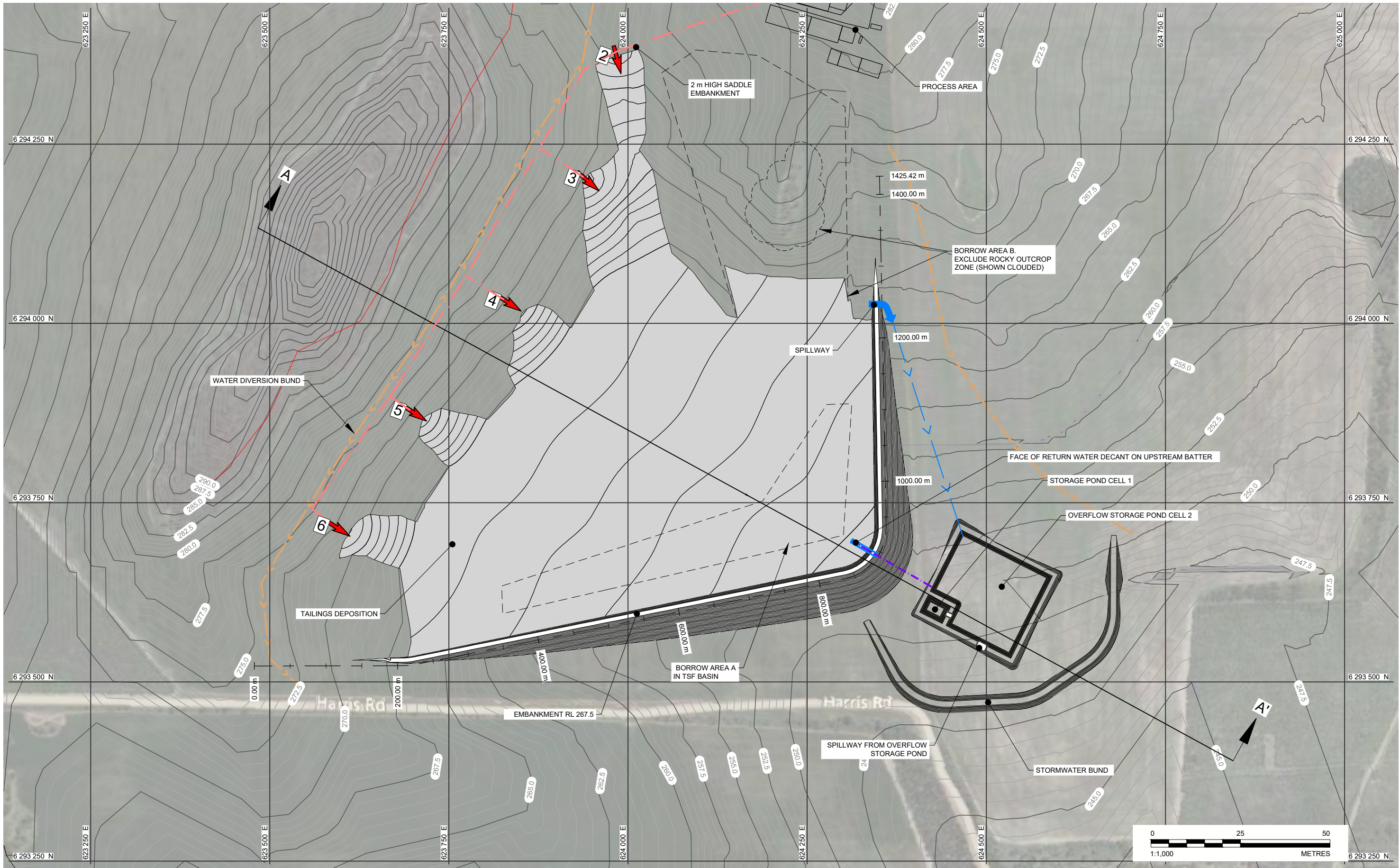
PROJECT No.
127663057

CONTROL
090

Rev.
1

FIGURE
005

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- LEGEND**
- GRAPHITE MINERALISATION BUFFER
 - WATER DIVERSION BUND
 - INDICATIVE TAILINGS DISTRIBUTION LINE
 - INDICATIVE SPIGOT LOCATIONS
 - SUPERNATANT WATER BUND AND DITCH
 - INDICATIVE SPILLWAY ALIGNMENT
 - RETURN WATER PIPELINE

NOTE(S)

1. SURVEY IS A COMBINATION OF 10m CONTOURS PROVIDED BY ARCHER IN FILE "Contours.shp" AND DTM POINTS PROVIDED IN "1401_Campoona_DTM_2014.xlsx"

CLIENT
ARCHER EXPLORATION PTY LTD

CONSULTANT



YYYY-MM-DD	2016-03-10
PREPARED	MMC
DESIGN	BT
REVIEW	PJC
APPROVED	PJC

PROJECT
CAMPOONA GRAPHITE PROJECT

TITLE
YEARS 9.5 - 13.5 - EMBANKMENT 267.5

PROJECT No.
127663057

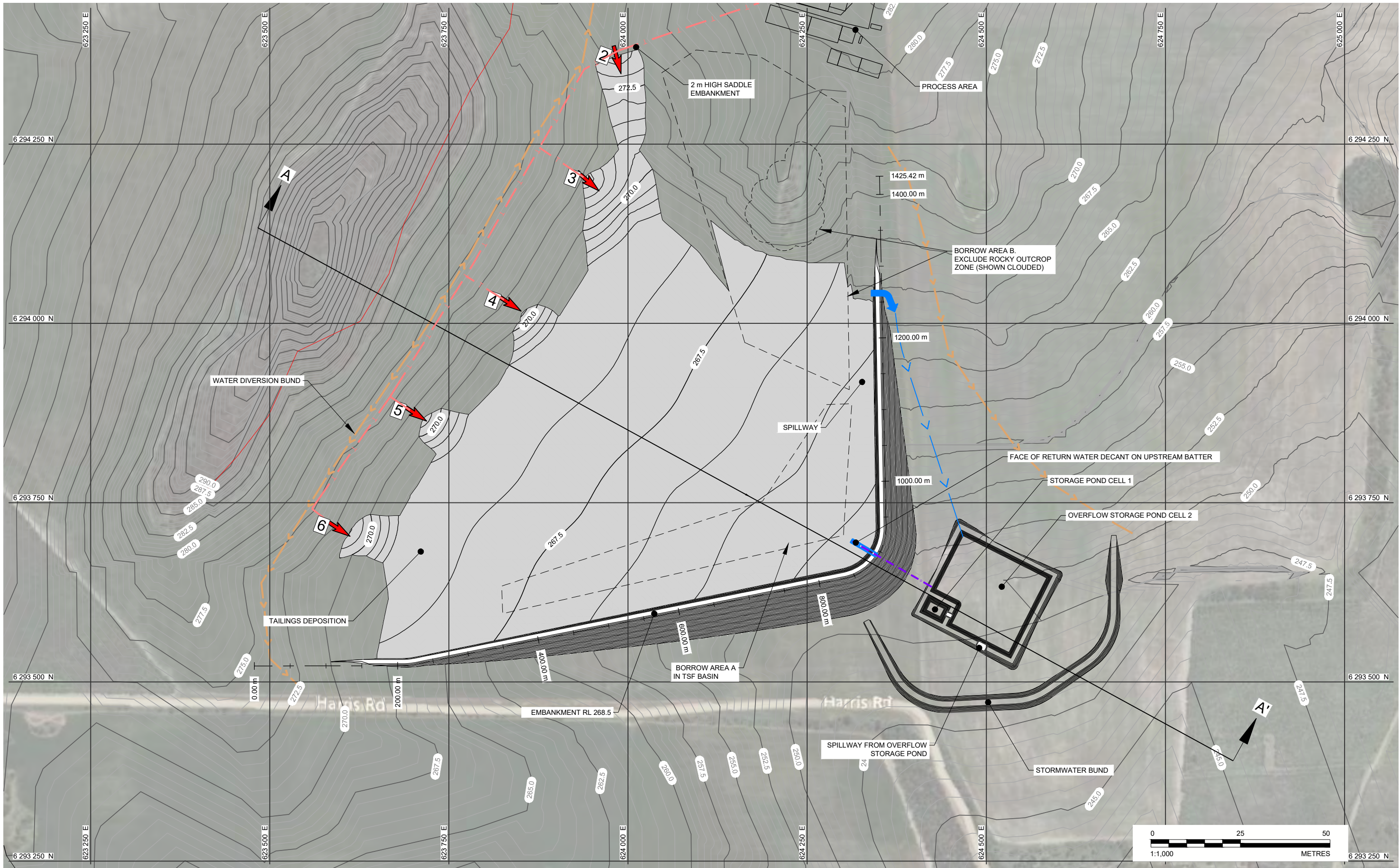
CONTROL
090

Rev.
1

FIGURE
006

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

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LEGEND

- GRAPHITE MINERALISATION BUFFER
- WATER DIVERSION BUND
- INDICATIVE TAILINGS DISTRIBUTION LINE
- INDICATIVE SPIGOT LOCATIONS
- SUPERNATANT WATER BUND AND DITCH
- INDICATIVE SPILLWAY ALIGNMENT
- RETURN WATER PIPELINE

NOTE(S)

- SURVEY IS A COMBINATION OF 10m CONTOURS PROVIDED BY ARCHER IN FILE "Contours.shp" AND DTM POINTS PROVIDED IN "1401_Campoona_DTM_2014.xlsx"

CLIENT
ARCHER EXPLORATION PTY LTD

CONSULTANT



YYYY-MM-DD	2016-03-10
PREPARED	MMC
DESIGN	BT
REVIEW	PJC
APPROVED	PJC

PROJECT
CAMPOONA GRAPHITE PROJECT

TITLE
YEARS 13.5 - 16.5 - EMBANKMENT 268.5 - ULTIMATE

PROJECT No.	CONTROL	Rev.	FIGURE
127663057	090	1	007

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3



3.9.2.10 Monitoring

Regular inspections and monitoring of the TSF landforms and associated infrastructure will be carried out to assess the performance of the TSF to track design performance indicators. This is described in Section 6 of this MLP.

3.9.3 Processing wastes

The tailings management is described in Section 3.9.2.

Process water is described in Section 3.9.2 and oversize waste described below.

3.9.4 Industrial and commercial wastes

The industrial and commercial waste expected to be produced are mostly associated with site construction general site operations such as offices, vehicle operating and the maintenance workshop. The key waste types expected (excluding tailings, soil/overburden) are shown below. Where possible, wastes will be segregated for recycling. Otherwise wastes will be sent to authorised waste depots for disposal. Earthmoving tyres may be retained on site e.g. for demarcation.

Table 3-16: Waste types and examples

Waste Types	Examples
General Waste and Recyclables	Paper and cardboard
	Glass
	Aluminium and steel cans
	Plastic containers and film
	Container deposit (10¢ bottles and cans)
	Electronic waste (e.g. computers)
	Toner cartridges
	Mobile phones
	Fluorescent tubes
	Food waste
Construction and demolition waste	Timber (e.g. pallets)
	Scrap metal
	Masonry (bricks, concrete, ceramics, plasterboard)
	Plastic packaging and film
	Glass
	Hard plastics and PVC
Commercial and Industrial waste (eg from Workshop / site works)	Waste oil, fuels and other lubricants
	Oily rags
	Oil filters
	Used batteries
	Used tyres (small vehicle and large earthmoving)
	Waste solvents and paints
	Empty chemical containers (e.g. plastics, IBCs, Steel containers and drums)

A section of the laydown area will be used for storing quantities of waste oil and lubricants that are not able to be contained in the workshop. This area will be hard stand and have appropriate spill prevention and controls in place. Other wastes will be stored for collection and removal offsite such as in general waste bins, cages and skips.



3.9.4.1 Sewage waste

Wastewater from the Campoona Shaft and Sugarloaf processing faculty office and ablutions buildings will be discharged to an onsite standard packaged septic system for treatment via an effluent soakage trench. The septic systems will be designed and installed to meet the Water Services Association of Australia 02 Sewerage Code of Australia for a 15 to 20 person capacity.

3.10 Supporting surface infrastructure

3.10.1 Access

Planned road upgrades are as follows:

3.10.1.1 ML Campoona Shaft

- The main site access at Campoona Shaft is via Elson-Campoona Road. Improvements are required for the surface of the Elson-Campoona Road to provide all weather access to accommodate mine traffic.
- Works to improve the ephemeral creek crossing on the Elson-Campoona Road are required, such as drainage, mattresses and cement treatment of rubble.
- The intersection of the site access and Elson-Campoona Road will need to be widened to accommodate turning vehicles.
- A new site access road is required to provide appropriate site distances (south of the current access) which will provide access to the site buildings and stockpiles, including a turning loop for B-Doubles.

3.10.1.2 MPL Sugarloaf

- The intersection between the Sugarloaf site access and Jamieson Tank Road would require upgrade and widening for turning and two-way heavy-vehicle traffic.
- Improvements are also required for the surface of Jamieson Tank Road. The improvements will be undertaken in consultation with the District Council of Cleve and likely involve re-sheeting with suitable coarse aggregate.
- The site access road to Sugarloaf from Jamieson Tank Road will need to be upgraded and widened to accommodate haulage vehicles.
- A new turning loop to suit B-Double heavy vehicles is required to access the ROM stockpile at Sugarloaf.
- An unsealed plant access road will be formed from the southeast of the main site access along the eastern, southern and western boundaries of the plant area mainly for product transfer and maintenance access by forklifts and cranes.

3.10.1.3 MPL Water (Pindari wellfield, pipeline and Jamieson Tank water supply)

No road upgrades are planned however the Pindari pipeline construction (along Jamieson Tank Road and Carapsee Hill Road) and the potable water supply line from Jamieson Tank to Sugarloaf will require the pipelines to be buried to meet DC Cleve requirements. The pipeline will be located in verges or within properties.

Negotiations with land owners and relevant authorities to obtain permission is underway.

3.10.2 Accommodation, offices and other auxiliary infrastructure

The facilities described below are for full scaled operations.



3.10.2.1 *ML Campoona Shaft*

No site infrastructure is planned for the initial small-scale trenching phase of the operation.

At full scale production the auxiliary mine site infrastructure is to be located between the East Waste Rock Storage Facility and the mine shaft comprises the following (infrastructure not described elsewhere in this MLP):

- Site office (approximately 6 m × 3 m), lunch / meeting room (approximately 7.2 m × 3 m), ablutions (approximately 7.2 m × 3 m) and car park. These will be transportable buildings.
- Storage:
 - Main warehouse (approximately 300 m² for storage of consumables, spare parts and goods receipts and dispatch).
 - Contractor equipment laydown and waste storage area (eg waste and recovered oils, grease, hydraulic fluids, solvents and paints), which will be approximately 5 m x 5 m bunded concrete pad for storage of wastes in Intermediate Bulk Containers (IBCs) – see Section 3.9.3.
 - 30 kL double walled diesel storage tank (around 2 weeks' supply) and refuelling area (including small balancing tank at the generator and spill collection sump).
- Workshop situated on hardstand and measuring approximately 20 m × 15 m for light vehicle maintenance, light fabrication and electrical repairs (runoff directed to the oil-water separator).
- Concrete vehicle washdown bay (with oil-water separator and silt trap).
- Water truck filling point and fire pump trailer for fire suppression.

Wastewater from the office and ablutions buildings will be discharged to an onsite septic system for treatment via an effluent soakage trench. The septic system will be designed and installed to meet the Water Services Association of Australia 02 Sewerage Code of Australia for a 15-20 person capacity.

Run-off and wash down water from the workshop, vehicle wash bay and diesel refuelling area will be directed to a common sump for treatment via settlement chamber and oil-water separator with submersible pump and laminar plate. The oil will be pumped from the system using a screw pump to a temporary storage tank, and then to the waste hydrocarbon IBS for removal and recycling offsite by an authorised third party. The treated water will be pumped to the sedimentation basin for reuse.

3.10.2.2 *MPL Sugarloaf*

- Site Office and associated car park, with meeting/lunch room, kitchen and ablutions.
- Storage areas:
 - Warehouse and product storage to be reconstructed over the footprint of the existing shed.
 - Laydown area with domestic and commercial/industrial waste storage area (nominally skip bins, intermediate bulk containers (IBCs) and bunded area for storing liquid wastes generated at the site, e.g. used oil and solvents).
 - Reagent storage shed (secure) e.g. for flocculants, sodium silicate and lime, hydrofluoric acid, with bunded area for liquids.
- Frother stored in 200L drums as delivered.
 - Storage and refuelling shed for kerosene, liquid petroleum gas (LPG) and diesel (bunded).
 - Kerosene will be directed to a balancing tank at the process plant and the LPG will be for the drying process.
- Site workshop for process plant maintenance (other maintenance to use existing facilities in the surrounding area where possible).



- Light fabrication and general plant and equipment repair.
- Water reticulation and storage, including process water and raw water ponds, mains supply reticulation, reverse osmosis plant, pipeline from raw water bores at Pindari and associated pumps and power.
- Stormwater runoff and sedimentation pond, pre-treated runoff via and oil/water separator from the warehouse, reagent store and workshop, with overflow directed to a process water pond.
- Water truck refill point (for dust suppression) near the raw water supply dam.

Fire system including tank, pressure pump and hoses to service the site, along with fire extinguishers in buildings. Water sprinklers and flame detectors are planned for the flotation cells and product storage area and hydrants for thickener tanks. Appropriate systems for managing the flammable materials including graphite dust and fuels will be implemented.

- Septic system including soakage trench built to approved standards to manage sewage from offices, lunchroom/meeting room and ablutions.
- Electrical infrastructure connection, high voltage switchboards (3.3 kV and 400 V), transformers and low voltage distribution to the process plant, TSF, water infrastructure, ROM stockpile, workshop, stores and offices.
- Pole and structure (building/plant) mounted flood lights including near buildings, plant and stockpiles.
- Communications hut, fibre connections and PBX.

3.10.3 Public roads, services and utilities used by the operation

3.10.3.1 Roads

The mining activity will require transport of ore between the Campoona Shaft and Sugarloaf processing facility. The route the vehicles will take will be via the eastern route which follows Elson-Campoona Road east from the site then north along the Cleve-Kimba Road and west along Jamieson Tank Road to the Sugarloaf processing facility access road. Further description of the route (including transport estimated number of vehicle movements) is provided in Section 2.15, with planned upgrades outlined in Section 3.10.1 and further detail on the impact assessment and proposed management measures to reduce risk described in Section 6.20.

Services and utilities required for the Campoona Shaft and Sugarloaf processing sites are:

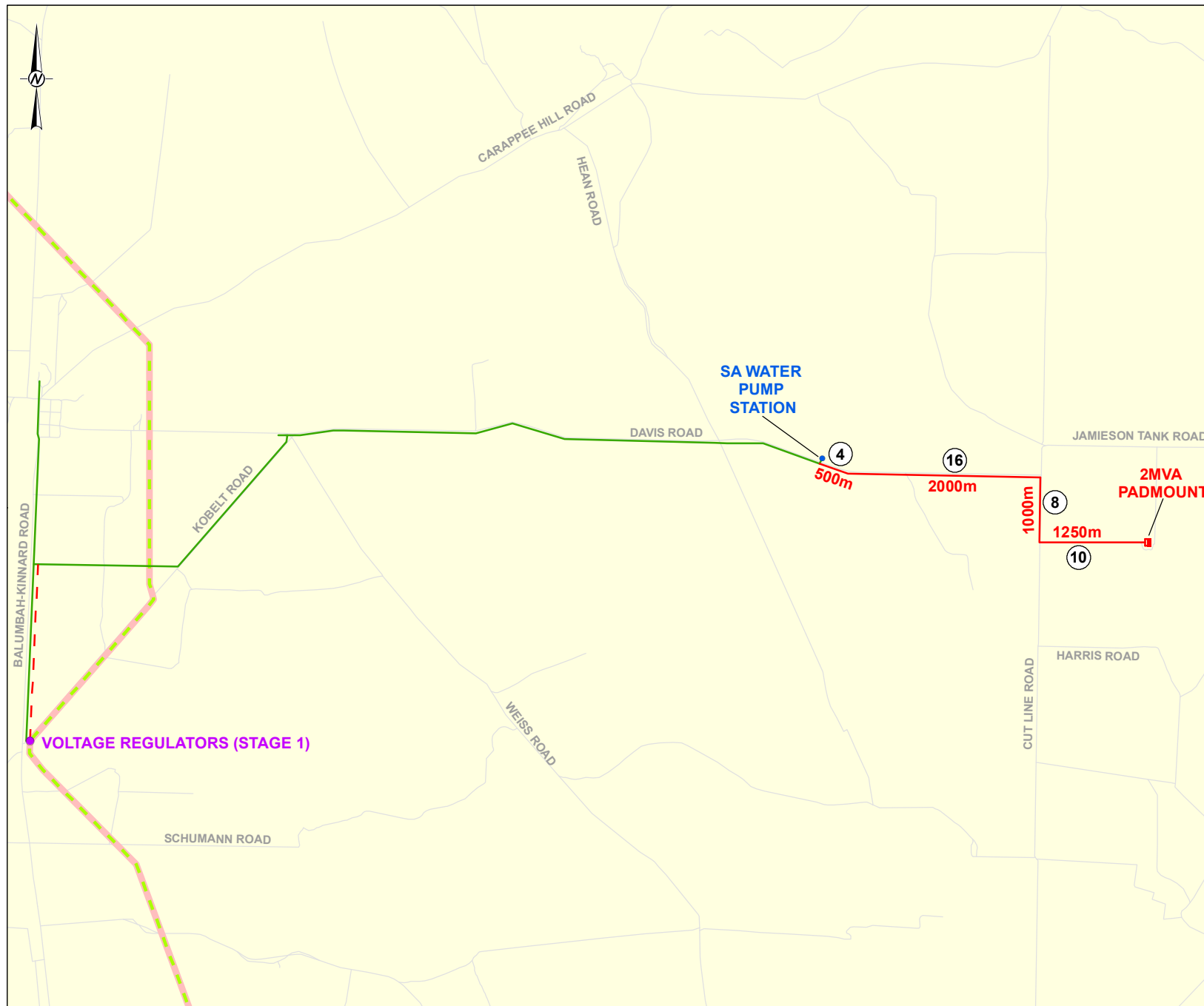
3.10.3.2 Electricity

Initially during small-scale operation, electricity will be supplied to site via the existing grid system which may need to be augmented with diesel generation.

For full scale operations, the total power demand at Sugarloaf is anticipated to be around 1165 kW including 390 kW to account for losses, future needs and contingency.

An 11 kV power transmission line will be constructed to connect power to the Sugarloaf processing site (Figure 3-27). The line from the Darke Peak water treatment facility will run parallel to and on the southern side of Jamieson Tank Road east to the Cut Line Road then 800 metres south before entering the Sugarloaf property. The line will cover 4.75 km and require an easement of at least 15 m wide and associated infrastructure. Power and associated will be provided and maintained by SA Power Networks.

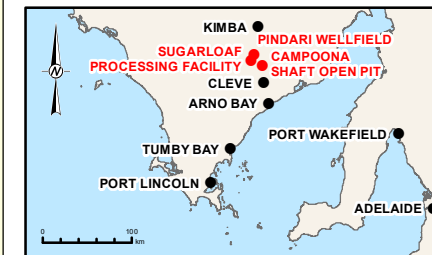
Discussions with the relevant authorities to construct this is underway.



CAMPOONA PROJECT MINING LEASE PROPOSAL

POWER ALIGNMENT SERVICING MPL SUGARLOAF

LOCATION MAP

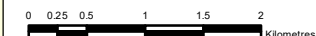


LEGEND

- Stage 1 & 2 Extension
- - Stage 2 Extension
- Existing 11kv Overhead Transmission Line
- Existing 66Kv Overhead Transmission Line
- ④ Powerline Poles Required
- Certificate of Title Boundary
- Road
- Town

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Roads data sourced from DPTI, Department for Transport Energy and Infrastructure, South Australian Government, sourced <http://www.dptapps.com.au/dataportal/Roads.zip>, sourced 19.06.2014.



REFERENCE SCALE: 1:65,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-27
PREPARED: KB
REVIEW: LVC
APPROVED: LVC

**FIGURE
3.27**





3.10.3.3 Water

The water supply for the proposed ML Campoona Shaft mine site will be sourced from a combination of onsite existing dams, bore, water recovered from the WRSF trench water system and any rain water run-off into the open pit. Rainwater or potable water will also be used to fill the 1500 L portable fire pump trailer at Campoona Shaft.

Saline process water for the MPL Sugarloaf processing facility will be sourced from the Pindari Wellfield and from decant water returned from the TSF. Initially some 10 ML of process water per year will be trucked to Sugarloaf from a production bore established at Pindari. At full scale production process water demand will be up to 0.012 ML/h (100 ML per year off set by TSF return water). The water will be supplied via a raw water pipeline from Pindari wells (MPL Water).

Initially potable water will be harvested using the current Sugarloaf collection system and if needed by trucking water from Jamieson Tank. MPL Water includes water to be supplied to the Sugarloaf MPL site by SA Water via a pipeline connecting the Jamieson Tank water reservoir to the site. The water will be stored in a dam with a capacity of 0.5 ML (10-day supply) pumped via 40 mm PE100 poly pipe network. Onsite tanks will store potable water to be trucked or pumped to the site office buildings via a 40 mm PE100 poly pipe.

3.10.3.4 Communications

Connection is proposed to be via the available Telstra fibre network to provide landlines and internet access. Access to the NextG network will also be considered. The site infrastructure will include fibre connections between the communications hut, offices, warehouse, workshop and process plant along with a Private branch exchange (PBX).

3.10.4 Visual screening

Screening that will be implemented to minimise impacts on visual amenity include:

- Placing the MLP Sugarloaf processing facility downslope to reduce visibility to sensitive receptors.
- Positioning waste rock storage facilities at the proposed ML to maximise the benefit as an amenity screen and rehabilitation slopes and vegetation to match the surrounding landscape.
- Tree planting along boundary areas of the proposed ML and if required, MPL Sugarloaf. The locations, density and species will be determined in collaboration with the community and to match local ecological communicates and native species.

An assessment of visual amenity is described in Section 2.4 and the impact assessment and mitigation measures are further described in Section 6.4.

3.10.5 Fuel and chemical storage at ML Campoona Shaft and MPL Sugarloaf

A number of chemicals including fuels will need to be stored at the site for site operations. Explosives storage may also be required at the mine site only. Types of chemicals and fuels that will be on site include the following as listed in Table 3-18.

Table 3-17: Fuel and chemical storages on site

Product	Annual Requirement (tonnes)	Weekly Requirement (tonnes)	Storage Method
Kerosene, diesel collector	210	4	Self bunded tank
Kerosene collector	239	5	Self bunded tank
Sodium silicate (Na ₂ SiO ₃)	52	1	Bulka box
Flocculent (6-3NP10)	630	12	Bulka box
Hydrofluoric acid (49%)	3583	69	Isotainers within a 120% volume bund
Caustic soda (46%)	279	5	Self bunded tank



If graphene is to be produced, small quantities of either sulphuric or phosphoric acid will be needed to facilitate the exfoliation extraction method. Quantities are not known at this time although for any foreseeable timeframe the quantity would be minimal and all permits, transport, storage and use will meet legislated standards.

All chemicals stored on site will have relevant Material Safety Data Sheets and will be stored to meet the *Dangerous Substances Act 1979* and *Dangerous Substances Regulations 2002* and associated guidelines as administered by SafeWork SA.

Appropriate containment (such as the self-bunded tanks) and incident response including spill kits will be in place and isolation and emergency procedures will be developed. Only appropriately trained personnel will be authorised to handle and dangerous substances.

Flammable liquids will be contained within an impervious bund that has 133% capacity, as stipulated by AS1940-2004 and the Dangerous Substances Act. A collection sump will be provided in the bund floor to make it easy to remove accumulated liquids.

All bunds will be routinely inspected to ensure their integrity is maintained.

3.10.6 Site security

The proposed ML Campoona Shaft site will have security fencing along Elson-Campoona Road, with a main double gate at the entrance to prevent public access. The site office and car park will be located near the entrance, where all visitors and deliveries will be directed, with appropriate signage installed. A new site access road will be constructed for access to the site buildings, ROM stockpile and includes a turning loop for large vehicles. A network of 9 m wide internal roads is planned to direct vehicles around the mine site. To ensure farming activities can continue on the surrounding land, Pirie Resources will also construct new stock fencing around the remainder of the site.

A security gate at the site access point will be installed to prevent unauthorised access. The Sugarloaf site office and car park near the entrance at MPL Sugarloaf will be used to control visitors and deliveries to the site. Appropriate signage will be installed to direct all people accessing the site to the correct areas.

Cameras along with access points with swipe cards or similar will be installed to allow authorised site access only to the proposed ML and MPL Sugarloaf. In particular, security cameras and secure storage will be provided for the magazine at Campoona Shaft to prevent unauthorised access.

3.10.7 Silt control and drainage

Swale drains and sedimentation/stormwater ponds on the proposed ML located in the northwest of the site will be constructed to manage runoff (potentially carrying silt) from the Western WRSF. Runoff from Eastern WRSF and site infrastructure will be directed and away from the shaft via a system of swale drains and sedimentation ponds to the east of the site. The water will first be directed to settlement ponds at each location which will be concrete lined to allow clean out of any silt build up, with overflow then directed to a stormwater pond. Further details for drainage around the WRSFs are also provided in the Mine Plan provided in Appendix L. No discharges from site are planned.

Stormwater runoff at MPL Sugarloaf is expected to be extremely low due to the nature of the soil profile however as a precaution stormwater runoff will be collected via two main swale drains and directed to a detention basin at the south east of the processing plant. No discharges from site are planned.

Surface water hydrology at the proposed ML Campoona Shaft and MPL Sugarloaf is described in Section 2.8. The impact assessment and mitigation measures are further described in Section 6.10.



3.11 Personnel inputs

3.11.1 Workforce

Pirie Resources aims to employ locally where possible including engaging a local mining contractor. It is not proposed to have a staff camp on either site and the workforce is likely to be based in Cleve, Cowell, Arno Bay, Kimba and surrounds. If it is not possible to source all the appropriate personnel from the region, external personnel may be sought. Whilst fly in/fly out workers are not specifically envisaged, there may be a limited need at particular stages of the project if specialised skills are required that are not able to be sourced locally.

The initial small-scale trenching at Campoona Shaft will involve 6 – 8 personnel consisting of 2 Company supervisory staff and a mining contractor using a backhoe or excavator and one or two trucks to mine the 10,000 tonnes of graphite ore.

During the construction and pre-stripping phase, the anticipated size of the workforce is up to 60 full time equivalents (FTEs).

At full production the MPL Sugarloaf processing site is expected to require up to 20 permanent people comprising operators, supervisors, electrical and mechanical technicians and a manager. At the proposed ML, permanent personnel will consist of a manager, administration staff, a mining engineer/mine manager, geologist and mine surveyor and vehicle plant operators and maintenance personnel. It is expected that the number of staff, including supervisory and technical staff, required at Campoona will range between 21 and 25 depending on the level of production. Appendix L includes further details on the makeup of the workforce.

Refer also to Section 4.1.1 for information on employment and training.

3.11.2 Energy sources

Refer to Sections 3.10.3 and 3.11.2.

There is currently no zero emission energy source associated with this Project. Pirie Resources may consider installing on-site small-scale wind turbines to supplement mains power requirements.

An assessment of energy use and greenhouse gas (GHG) emissions potentially generated including during construction and operation phases has been completed for the project (Appendix T).

The energy sources considered include diesel fuel and electricity for mining and processing along with consideration of embodied energy in construction materials. Emissions from clearance of vegetation (largely pasture) were considered as part of the construction phase and on-site wastes and wastewater treatment have also been included in the overall greenhouse gas assessment.

The assessment has been completed considering construction versus operational phases on a whole of project basis (i.e. for proposed ML Campoona Shaft, MPL Sugarloaf, MPL Pindari, MPL Potable water and MPL Power). It was completed in accordance with the National Greenhouse and Energy Reporting (NGER) Scheme, operating under the *National Greenhouse and Energy Reporting Act 2007* and using the National Greenhouse Account (NGA) Factors, and with consideration to the *Climate Change Adaptation Framework for South Australia* and *Tackling Climate Change: South Australia's Greenhouse Strategy 2007-2020*. The estimated GHG emissions resulting from vegetation clearing was considered by using the Full Carbon Accounting Model v3.55 (FullCAM).

The main GHG associated with the project is carbon dioxide due to emissions associated mainly with combustion of fuels. Over the lifetime of the project, it is estimated that the project will emit a total of 111,938 tonnes of carbon dioxide equivalent (t CO₂-e) (Scope 1 emissions). Total estimated Scope 1, 2 and 3 emissions is 165,451 t CO₂-e (Table 3-20). Details for the expected energy sources, the annual energy usage and corresponding calculated emissions are provided in Appendix T.



Table 3-18: Total estimated Scope 1, 2 and 3 emissions during clearing, construction and operation over project life

Activity/Phase	Total GHG Emissions (t CO ₂ -e)
Construction (3 months)	
Scope 1 (excluding vegetation)	3,782
Vegetation Clearing	1,060
Scope 3	891
<i>Sub-total</i>	<i>5,733</i>
Operation (13 years)	
Scope 1	107,107
Scope 2	46,891
Scope 3	5,720
<i>Sub-total</i>	<i>159,718</i>
Total	165,451

3.11.2.1 Carbon offsets and efficiency gains

The risks and mitigations measures for greenhouse emissions generated by the project including through carbon offsetting and efficiency gains are detailed in Section 6.4.3.

The vegetation planting along boundaries will serve two purposes: to help screen the site and improve amenity outcomes and will offset some of the emissions generated by this project. The exact amount of offset will be determined once the vegetation plan is completed in collaboration with the local community. The impact from vegetation clearance has also been minimised by shifting project activities away from dense stands of trees and shrubs at the mine and processing site.

Potential efficiency gains can be achieved through actions including implementing energy-efficient guidelines for construction work, such as minimal idling time for machinery or complete shut off using vehicles with good GHG emissions ratings and having transport planning to optimize the efficiency of freight and transport of personnel to site. Pirie Resources will also investigate opportunities to improve energy efficiency of its operations, plant and resource use during the life of the project in line with a project environmental management system.

3.11.3 Water sources

3.11.3.1 ML Campoona Shaft

Initially during the small-scale start-up trenching phase, any water required during the short mining campaign would be recovered from the existing farm dam that lies immediately west of the trenching area.

Rainwater will also be harvested from the open pit and the WRSF trenches. Offices will have a water tank filled with potable water and rainwater tanks will also be installed.

Daily water demand at Campoona Shaft is expected as follows:

- Warehouse and workshop: 3.6 kL
- Washdown water: 15 kL
- Dust suppression: 30 kL
- Potable water: 1.3 kL
- Evaporation losses: 5kL.

Water will be collected via sumps and reused in site-based activities. No water is expected to be discharged from the site.



Depending on annual rainfall, it is possible that an onsite bore at the proposed ML will be developed and used for small scale operational needs such as dust suppression.

3.11.3.2 *MPL Sugarloaf*

A key water supply will be provided by the MPL Pindari groundwater bores where two water sources have been identified at around 15 m bgl and 30 m bgl. This area has good yield to provide process water (salty water is appropriate for this process) for the mining operation. The supply will be supplemented by mains supply from SA Water's Jamieson Tank from where between around 40 ML to 80 ML may be sourced.

Initially during the small-scale operation process water will be trucked to Sugarloaf from Pindari and stored in a lined process water pond.

The raw water will be stored in a pond and used to supply up to 0.012 ML/hr process water demand (100 ML per year off set by TSF return water). The water will be continuously pumped to a holding tank and then via a transfer pump which operates 12 hours a day to a 0.75 ML pond at the processing facility. The process water pond will also include treated water from an oil-water interceptor trap from the warehouse, workshop and stores. Up to 90% of the tailing slurry water will be available for reuse in the processing facility.

Up to 2 days supply will be stored on site.

Refer to Sections 3.8.4 and 3.10.3 for further information.

3.12 Mine closure

3.12.1 Closure domains, component and anticipated land uses

The aims of this conceptual mine closure plan are to demonstrate acceptable planning to successfully rehabilitate and close the project. The objectives are as follows:

- Establish an initial and conceptual detail mine closure plan that will be reviewed and updated in accordance with the Program for Environment Protection and Rehabilitation (PEPR) review schedule.
- Align closure planning with the expectations of stakeholders for post-mining land use.
- Ensure vegetation is resilient, self-sustaining and congruent with final land use objectives.
- Make the site physically safe post-mining.
- Ensure the site does not pose a geochemical risk to human-health or the environment over a long-term (hundreds of years).
- Enable mine closure process and lease relinquishment to occur in a cost-effective and efficient manner.
- Incorporate progressive rehabilitation and relinquishment where opportunities present.

Figure 3-28 shows the closure planning process and the increasing level of accuracy that will be developed throughout the life of the mine in accordance with industry standards as described by the International Council on Mining and Metals. Key stakeholders such as local landholders, the District Council of Cleve and DSD will be consulted in relation to their concerns and interests for mine closure which will be taken into in revisions as Pirie Resources progresses to the detailed Mine Closure Plan.

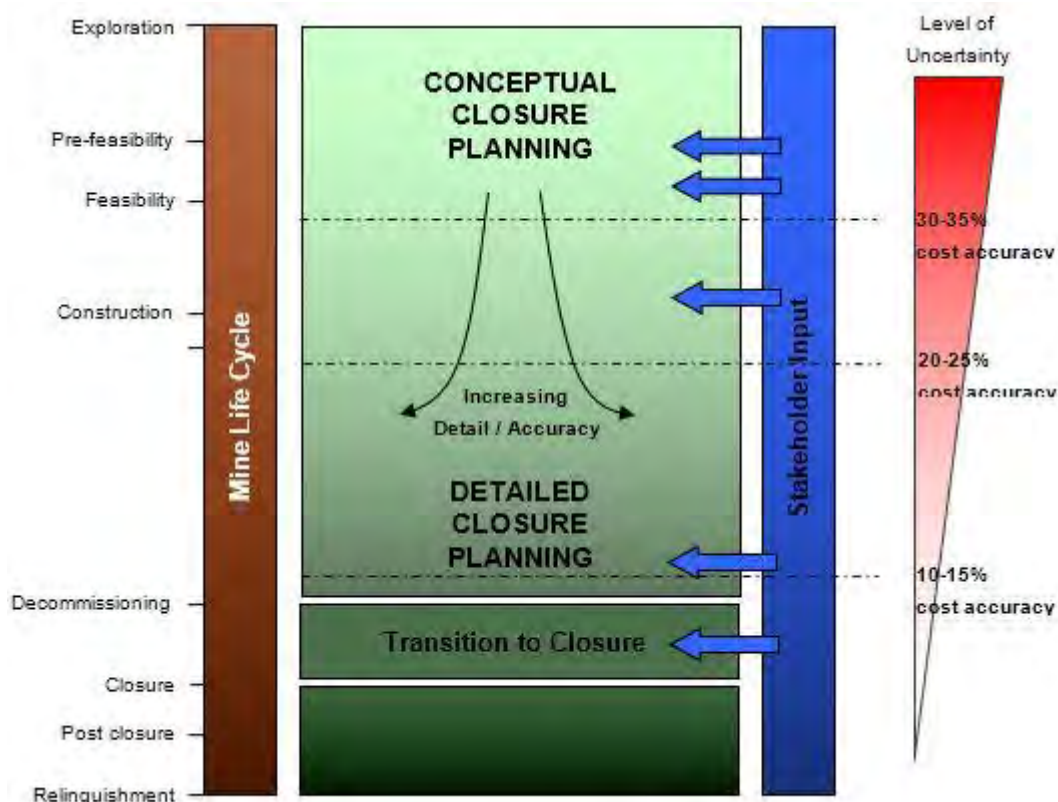


Figure 3-28: Mine closure planning development process

The Project has been broadly divided into categories, generally known as domains, for closure. Closure domains are areas or items with common characteristics that have similar closure methodologies, landforms and land uses. The domains, their components, closure criteria and conceptual final land uses are provided on a whole of project basis in Table 3-19. The preliminary closure criteria presented have been discussed with stakeholders.



GRAPHITE PROJECT MLP AND MPS

Table 3-19: Closure domain components, closure criteria and conceptual final land uses

Closure Domain	Components	Conceptual Final Land Use
Site infrastructure	■ Processing plant and associated infrastructure ■ Borefield and associated pipeline ■ ROM ■ Administration offices ■ Workshop areas ■ Magazine storage ■ Sewage and potable water	Pastoral use.
Open pit	■ Open pit	Open void with ephemeral lake for wildlife habitat.
Waste rock storage facilities	■ E-WRSF ■ W-WRSF	Stabilised landform with resilient, self-sustaining native vegetation of local provenance.
Exploration	■ Drill holes, pads, sumps and costeans ■ Tracks and gridlines	Pastoral use.
Access and haul roads	■ Haul roads ■ Internal access roads	Pastoral use. Some access tracks may be left to facilitate landowner access to property.
TSF	■ TSF and associated pipes and pumps	Stabilised modified landform suitable for grazing. Aesthetic scenery with limited wildlife habitat.
Water drains and ponds	■ Surface water management structures	Ephemeral drainage.
Extractive workings	■ Borrow pits	Stabilised landform with resilient, self-sustaining native vegetation of local provenance.

3.12.2 Description of sites at completion

Pirie Resources recognises that the progressive rehabilitation of mining disturbances while the operation is still active plays an important role in closure and is committed to progressively rehabilitating the mine where practicable. The ability to progressively complete large areas of rehabilitation during operations will be influenced by the mine schedule, availability of areas, the availability of materials and site conditions, particularly rainfall that is essential in the establishment of vegetation cover. For example, the tailings storage facility, open pit and processing plant will not be available until closure whereas the WRSFs will be available for progressive rehabilitation during the life of the mine (E-WRSF from year five and stage one of W-WRSF from year 10). Other areas that may be available for progressive rehabilitation during the life of the mine include any areas of exploration activities at Sugarloaf and borrow pits.

While it is intended to undertake as much progressive closure and rehabilitation as possible during operations, by its nature closure rehabilitation will primarily happen once operations are complete. In addition, while every effort has been made to plan and hence describe operations accurately, it is expected that some changes will occur to the current project description during the life of the mine.

At closure, the project will have infrastructure and land disturbance at the three main locations: the proposed ML Campoona Shaft, MPL Sugarloaf and MPL Pindari, along with minimal disturbance at MPL Water.



3.12.2.1 Site infrastructure

The general closure strategy to meet the conceptual final land use of pastoral use will include removal of all structures, buildings will be removed from site, unless otherwise agreed with the post-mining landholder. Should the post-mining landholder wish to retain any infrastructure, Archer will leave the infrastructure in a safe and secure manner.

Any residual liquids, chemicals and hazardous materials from pipes, tanks and storage will be removed. Contaminated material will be remediated, and if necessary, removed and disposed of at an appropriately licensed facility. Concrete pads will be broken up and either disposed of on site, used as clean landfill in areas of existing disturbance where the landform is amenable to filling, or transported off site for disposal in an appropriate clean fill facility. Large concrete footings remaining in place (i.e., below 0.5 m bgl) will be made safe and buried in situ.

Areas covered by road base, fill or hardstand will be excavated. Pipelines and services brought to the surface during ripping will be removed from site. Services below 0.5 m bgl will remain buried if it does not pose an environmental or safety risk.

Site preparation and revegetation for areas within the site infrastructure domain will be as per the strategy detailed in Section 3.12.5.

All product stockpiled on the ROM will be transported off-site. The area of the ROM will be deep ripped to reduce the impact of compaction, topsoil respread and the area ripped and contour furrowed or ripped prior to replanting. Following site preparation, the revegetation of the ROM areas will occur by seeding or direct planting.

3.12.2.2 Open pit

A pit void will remain at the cessation of mining at Campoona Shaft. This pit void has the potential to form an ephemeral pit lake, as such the final land use is proposed to be wildlife habitat. At closure the pit void will be completed with a pit abandonment bund to meet accepted closure specifications DOIR (1997) set back past a geotechnically stable point, with access ramp blocked and a perimeter fence and warning signage established. The mine plan and mine design shows the perimeter of the pit remains within the MC/ML boundary. Further geotechnical stabilisation such as high wall re-profiling is a possibility if for any unforeseen reason, the pit slope could impact on the road. Regular geotechnical assessments will be undertaken to address this risk in a practicable, progressive and proactive manner.

Groundwater in the fractured rock system could be encountered at depths below 50 m. However, groundwater yields from the fractured rock system in the Campoona Shaft are low to negligible and although the pit will probably extend below the water table, it is expected to be dry during operations, apart from runoff from incident rainfall (Golder 2015). The pit void is also therefore, expected to act as a terminal sink (in the sense of McCullough *et al.* 2013), further preventing transmission of any existing pit waters into regional aquifers.

3.12.2.3 Waste rock storage facilities

There will be two waste rock storage facilities at cessation of mining (E-WRSF and W-WRSF). The foremost rehabilitation objective for the waste rock storages will ensuring the final landform will be stable (physically and chemically) and supports self-sustaining native vegetation of local provenance. The waste rock storages will be progressively rehabilitated if no longer required for mining. The E-WRSF will be available for progressive rehabilitation from year four. W-WRSF will be developed in two stages, with the first stage available for progressive rehabilitation from year 10, while the second stage will not be available for rehabilitation until after mining has ceased in year 13.

Earthworks associated with rehabilitation will be undertaken to shape landforms to mimic the regional topography, with batter angles reduced to 20° leaving 5 m berms in between. The progressive revegetation undertaken during mine life will guide the revegetation technique used to cover the final waste rock storage facilities; however, as a minimum, topsoil will be applied at a minimum of 0.1 m thickness before ripping to 0.3 m to 0.5 m depth at 0.5 m spacing. Following site preparation, the revegetation of the waste rock facilities will occur by seeding or direct planting.



Potentially acid forming (PAF) material is known to be present in the waste rock and is anticipated to be encountered in Stage 3 of the mining operation. A donut-shaped PAF cell will be incorporated within the W-WRSF. The PAF cell will be a void (average radius of 40 m) generated in the middle of W-WRSF. All PAF waste rock will be encapsulated in this cell, which can accommodate up to 250,000 t, including capping. Detailed design of the PAF cell, including capping design, will be undertaken during preparation of the PEPR.

3.12.2.4 *Exploration*

All exploration areas will be rehabilitated and revegetated to establish landscape function and vegetation that is resilient, self-sustaining and comparable to surrounding areas. To accomplish this, drill holes, costeans or bulk sampling pits and drill pads will be rehabilitated according to South Australian regulatory requirements at the time of closure.

All exploration tracks and gridlines will be rehabilitated as per the strategy detailed in Section 3.12.5. The objective will be to provide landscape function and vegetation that is resilient, self-sustaining and comparable to surrounding areas.

3.12.2.5 *Access and haul roads*

The site access road will be left in place at Campoona Shaft, albeit following rehabilitation to a single track. This will provide access to the areas for ongoing monitoring and maintenance while discouraging public access. All other access tracks and haul roads not required to access ongoing monitoring sites will be rehabilitated and revegetated to provide landscape function and vegetation that is resilient, self-sustaining and comparable to surrounding areas.

3.12.2.6 *Tailings Storage Facility*

The TSF is planned to be located in a cross-valley area to the south west of the processing plant. This location was selected to take advantage of the natural topography to direct and contain the tailings and to allow for the closure landform to be sympathetic to the surrounding landscape by filling the valley to produce a gently undulating ridge.

By using existing topography, the existing valley and depression will be filled to form an elongated ridge that sheds the water to the south and the east to the natural slopes adjacent to the TSF. The slopes of the embankment shall be flattened to a maximum slope of 1V:5H, with a majority of the slope in the order of 1V:7H or flatter. This work will likely take place as part of the final wall raise, allowing the slopes to be constructed in a concave shape, to mirror natural slopes and manage erosion. The pond is anticipated to be incorporated into the closure landform, within the footprint of the closure slope.

Results from the consolidation assessment indicate that the majority of consolidation occurs by the end of deposition. Tailings are expected to settle by 32% to 36% over the life of the TSF, and the average dry density at the end of operations will be around 1.2 t/m³.

The closure design criterion for the area is for the TSF to be returned to grazing land. A cover using a mix of tailings, natural clayey sands and topsoils collected from the TSF area will be placed to promote grass growth will be placed over slopes and re-profiled to a water shedding design. By utilising the existing topography, the existing valley and depression will be filled to form an elongated ridge that sheds the water to the south and the east to the natural slopes adjacent to the TSF. The slopes of the embankment shall be flattened to a maximum slope of 1V:5H, with a majority of the slope in the order of 1V:7H or flatter with concave slopes constructed to mirror natural slopes and manage erosion. On flatter slopes, a growth medium suitable for typical grasses found in the area and grasses will assist to reduce rainfall runoff and encourage water infiltration and sustain grass cover.

The pond is anticipated to be incorporated within the footprint of the closure slope. The stormwater dam associated with the TSF will be levelled and graded to fit in with the existing topography.

Geotechnical stability for the closure landform was assessed for both static conditions and pseudo-static loading considering both block and circular slip planes. Assuming the likely phreatic surface from the seepage assessment, the model indicates a FoS of 3.0 under static conditions and a FoS of 1.1 under pseudo-static loading.



Detailed design of the TSF will be undertaken during the preparation of the PEPR. During this stage of planning detailed design will include requirements for a cell within the TSF to contain the volume all tailings material identified as PAF. Proposed cover design consistent with closure objectives of the final land use will also be provided within the PEPR.

In the event that early termination of mining operations is necessary, the TSF would need to be decommissioned prior to achieving the design capacity. In that case, the following steps would be implemented:

- A pre-decommissioning review of the TSF will be carried out and a specific closure plan developed to meet the closure needs at the stage of development of the TSF.
- Depending on the stage of development, the slopes will be graded to shed water to the east and south.
- The exposed tailings surfaces would be covered with topsoil spread over the area and revegetated with pasture grasses.

3.12.2.7 *Water drains and ponds*

Major surface water management structures will primarily comprise sedimentation ponds and drains. Following closure any residual material in the sedimentation ponds will be analysed to determine if it constitutes contaminated material. Contaminated material will be remediated, and if necessary, removed and disposed of at an appropriately licensed facility. All pipework and infrastructure will be removed.

Immediately following closure, it is likely that these surface water management structures will continue to be required to capture any sediment from the recently rehabilitated areas and demonstrate that water quality objectives have been achieved. Once surface water structures are no longer required, structures will be removed and land surface re-contoured prior to replanting with vegetation of regional relevance and provenance. The areas will be revegetated to provide landscape function and vegetation is self-sustaining and comparable to surrounding areas.

3.12.2.8 *Extractive workings*

Borrow pits will be contoured to provide safe batters for fauna and public. The borrow pit areas will then be revegetated with species of regional relevance and provenance. The areas will be revegetated to provide landscape function and vegetation is self-sustaining and comparable to surrounding areas.

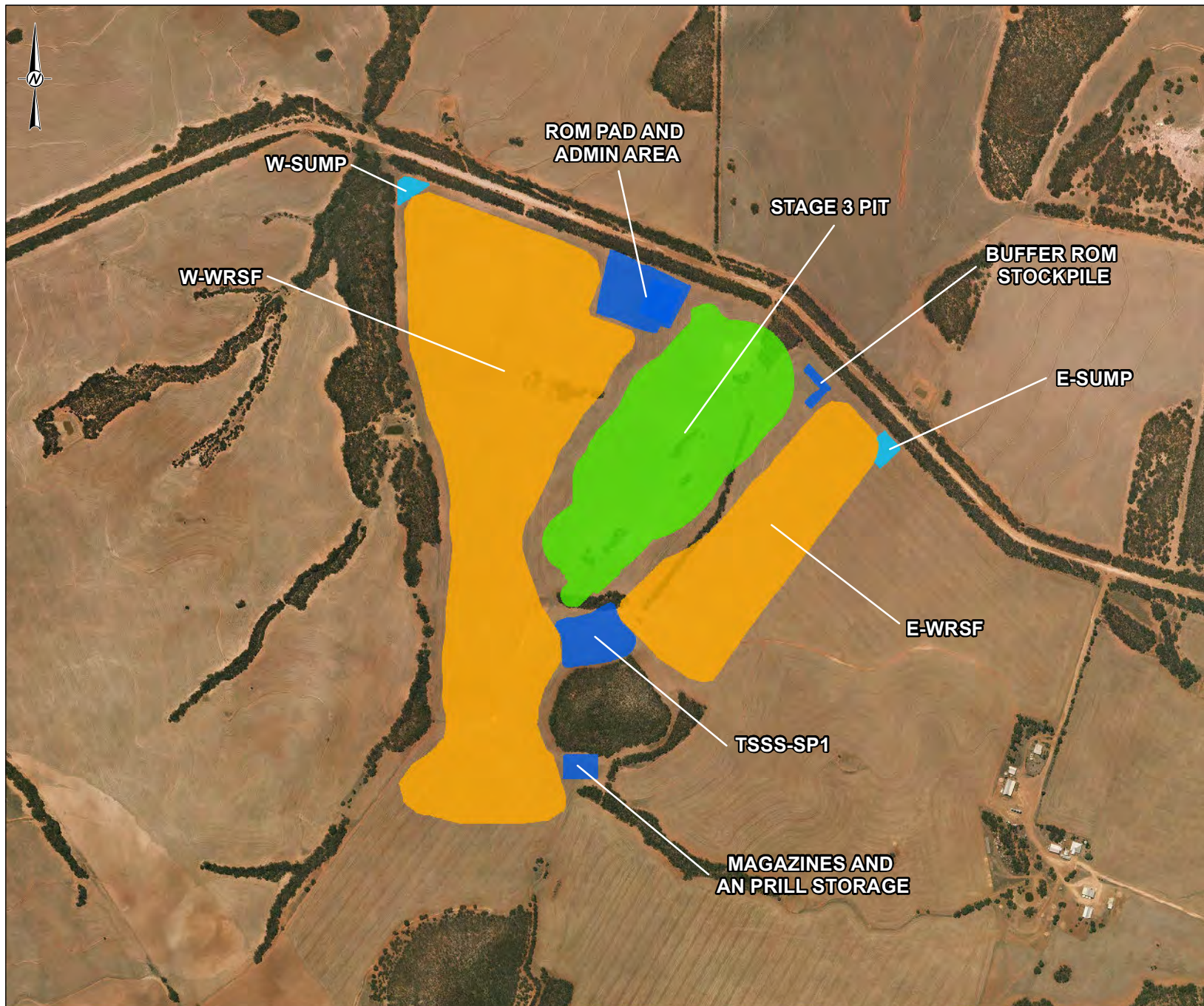
3.12.3 *Natural contour disturbance*

Contours of land that will be disturbed include the areas where ROM, topsoil and WRSF stockpiles will be located, supporting site infrastructure and the open pit mine itself. Rehabilitation of stockpiles will be undertaken to blend with the natural topography of the surrounding land. Existing drainage lines (creeks) will also not be disturbed.

ML Campoona Shaft open pit and WRSF cross sections are found in Figure 3-30, Figure 3-31 and Figure 3-32 (Stage 3 profile).

3.12.4 *Location of closure domain areas and closure contours*

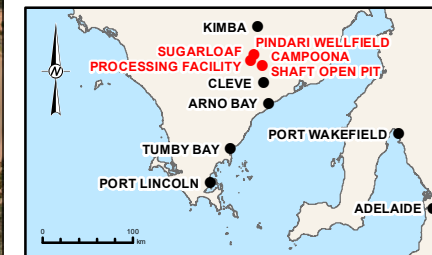
The location of the closure domains and relevant surface infrastructure for the proposed ML Campoona is shown in figure 3-29.



CAMPOONA PROJECT MINING LEASE PROPOSAL

PROPOSED ML CAMPOONA SHAFT CLOSURE DOMAINS AND INFRASTRUCTURE

LOCATION MAP



LEGEND

Closure Domains

Site Infrastructure

Open Pit

Waste Rock Storage Facilities

Water Drains and Ponds

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Site plans sourced from Archer Exploration.

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1. Aerial image sourced from Mapland, Department of Environment, Water and Natural Resources, South Australian Government.



REFERENCE SCALE: 1:10,000 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: RP
APPROVED: LVC

**FIGURE
3.29**





The natural landscape of the proposed ML Campoona Shaft is generally flat to gently sloping. The main changes to topography will be the open pit mine and WRSFs. Cross sections and / or original topography and closure profiles are provided as follows:

- ML Campoona Shaft open pit and WRSF cross sections: Figure 3-30, Figure 3-31 and Figure 3-32 (Stage 3 profile).

Revegetation is discussed in Section 3.12.5.



Figure 3-30: ML Campoona Shaft plan view of cross sections (projection GDA 1994, MGA Zone 53)

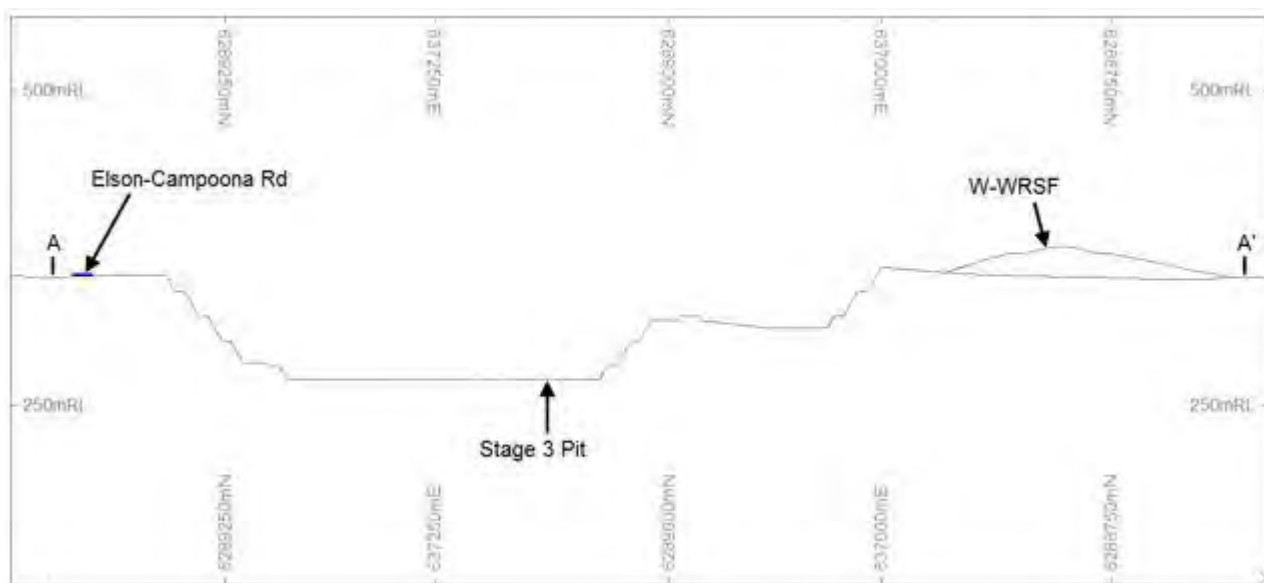


Figure 3-31: ML Campoona Shaft cross section A (projection GDA 1994, MGA Zone 53)

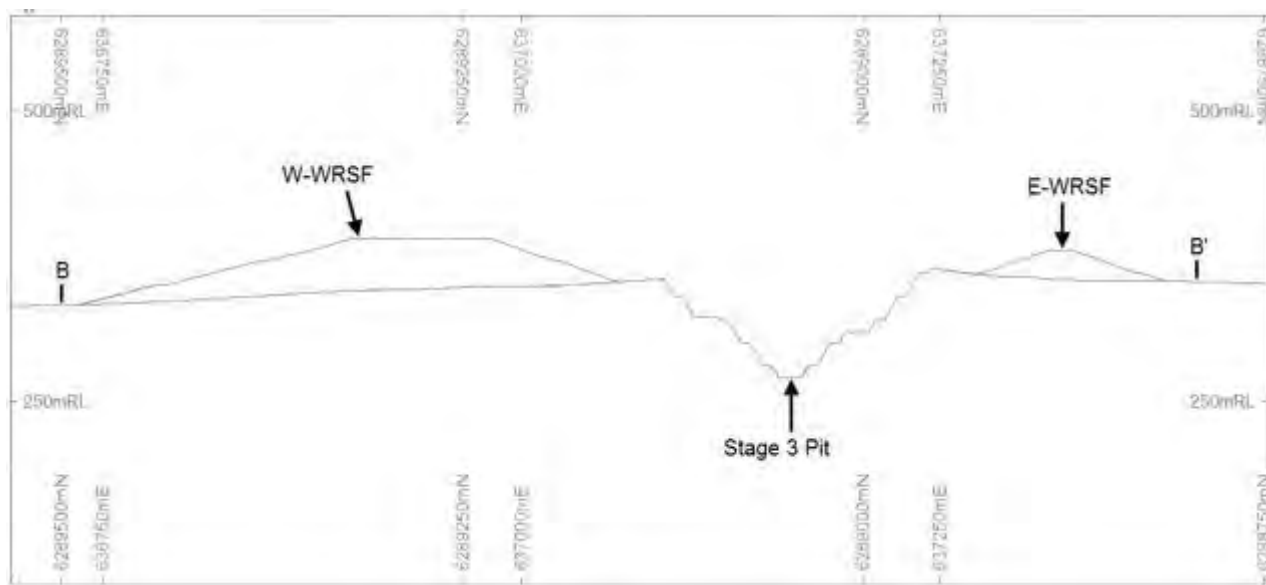
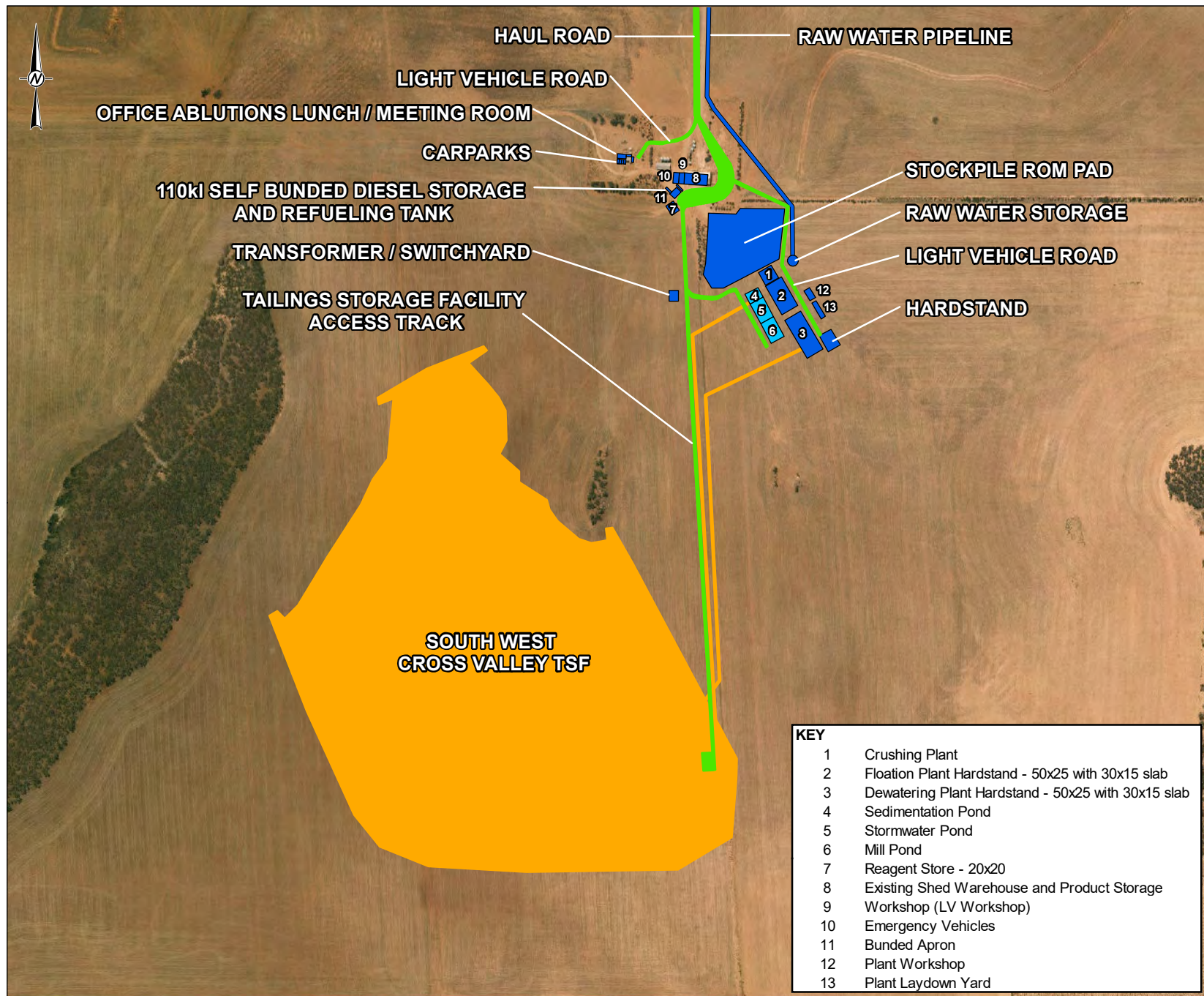


Figure 3-32: ML Campoona Shaft cross section B (projection GDA 1994, MGA Zone 53)

The location of the closure domains and relevant surface infrastructure for the proposed MPL Sugarloaf is shown in Figure 3-33. Figure 3-34 shows the location of the rehabilitated TSF at closure.

The natural landscape of MPL Sugarloaf is generally flat to gently sloping. The main changes to topography will be the TSF. Cross sections and / or original topography and closure profiles is provided in Figure 3-35.

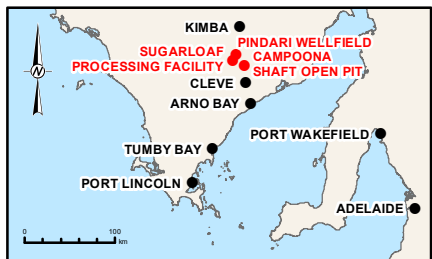
Revegetation is discussed in Section 3.12.5.



CAMPOONA PROJECT MINING LEASE PROPOSAL

MPL SUGARLOAF CLOSURE DOMAINS AND INFRASTRUCTURE

LOCATION MAP



LEGEND

Closure Doamains

- Site Infrastructure
- TSF
- Access and Haul Roads
- Water Drains and Ponds

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Site plan sourced from Archer Exploration. Drawing No: Sugarload_layout_20150216.

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1. Aerial image sourced from Mapland, Department of Environment, Water and Natural Resources, South Australian Government.



REFERENCE SCALE: 1:7,500 (AT A4)

PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: KB
REVIEW: RP
APPROVED: LVC

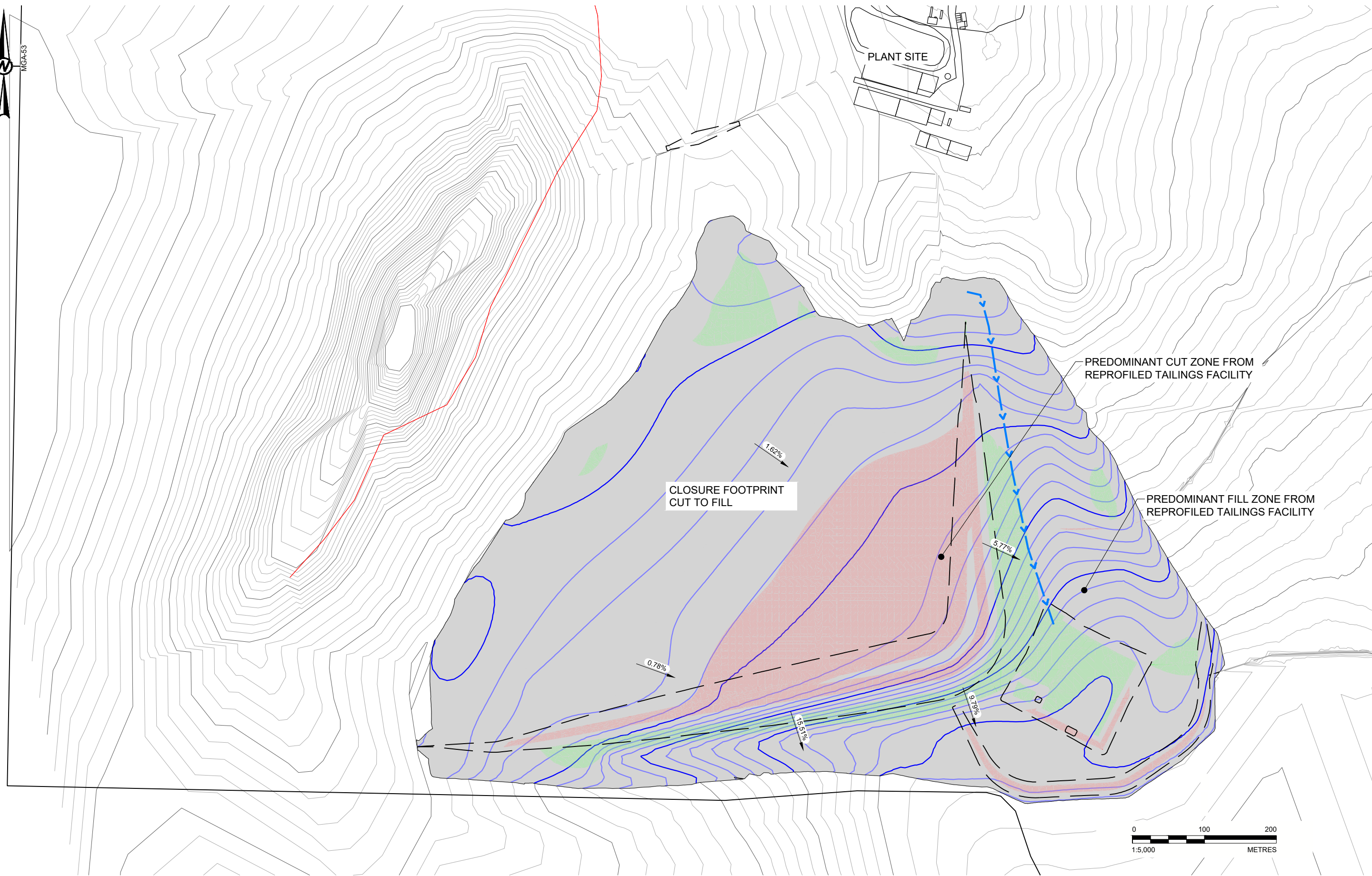
**FIGURE
3.33**



Path: \\pdr\dfs\pdr\Brabner\Geomatics\pdr_resources\CAMP00\VA199_projects\127663057_deposition02_PRODUCTION\DWG_1 File Name: 127663057-100-F-009.dwg



MGA-53



LEGEND
GRAPHITE MINERALISATION BUFFER

CLIENT
PIRIE RESOURCES PTY LTD

CONSULTANT



YYYY-MM-DD	2015-08-21
PREPARED	BGK
DESIGN	BT
REVIEW	PJC
APPROVED	PJC

PROJECT
CAMPOONA GRAPHITE PROJECT
CONCEPTUAL CONSTRUCTION DIAGRAMS

TITLE
CLOSURE PLAN

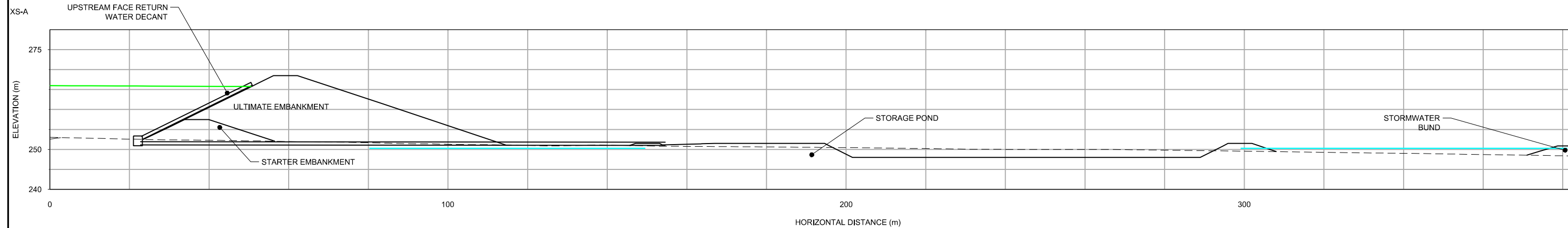
PROJECT No.
127663057

CONTROL
100

Rev.
A

FIGURE
009

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

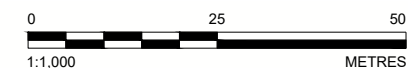
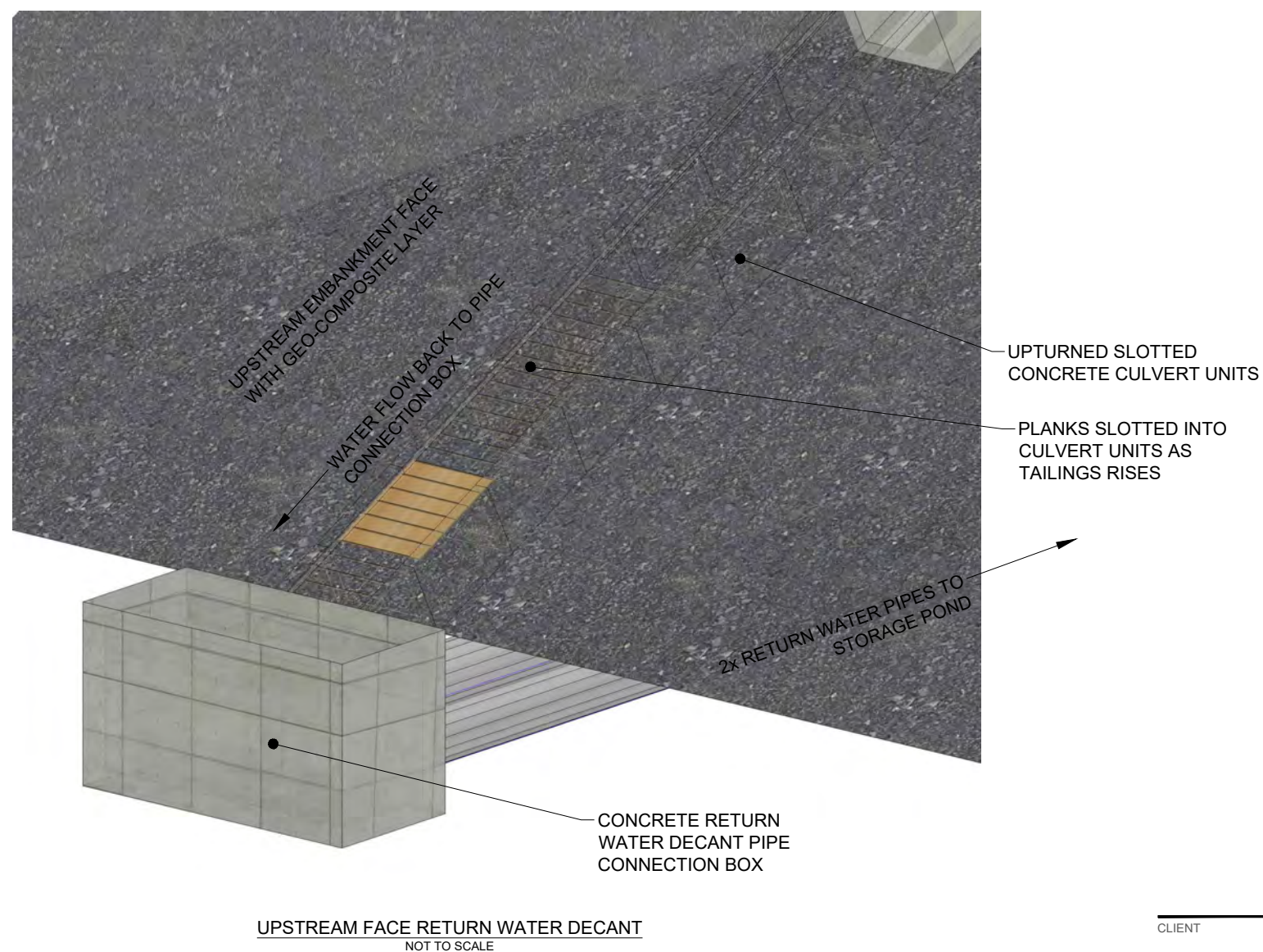


SCALE 1:1,000 m

1

007

DETAIL - EMBANKMENT AND POND



CLIENT

PROJECT

CONSULTANT

YYYY-MM-DD 2015-08-21

PREPARED BGK

DESIGN BT

REVIEW PJC

APPROVED PJC

TITLE

TYPICAL SECTION EMBANKMENT AND POND

PROJECT No.
127663057

CONTROL
100

Rev.
A

FIGURE
008





3.12.5 Supporting surface infrastructure

The components of the MPL Water at closure will comprise the Pindari Wellfield and associated water supply pipeline to the Sugarloaf processing facility (Table 3-19).

Table 3-20: MPL Water closure domains

Closure domain	Components	Conceptual Final Land Use
Site infrastructure	■ Borefield and associated pipeline ■ Potable water	Pastoral use.

Pindari wellfield and pipelines comprise part of the site infrastructure domain. The general closure strategy to meet the conceptual final land use of pastoral use will include removal of all structures, buildings will be removed from site, unless otherwise agreed with the post-mining landholder. Should the post-mining landholder wish to retain any infrastructure, Pirie Resources will leave the infrastructure in a safe and secure manner.

Any residual liquids, chemicals and hazardous materials from pipes, tanks and storage will be removed. Contaminated material will be remediated, and if necessary, removed and disposed of at an appropriately licensed facility. Concrete pads will be broken up and either disposed of on site, used as clean landfill in areas of existing disturbance where the landform is amenable to filling, or transported off site for disposal in an appropriate clean fill facility. Large concrete footings remaining in place (i.e., below 0.5 m bgl) will be made safe and buried in situ.

Areas covered by road base, fill or hardstand will be excavated. Pipelines and services brought to the surface during ripping will be removed from site. Services below 0.5 m bgl will remain buried if it does not pose an environmental or safety risk.

3.12.6 Revegetation - proposed vegetation cover

Where practicable disturbed areas and/or areas no longer required for mine operations will be rehabilitated concurrently with continuing activities on other sections of the site. The general proposed process of revegetation during operations is described in the following sections.

3.12.6.1 Site preparation

Areas available for rehabilitation will be prepared by:

- Deep ripping areas of compacted soil.
- Re-profiling ripped or stockpiled soil.
- Respreading topsoil.
- Contour furrowing or ripping respread areas.

3.12.6.2 Revegetation

A detailed Closure Revegetation Plan will be developed closer to actual closure. The plan will include the following key aspects:

- planting of local native vegetative species for habitat creation and visual amenity;
- establishment of planting on higher crests and slopes;
- consider overall site visual amenity, and
- allow for maintenance of revegetation and monitoring.

Revegetation will aim to establish structural and biological diversity, with plantings undertaken over a minimum two-year cycle. This cycle is required because of the time needed to re-establish functioning, terrestrial ecosystems and permit management of weeds.



A conceptual overview of the final pit with battered and stabilised WRSFs is provided in Figure 3-21.

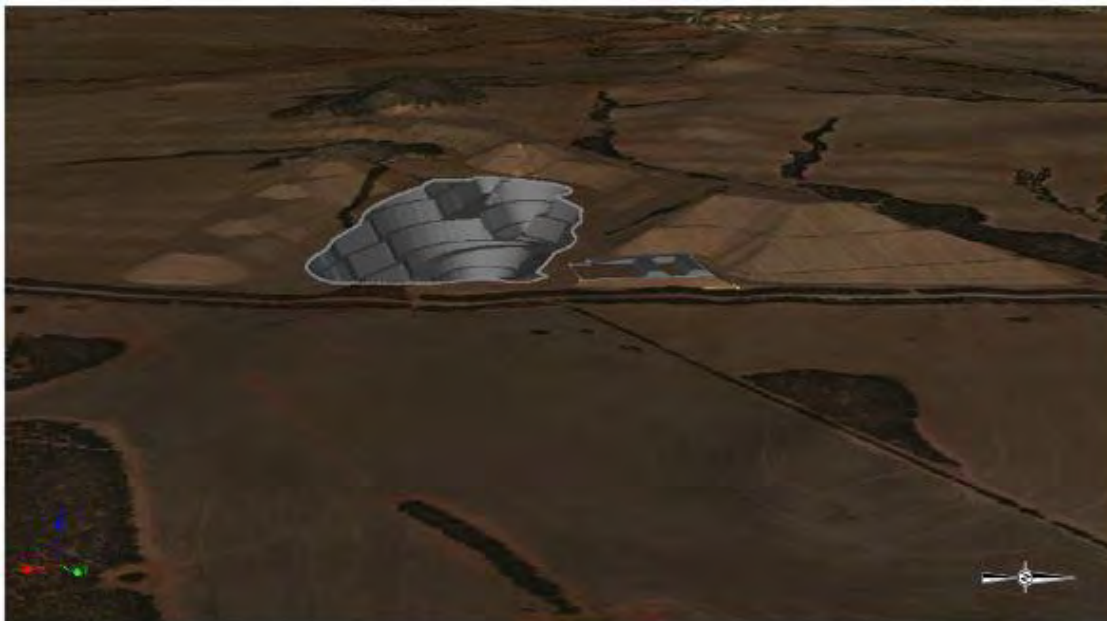


Figure 3-36 Final pit with rehabilitated WRSF (looking south west)

The general approach to revegetation is described below. Suitable grasses will be planted to ensure the landform mimics the surrounding areas and encourages future grazing. Planting trees will be considered on the battered slopes.

Revegetation from seed stock in respread topsoil

The successful removal, storage and subsequent re-spreading of topsoil removed during pre-stripping will assist revegetation from seed stock in soil. Topsoil is an average depth of 20 cm across the site. Topsoil will be stripped to this depth and include ground cover plants. Topsoil will be stripped during periods where it is not raining where possible to minimise the likelihood of erosion by surface runoff and destruction of soil structure.

Topsoil will be stockpiled away from drainage areas. Topsoil will be stockpiled in two locations and will have a maximum stockpile height of 4 m and a slope angle of 35°. Erosion controls will be placed around topsoil and subsoil storage areas.

When required for revegetation, topsoil will be respread, followed by contour furrowing or ripping to allow for infiltration of rainfall, some mixing of subsoil and topsoil and to loosen the soil surface for sowing or planting tube stock if required.

Revegetation from physical preparation and planting

Revegetation from physical preparation will include the selection of seed and plant species mix, planting methods, timing, weed control, and monitoring and maintenance. Revegetation will focus on expanding existing site native vegetation.

The species seed mix and planting densities for revegetation (along with fertiliser requirements) in disturbed areas will be determined in consultation with relevant experts. Consideration will be given to the appropriate use of the planting methods for the species selected. These planting methods may include seed broadcasting, direct seeding, spreading of seed-bearing slash or nursery-grown tube stock.

Weed control

Rehabilitated areas will be carefully monitored for evidence of the introduction and establishment of weeds of national significance, with the objective of identifying and treating them before they become persistent. If weeds become established in rehabilitated areas, appropriate weed control measures will be undertaken. These will include hand pulling and spraying of weeds with an appropriate herbicide.



4.0 DESCRIPTION OF POTENTIAL BENEFITS

The Eyre Peninsula Mining Alliance Inc (EPMA) of which Pirie Resources is a member, was formed in 2010 with the aim to increase suitable mining infrastructure and promote minerals development on Eyre Peninsula. Such development is anticipated to bring benefits to boost and diversify the regional economy through jobs, training and improved services. These all combine to benefit the community into the future. It is estimated that for each job created by mining, three additional support jobs are created on average (EPMA 2014). The social, environmental and economic benefits that are anticipated to result from seeing this proposed graphite mining project through to fruition are described in the following sections.

4.1 Social

Throughout exploration and mine planning, Pirie Resources has engaged with the local community to understand their concerns relating to the mine, and ensure that the project maximises the benefits for those living in the District and region (Appendix P). Pirie Resources has a commitment to working closely with the community through the development, operation and closure of the Campoona Graphite Project.

4.1.1 Employment and training

Pirie Resources' policy is to build community capacity and employment opportunities, and hire from the local community and broad stakeholder base including traditional owners wherever possible. Pirie Resources has a local employment target of a minimum of 60-70% fulltime equivalents (FTEs) from the broader local community.

Further, Pirie Resources has committed to buying locally where it is commercially viable and will employ practices that encourage local contractors and suppliers to support the mine's activities. These opportunities are expected to lead to:

- Economic benefits for the local community through an increased number of job opportunities and increased opportunities for local business and suppliers to support the construction and mining activities such as (but not limited to) administration, building and road construction and maintenance, cleaning, catering, environmental services, equipment hire, security, transport, mining contractors, shipping, goods and services.
- Improved direct and indirect employment rates for the region.
- Improved lifestyle conditions for employees and others indirectly employed due to higher employment rates and increased income being spent in the community.
- Building community capacity, training and education.

Pirie Resources is committed to implementing a local industry/business participation plan and working with local employment and training providers and networks to ensure the maximum benefits of local employment opportunities are realised. This will be formalised in a 'Sustainable Procurement Policy'. Further consultation will take place during the development of the mine with key employment and training stakeholders.

The process plant and mining workforce is anticipated to be 60 FTEs during construction and pre-stripping. During operations the workforce will reduce to between 21 and 25 personnel in mining operations, 15 to 18 in the processing operations, and around 5 in administrative tasks. Notwithstanding the desire to employ locally, it might not be possible to source all the appropriate personnel from the region particularly specialist technical skills to fill certain rolls such as mine manager, project manager, metallurgists, engineers and geologists. Whilst it is not envisaged that personnel are engaged on a fly in/fly out basis, there may be a limited need for such at particular stages of the project particularly during construction.

In general, an indirect multiplier of 3 to 4 is used to estimate indirect employment in the Australian mining industry (ACIL Tasman 2009). The Minerals Council of Australia (2010) estimated that for every job created in mining, a further 3.2 jobs were generated indirectly in employment supporting mining. The Australian Bureau of Statistics (ABS 2011) similarly provides a multiplier of 3.0. Accordingly, assuming the total ongoing workforce is 43 (ie excluding the administration tasks), the Campoona Graphite Project has the potential to result in an additional 135 FTE jobs over the life of the project.



A detailed training needs analysis has not yet been undertaken in relation to the local workforce, but it is anticipated that training would include mining specific training such as Certificate III in Mining, emergency response, occupational health and safety, environmental and community awareness and senior first aid as a minimum. Through its membership with EPMA, Pirie Resources will work with schools, TAFE, Universities and recruitment agencies to maximise the career opportunities available on Eyre Peninsula.

4.1.2 Indigenous employment

The aim is to maximise local and indigenous benefits and employment opportunities through direct, indirect or induced employment. This approach, established in other activities by Pirie Resources and through its membership in the EPMA, will continue throughout the graphite project, from construction and operation to rehabilitation phases.

4.1.3 Community support

Pirie Resources recognises its status not just as a guest within the community but as a valued member of the community (employer, business operator). Therefore, Pirie Resources is committed to providing benefits and ongoing support to local community development programs.

Pirie Resources will continue its policy of local purchasing where it is able and provide education and training opportunities to the community.

4.1.4 Provision of infrastructure

Based on the traffic impact study, the development of the Campoona Graphite Project does not require significant local road upgrades. Transport will be via semi-trailers, which are rated for all roads. However, Pirie Resources is considering upgrading and maintaining roads for all-weather use in conjunction with the Cleve District Council to make it safer and easier for access for not only project personnel and contractors but also the local community including school buses, harvest and stock trucks. All road upgrades and improvements will be funded through the Graphite Project.

Although power requirements for the proposed mine and processing plant are relatively small, the Eyre Peninsula power supply does not have very much spare capacity. Therefore, the Pirie Resources Project may act as a stimulus to upgrade power supplies to Eyre Peninsula sooner rather than later.

4.2 Economic

Expected direct economic benefits during full scale production include, but are not limited to the following:

- Capital expenditure is estimated to be up to \$36 million some of which will go directly to local and regional businesses.
- Direct employment of approximately 60 people during construction.
- Direct and ongoing long-term employment of about 25 staff and process operators.
- Up to 20 contract mining personnel operating for approximately 6 months of each year during the two mining campaigns.
- Indirect employment of up to 135 FTE service providers, suppliers and miscellaneous contractors.
- Direct wages for the life of the mine.
- Project royalty to the State of South Australia would be about \$14 million over the life of the project assuming an average royalty rate of 3.2% (2% for first five years and 3.5% thereafter).
- State and federal taxation.
- Increased support to local communities through mechanisms such as sponsorships, donations, employment opportunities, training and education opportunities, and volunteers.

Assuming a market value of \$3,310 per tonne of graphite product, the total revenue from 130,000 tonnes would equal approximately \$430 million over the life of the project.



The Project will bring both social and economic benefits through direct and indirect employment for the local community. It is likely that the indirect workforce, including construction workers, contractors and suppliers will also be from the Eyre Peninsula.

Ongoing operational opportunities for regional businesses include road and mine maintenance, vehicle maintenance, product transport to port, water carting, equipment hire, process plant and fuel supplies, security services, and environmental services such as waste removal, rehabilitation and plant nurseries.

The ongoing benefits of developing a graphite business in South Australia cannot be underestimated.

4.3 Environmental

High end graphite, such as that anticipated to be produced by Pirie Resources, is used in lithium-ion batteries, fuel cells, solar energy and semi-conductors which can provide environmental benefits. The demand for the products and consequently graphite is increasing as a result of green initiatives. This is expected to continue to grow as the world seeks improved energy storage solutions for clean energy such as solar energy and use in alternative fuel for the hybrid automotive industry.

Pirie Resources is also expecting to contribute to the environment benefits through the following:

- Discussions with Natural Resources Eyre Peninsula have highlighted numerous local programs that could benefit from fund contributions made to offset the minimal local vegetation losses associated with the project. Pirie Resources is excited to be able to contribute to local programs to ensure the viability of these projects.
- Pirie Resources will be responsible for environmental management (including weed and pest management) in the proposed ML area. The program may have an effect on the wider area.
- Pirie Resources has already obtained and compiled considerable amounts of new information on the flora, fauna, groundwater, soils and air quality in the local area and broader Campooona and Sugarloaf region as part of the baseline data collection for this proposal. Ongoing monitoring of flora, fauna, groundwater, soils and air quality in the proposed ML and adjacent areas will add significant research information regarding the environment character of the region.

Pirie Resources is committed to reducing the carbon footprint of its operations. A greenhouse gas assessment will identify strategies for Pirie Resources to off-set greenhouse emissions through the project's life cycle.

Pirie Resources will rehabilitate the proposed ML and MPL areas to achieve a stable and sustainable landscape, consistent with surrounding natural landforms and conditions. Pirie Resources will rehabilitate the area in accordance with leading practice environmental management using a continuing, integrated process from construction, to operation and closure. The closure principles that will guide the rehabilitation of areas will include:

- Developing landforms that are consistent with the surrounding area and/or meet community expectations.
- Rehabilitating the site to an appropriate land use consistent with the standards identified for that land use.
- Protecting human health and safety.
- Reducing the need for long term monitoring and maintenance through design and construction of landforms that are geotechnically and geochemically stable.
- Ensuring visual amenity meets community expectations.
- Developing appropriate monitoring system and remedial action program.



5.0 RESULTS OF CONSULTATION

5.1 Objectives

The objectives of the stakeholder consultation for the project are consistent with the South Australian Chamber of Mines and Energy (SACOME) *Industry Code of Practice for Community Engagement* (2012). The primary objectives are to:

- ensure that all stakeholders are aware of Pirie Resources' proposal for the commencement of mining at Campoona Shaft (proposed ML) and mineral processing at Sugarloaf (MPL ((Sugarloaf)), outlining the progression from small-scale start-up through to full scale production and gather feedback on the proposal.
- inform stakeholders of the approvals process, including the submission of the MLP and subsequent stages of environmental and board approvals.
- ensure that the MLP process considers feedback and comments raised and that protocols are developed to communicate to stakeholders how their feedback was considered.
- provide regular and consistent information and updates to stakeholders based on facts to eliminate incorrect perceptions or misinformation.
- identify and manage issues proactively before they escalate.
- demonstrate to shareholders and stakeholders Pirie Resources' commitment to environmental and social sustainability of their operations.
- identify opportunities to highlight the economic, social and environmental benefits of the project.

5.1.1 Stakeholder identification

Stakeholders for the project were targeted as four key groups (Table 5-1):

- directly affected landowners.
- surrounding landowners.
- stakeholders and government agencies.
- the broader community.



Table 5-1: Stakeholder identification

Stakeholder Group	Targeted Stakeholders
Directly affected landowners	■ Pirie Resources has an agreement to purchase the land at the proposed ML (Campoona Shaft) and owns the land the subject of MPL (Sugarloaf) ■ Landowners who are affected by the location of the mine footprint and/or associated infrastructure (e.g. MPL (Pindari))
Affected landowners	■ Those who live near the proposed mine and may reasonably be expected to have their day-to-day life impacted by the activities. For example, they may hear, smell, or see the Project from their property.
Primary community	■ Landowners and stakeholders located within a 5 kilometre radius of the proposed mine, and associated infrastructure.
Secondary community	■ Landowners and stakeholders located outside of the 5 kilometre radius of the mine site.
Community Groups	■ Community Consultation Committee
Stakeholders and government agencies	■ Department of State Development (DSD) ■ Department of Planning, Transport and Infrastructure (DPTI) ■ Department for Environment, Water and Natural Resources (DEWNR) ■ Environment Protection Authority ■ SA Water ■ District Council of Cleve ■ Regional Development Australia ■ Natural Resources Eyre Peninsula
Broader community	■ Cleve ■ Kimba ■ Darke Peak ■ Franklin Harbour

5.1.2 Approach

All communication with the community and stakeholders is developed in line with a Campoona Community and Stakeholder Engagement Strategy framework. This framework was the basis for the development of relationships with key stakeholders, and details an approach to engagement which aims to:

- build trust with stakeholders and to enable Pirie Resources to become part of the community through open and transparent communications.
- establish mechanisms for the two-way flow of information through project planning, approvals, construction and operations.
- provide opportunities for stakeholders to obtain information and have in place mechanisms for comments to be considered.

These key elements are incorporated in the tools and activities which have occurred to date, and will inform ongoing communications during construction and operations.

Pirie Resources (under the Archer name) has been working on the Project site since 2009. Formal stakeholder engagement completed to date includes:

- Hosted a focus group meeting in September 2013.
- Established a Community Consultative Committee (CCC) with community representatives, Pirie Resources and facilitated by Mr Stephen Marlow. CCC meetings were held regularly (approximately 2 monthly during 2014 and 2015 and twice in 2016). To date, 14 CCC meetings have been held.
- Provided written publications to the region through mail and internet access, including project newsletters in October and December 2013, and February, April, June, August and October 2014.
- Provided written information in the EP Tribune.



- Hosted a community open house information day in October 2014.
- Provided online technical study information: <http://www.archerexploration.com.au/index.php?PID=561>.
- Participated in Eyre Peninsula Field Day (Cleve) 2012, 2013, and 2014.
- Liaised with Cleve Council, local and State government regulators through the life of project.

The Socio-Economic Impact report (Appendix P) includes a register of stakeholder consultation and engagement activities. Pirie Resources' collaborative approach to stakeholder engagement will be continued throughout mining development, construction, operation and rehabilitation.

5.1.3 Outcomes of consultation

Community interests and concerns have been documented by Pirie Resources in Appendix P. Questions and concerns were later published in community newsletters along with responses from the proponent. Day-to-day informal interactions have indicated strong general support for the project and some reservations. Community feedback identified the following issues:

- Potential environmental impacts to downstream surface water close to the proposed ML Campoona Shaft (Ore Body Creek). Subsequently the Western WRSF at Campoona Shaft was designed to direct surface water runoff east to diversion channels, and the western face promptly rehabilitated, to reduce the likelihood for surface water runoff to enter the ephemeral Ore Body Creek (to the west).
- Location of the tailings storage facility (TSF) at the proposed processing facility at MPL (Sugarloaf) and potential environmental impacts from TSF leakage. Subsequently information has been provided to community through newsletters, website releases and during the community information day.
- Potential visual impacts from the processing facility and the variety and species of trees used during screening and rehabilitation. Subsequently the site of the processing facility at MPL (Sugarloaf) was moved approximately 150m southeast, behind the crest and down the hill, to reduce visual impact from the Darke Peak direction.
- Concerns regarding potential traffic impacts.
- Concerns were identified about the risks of using and transporting Hydrofluoric Acid.
- Potential dust and noise impacts to nearby residents.
- The desire to have new families attracted to the district.
- The desire for learning opportunities in conjunction with Cleve Area School.
- Employment and business opportunities.

Engagement has also extended to a range of government agencies to ensure that views and concerns around state-based issues have been captured and addressed.



6.0 ENVIRONMENTAL COMPONENTS

6.1 Methodology

In order to capture the environmental aspects (and associated risks) related to the Project, an Environmental Aspects and Risk Assessment Register was developed and is contained in Appendix Q. The Register identifies the potential environmental and social aspects/impacts that may be associated with the mining project.

The Environmental Risk Assessment (ERA) has been developed based on the DSD requirements as detailed in *Guidelines for Miners: Preparation of a Mining Lease Proposal or Mining and Rehabilitation Program (MARF)* Version 4.11, January 2011.

The Primary Risk Level (PRL) of the identified aspect was considered without taking into account any management and mitigation measures that will be employed by Pirie Resources. The assessment considered impacts during all stages of the project (i.e. construction, operations and mine closure). Identification of the potential impacts is based on knowledge of the existing environment, experience with similar operations elsewhere and issues of concern to key stakeholders.

In undertaking the ERA, consideration has been given to avoidance, mitigation and/or management strategies that are technically and economically feasible and reflect Pirie Resources' commitment to minimising environmental impact and adopting an approach to the Project that demonstrates best practice mining and environmental management.

The final component of the assessment involves describing the Residual Risk Level (RRL) associated with each of the identified aspects. This assessment assumes the effective implementation of the proposed Design Control and Operational Management Measures.

The RRL is developed in the same way as the PRL by examining the potential consequences (measure of severity of environmental impact and the likelihood that those impacts will occur).

A number of categories are used to describe the consequence (severity) of each impact and the likelihood of that impact occurring.

The requirement for an outcome has been determined through the results of the risk assessment, on the basis of implementing good environmental performances with tangible outcomes, and/or as part of the commitments made by Pirie Resources during consultation.

Outcome measurement criteria are presented for construction (Co), operation (O) and closure (Cl) in each table associated with environmental outcomes and measurement criteria.

Closure planning risks, mitigation and management is presented Appendix R.

6.2 Risk Assessment

The descriptors used in the assessment are based on those provided in the *DSD Guidelines for Miners: Preparation of a Mining Lease Proposal or Mining and Rehabilitation Program (MARF)* Version 4.11, January 2011.

The following definitions are provided of key risk assessment terms:

- Likelihood: the estimated probability or frequency of occurrences or an event occurring over time (Table 6-1).
- Consequence: the outcome or severity of an impact/event occurring (Table 6-2).
- Risk: is a combination of the likelihood of an event occurring and the severity or outcome of the consequence of the event (Table 6-3).



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Table 6-1: Description of likelihood

Description	Likelihood Criteria (read as either/or)
Almost Certain	■ The event will occur ■ The event is of a continuous nature ■ The likelihood is unknown
Likely	■ Will probably occur during operation lifetime
Possible	■ Could occur in most operations
Unlikely	■ Could occur in some operations but is not expected to occur
Rare	■ Has almost never occurred in similar operations but conceivably could

Table 6-2: Description of consequence

Description	Consequence Criteria (read as either/or)		
	Social	Environmental	Economic and Legal
Insignificant	■ Not of concern to the wider community ■ No inquiries or complaints	■ Possible impacts within the proposed Project site boundaries and immediate marine environment but without noticeable consequence ■ No impacts of consequence at local, regional or State level	■ No costs or limited cost for rehabilitation or mitigation ■ No breach of regulator standards or licences
Minor	■ Not of significant concern to local or wider community ■ Isolated inquiries or complaints	■ Some reversible impact within the proposed Project site boundaries and immediate environment with no significant long-term changes ■ May be rehabilitated or alleviated without outside assistance	■ Cost for any rehabilitation is minor ■ No breach of regulator standards or licences
Moderate	■ General local concern ■ Multiple inquiries and/or complaints	■ Significant changes within the proposed Project site boundaries with potential for long term change and remediation required ■ Minor changes outside proposed Project site boundaries that may be simply rehabilitated or alleviated with outside assistance	■ Possible breach of legal obligations – inquiries and/or instruction from regulatory authorities
Major	■ Will attract significant public concern ■ Widespread complaints and/or lobbying by representative groups	■ Substantial and significant changes within and/or outside the proposed Project site boundaries that can only be partially rehabilitated or alleviated ■ Long-term consequences	■ Major costs associated with rehabilitation / alleviation ■ Serious breach of legal obligations – regular inquiries by regulatory authorities and penalties for non-compliance
Catastrophic	■ Major public outrage ■ Deaths or widespread health and economic effects on public	■ Extreme permanent changes to social or natural environment that cannot be practically or significantly rehabilitated or alleviated	■ Major costs associated with rehabilitation / alleviation and penalties ■ Major breach of legal obligations – continual involvement of regulatory authorities and legal investigation for non-compliance



Table 6-3: Qualitative risk matrix

			Likelihood of Consequence				
			E	D	C	B	A
			Rare	Unlikely	Possible	Likely	Almost Certain
Severity of Consequence	5	Insignificant	Low 5E	Low 5D	Low 5C	Moderate 5B	Moderate 5A
	4	Minor	Low 4E	Low 4D	Moderate 4C	High 4B	High 4A
	3	Moderate	Moderate 3E	Moderate 3D	High 3C	High 3B	Extreme 3A
	2	Major	High 2E	High 2D	Extreme 2C	Extreme 2B	Extreme 2A
	1	Catastrophic	High 1E	Extreme 1D	Extreme 1C	Extreme 1B	Extreme 1A

6.3 ML Campoona Impact and Risk Assessment

The Campoona Graphite Project is a small-scale campaign mining operation proposed in a highly modified and sparsely populated landscape that has been cleared for broad acre farming. Whilst mining will occur on the Mining Lease at Campoona Shaft, processing and tailings storage is proposed at the Pirie Resources-owned Sugarloaf property using a mixture of existing farming and upgraded facilities on site. This section details the risks and management of risks associated with mining on the proposed ML (Campoona Shaft).

Briefly, the infrastructure at ML (Campoona Shaft) includes the development of an open pit over 13 years, which will be free-dug to an approximate depth of 60 m and then dug to approximately 100m depth with the assistance of controlled blasts. There will be two waste rock storage facilities (WRSF) progressively built and rehabilitated and contoured to reflect the surrounding land. There will also be small-scale buildings for site personnel requirements and a magazine. At the end of mining, all infrastructure is expected to be removed, with the rehabilitated land forms remaining.

This section assesses the risks and management of the interaction that construction and operation that the ML has on:

- Visual amenity
- Noise
- Dust and air quality
- Topography and landscape
- Geohazards
- Surface water
- Groundwater
- Vegetation
- Weeds
- Fauna
- Pest species
- Topsoil and subsoil
- Heritage and conservation
- Traffic and transport
- Public safety

It then identifies the activities, risks and outcomes associated with the mine closure.

6.3.1 Visual amenity

The Campoona Shaft mine on the proposed ML Campoona Shaft is a small-scale campaign mining operation proposed in a highly modified landscape cleared for broad acre farming. The area is sparsely populated.



As the site is proposed only for daytime operations, no light sources, other than those for safety will be notable.

Pirie Resources has modified the location of facilities to ameliorate community concerns and will be contouring the WRSFs and other stockpiles to replicate the existing landscape. No credible risk and impact pathways exist in relation to visual amenity.

6.3.1.1 Context and views of affected parties

The proposed ML at Campoona Shaft is within a highly modified landscape that has been historically cleared to facilitate broad acre farming (Appendix B).

The Campoona Shaft site currently comprises cleared open farm land with small stands of degraded natural vegetation site (Figure 6-1). The site is surrounded by small hills in the south, east and west, including Campoona Hill to the south which ranges in elevation from 360 m to 410 m AHD. The entrance to the site is screened by established vegetation.

Consultation regarding visual amenity impacts and landscape change resulting from of the proposed Campoona Graphite Project provided a clear preference for the mine footprint to be minimised thus limiting its impact on land available for agricultural purposes. It was recognised that this would result in higher WRSFs.

One residential property is approximately 750 m to the south east of the pit.

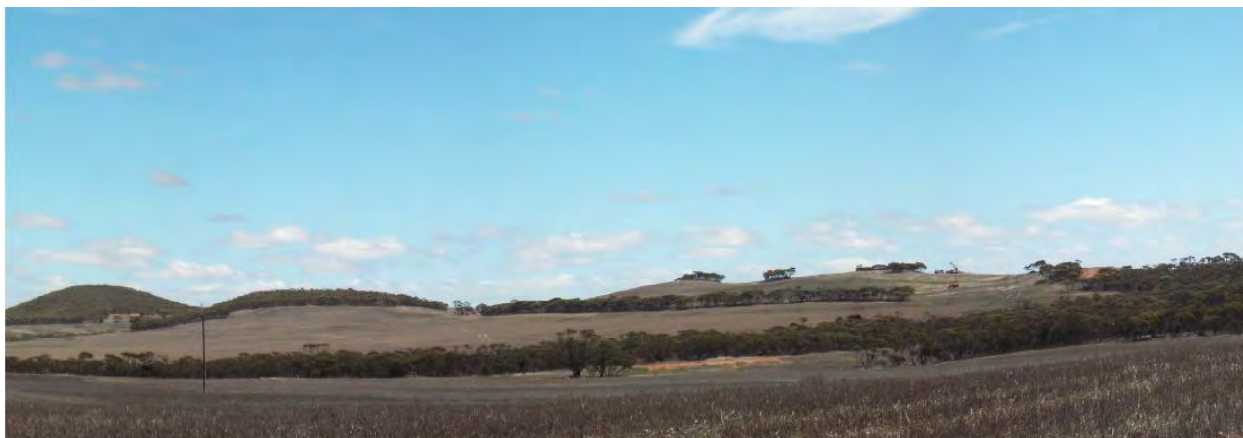


Figure 6-1: Existing visual amenity of proposed ML

6.3.1.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to visual amenity include the following:

- *Mining Act 1971.*
- *Development Act 1993.*
 - *Development Plan: Cleve Council (DCC 2013).*

6.3.1.3 Potential construction operation and closure impact/events

The initial small-scale mining operation is planned to occur in years 1 – 3. Trenching will occur west of the ridgeline and no noise attenuation will be required during the expected 4-week day shift only campaign. The small footprint associated with trenching will not impact visual amenity.

During full scale production the eastern WRSF (which is designed to act as an Amenity Mound) will provide a visual relief from pit operations for the same resident.



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As identified during community consultation, operations will alter the existing landscape through the progressive construction of the western WRSF, eastern WRSF, and the development of the mining pit. These have the potential to impact the rural farm amenity of the local region.

During full scale operations, material will be stockpiled and stored on the ROM ore stockpile. The ROM stockpile will have capacity to store 26 kt of material with a height of 4 m. This stockpile may be seen from the road.

The WRSFs will be seen from the road (Figure 6-2). The Amenity Mound will be constructed in Years 4 – 7 after the initial small scale trenching phase. The Amenity Mound will be constructed to a height of 50 m in 10 m benches. The Western WRSF will be built in two stages and reach 60 m above existing ground levels. All WRSFs will have initial 35° batter angles and will be progressively battered back to achieve final slopes of 20° before being rehabilitated. At closure, the WRSF and Amenity Mound will mimic the existing topography and will be revegetated.

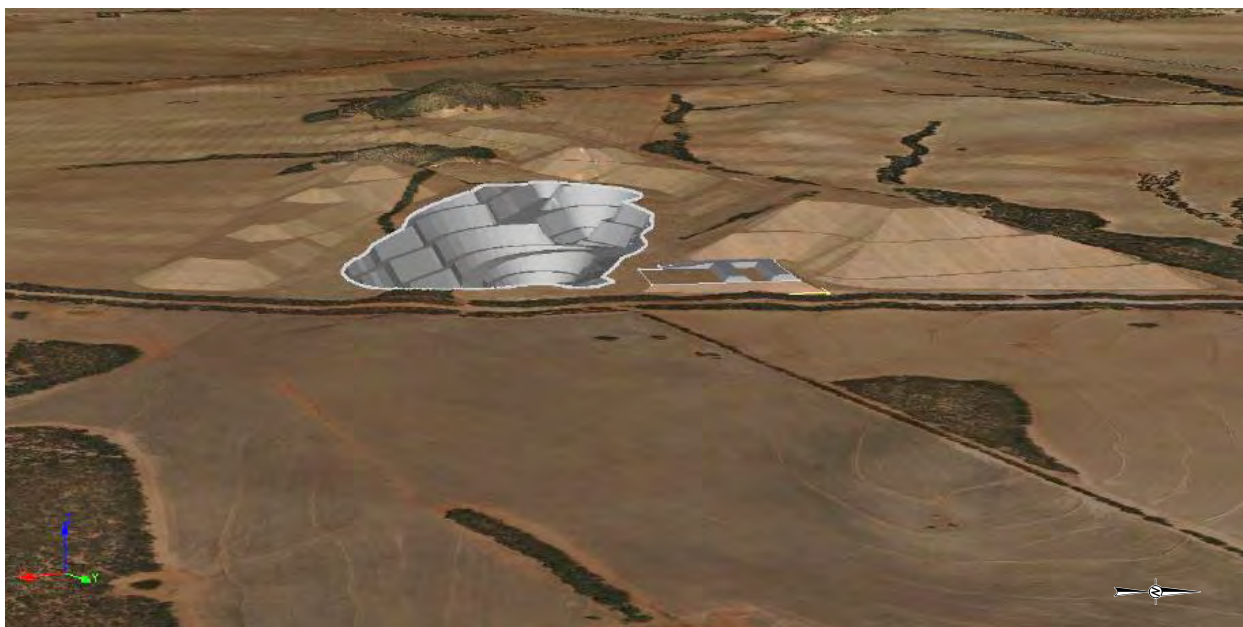


Figure 6-2: Visual amenity at the proposed ML at the completion of mining at Campoona



6.3.1.4 *Control and management strategies*

The proposed entrance to ML Campoona Shaft is lined by vegetation, predominately medium sized trees and low shrubs, which partially screen between the site and users of Elson-Campoona Road.

Whilst specific amenity issues have not been raised for ML Campoona Shaft, Pirie Resources' control and management strategies will be applied to reduce the potential impacts:

- Minimise the footprint of the mine.
- Determine placement of mine infrastructure to minimise visual impact as far as practicable in terms of location.
- Colour buildings neutral so as to not stand out but blend with the surrounds.
- Incorporate requirement to minimise land disturbance into Project design.
- Prompt revegetation of stockpiles.
- Locate the WRSFs to provide a visual barrier from public roads.
- Design of WRSF to incorporate elements that assist with progressive rehabilitation and vegetation (e.g. through final slopes and progressive rehabilitation).



6.3.1.5 Evaluation of residual risks

Table 6-4 summarises the source, pathway and receptors of risks and impacts as they relate to visual amenity. The full Risk Assessment can be found in Appendix Q.

Table 6-4: Risk assessment of impacts on visual amenity

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_22	Reduced visual amenity for local residents from construction and operation of site infrastructure.	Unlikely	Minor	Low	Pirie Resources has designed the Amenity Mound which will be priority built once full scale production has been reached and it will be hydroseeded to eliminate any long term visual impacts	Unlikely	Insignificant	Low
C_23	Reduced visual amenity from operation and rehabilitation of site infrastructure for the broader community.	Unlikely	Minor	Low	Placement of mine infrastructure determined (as far as practicable) to minimise visual impact Project design incorporates requirement to minimise land disturbance (i.e. retention and creation of contours) Design WRSFs to incorporate elements that assist with progressive rehabilitation and vegetation Location and revegetation of a soil stockpile and Amenity Mound	Unlikely	Insignificant	Low



6.3.1.6 Justification for acceptance of residual risk

The construction of the WRSFs will change the landscape. However, at completion, the structures will be of similar elevations to the existing natural landscape and will be rehabilitated. It is also envisaged that the WRSFs will be contoured similar to the existing hills.

As Elson-Campoona Road is an unsealed rural road that carries less than 50 vehicles a day, the rural impacts to amenity are considered low risk.

Pirie Resources' vision for the project is to return the land in a state that is compatible with the current farming practice. To that end, the WRSFs are considered likely to be suitable for grazing.

6.3.1.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-5):

Table 6-5: Environmental outcomes and measurement criteria – visual amenity

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_22 C_23	No long term adverse visual impact to nearby residents from the WRSFs	Audit demonstrates rehabilitated structures at mine completion are in accordance with approved Closure Management Plan (O, CI)	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.3.2 Noise

Modelling was undertaken based on the likely noise levels of equipment to predict noise levels associated with construction and operation at ML Campoona Shaft (Appendix C).

The initial small-scale trenching operation will be excavated with one excavator and a truck on an estimated 4-week day shift only campaign.

For full scale production mining will occur only daylight hours, Monday to Saturday, nominally during autumn and spring. Processing will occur continuously (i.e. 24 hours/day). The noise modelling used conservative assumptions, such as the unlikely scenario of all equipment operating simultaneously.

The noise model outputs identify that the project complies with EPA-derived noise limits at all sensitive receivers. Irrespective of this, Pirie Resources has committed to noise management measures to further reduce noise generated by the project.

6.3.2.1 Context and views of affected parties

Key stakeholders in relation to noise and vibration include EPA, DSD and SafeWork SA (ground vibration), DPTI (transport noise), as well as the adjacent community.

Noise differences (measured in dB) can be noticed with a 5 dB change. A 3 dB change is barely perceptible, with a 1 dB different imperceptible. An increase of 10 dB is considered to be twice as loud, while a 20 dB increase is four times as loud. The noise level generated by a conversation within a metre of each person is in the range of 60 dB to 65 dB.

The two main noise measures used are dB(A) L_{eq} , which is the equivalent continuous noise level for describing the general noise level for noise that may fluctuate over time, and dB(A) L_{max} , which is the maximum sound level expected.



Based on the council zoning, the EPA has indicated the following noise limits will be applied when measured and adjusted at noise sensitive receivers (such as nearby residences) in accordance with the Environment Protection (Noise) Policy:

- 52 dB(A) between the hours of 7 am and 10 pm.
- 45 dB(A) between the hours of 10 pm and 7 am.

The noise criteria were established with reference to the relevant legislation and guidelines, consistent with leading practice in South Australia to ensure that the construction and operations do not unreasonably interfere with the acoustic amenity at the noise sensitive receivers.

6.3.2.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to noise include the following:

- *Environment Protection Act 1993.*
- *Environment Protection (Noise) Policy 2007.*
- *Guidelines for Separation Distances* (EPA 2007).
- The SA Department of Planning, Transport and Infrastructure's (DPTI) *Road Traffic Noise Guidelines* (RTNG) has been adopted to establish the project specific noise criteria for the road traffic noise from the proposed access road.
- Australian and New Zealand Minerals and Energy Council (ANZMEC) *Guidelines for blast overpressure and ground vibration for residential receivers* (ANZMEC 1995).

6.3.2.3 *Potential construction operation and closure impact/events*

Noise predictions were conducted to determine noise levels from the project at noise sensitive receivers in the vicinity and compared against the established noise criteria. Importantly, the assessment considered an unlikely worst case scenario for site operations in that:

- The plant was closest to receptors.
- Weather conditions were conducive for noise propagation.
- All equipment was operated simultaneously.

It is not expected that the predicted effects would be realised in real operational terms.

Vibration as a result of blasting has not been considered in absence of a blasting plan. This will be developed for the PEPR.

6.3.2.4 *Construction noise*

Construction works in preparation for full scale mining operations are not proposed to occur after 10pm or before 7am on any day.

The following equipment is likely to be used during construction works at ML Campoona Shaft:

■ Bulldozers (mine operations)	■ Cranes
■ Excavators (mine operations)	■ Forklifts
■ Trucks	■ Concrete mixer trucks
■ Prime movers	■ Generator
■ Graders	■ Generator for welding
■ Front end loaders	■ Drill rigs
■ Compaction rollers	■ Large side booms.



General power tools and hand tools may also be used, although these are not expected to be significant sources of noise compared to the large plant and equipment listed above.

Table 6-6 summarises the noise modelling predictions, at various distances from the source.

Table 6-6: Predicted construction activity noise levels – ML Campoona Shaft

Construction Stage	Predicted Noise Level (dB(A)) at Various Setback Distances	
Criterion (dB(A))	800 m	900 m
Site preparation and earthworks	52	51
Foundation works and building constructions	52	50
Equipment installation and construction	52	51

Based on the expected equipment and their predicted noise generation, the model shows that construction noise at the proposed ML does not unduly influence noise amenity at any sensitive receivers. However, the recommended noise limit is reached for a nearby resident.

6.3.2.5 Operational noise

The initial small-scale trenching phase will consist of very short duration (< 4 weeks per year) trenching operation.

For full scale production operational noise predictions are relevant to the proposed ML Campoona Shaft and predictive modelling has used conservative assumptions including the following:

- All equipment will be operating at the same time and continuously.
- All fixed plant and equipment is located outside, without any attenuation from buildings or structures (e.g., sheds or enclosures, except for the power generation units as required to achieve the specified sound power levels).
- The mobile equipment onsite is located nearest to the noise sensitive receivers and at the highest point of the area under consideration.
- The mining fleet is located at the top of the mine pit.
- The operation has the worst-case meteorological conditions that would provide conditions that are the most conducive for noise propagation in accordance with the Policy default conditions.
- There is no attenuation barrier provided by the waste rock storage facilities that will be formed during the life of the mine.

The Campoona graphite deposit is situated immediately west of a ridge crest line. Initial mining operations will commence west of the deposit ridgeline which will afford a natural noise barrier for the operation. Once full scale production is reached waste rock will be used to commence construction of the Eastern WRSF. Once the Eastern WRSF develops sufficient height, the pit will have attained a depth sufficient to provide an effective barrier limiting noise propagation in an easterly direction towards the nearest receptor.

Mining activities at the proposed ML will not be a continuous operation, rather it will occur over campaigns during the year, with no mining expected to occur during summer and winter to avoid the hottest months (reducing dust and fire risk) or the wettest months (graphite is naturally highly lubricious which is exacerbated if the ore is wet making access difficult for the mine trucks). In addition, the mining activities will be restricted to daytime hours, further limiting the potential for adverse noise impacts on the local community.

Table 6-7 shows that mining at the proposed ML will achieve daytime policy goal noise levels during operation.



Table 6-7: Predicted operational activity noise levels in the ML (Campoonna Shaft)

Residence	Distance from site (m)	Daytime (7am to 10pm)	
		Criterion (dB(A))	Predicted Noise Level (dB(A))
Neild Residence	800	47	47
Elson Residence	1,150	47	19
Bartel Residence	5,575	47	42
Hannemann Residence	7,590	47	13
Residence #1	2,240	47	36
Residence #2	3,085	47	41
Residence #3	6,145	47	21
Residence #5	5,380	47	19
Residence #5	5,325	47	19
Residence #6	7,820	47	12
Residence #7	3,120	47	29
Residence #9	6,600	47	16
Abandoned Residence	3,015	47	30

6.3.2.6 Control and management strategies

- Double glaze residential windows for the nearest sensitive receptor (as agreed with the landowner).
- Train staff on site to good work practices and behaviours to control noise emissions from site.
- Campaign mine nominally in autumn and spring.
- Use broadband reversing beepers on all mobile equipment to remove the annoying tonal characteristic of reversing beepers.
- Use low noise equipment and plant or noise reducing kits where practicable.
- Use berms or acoustic barriers to block line of site from the main haul routes to the residences.
- Avoid unnecessary revving of engines and switch off equipment when not required.
- Keep internal haul routes well maintained and avoid steep gradients.
- Minimise drop height of materials (lowered and placed rather than dropped).
- Keep equipment enclosure panels closed.
- Regularly maintain equipment and plant.



6.3.2.7 Evaluation of residual risks

Table 6-8 summarises the source, pathway and receptors of risks and impacts as they relate to noise. The full Risk Assessment can be found in Appendix Q.

Table 6-8: Risk assessment of impacts from noise generated during construction and operation

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_19	Disturbance to sensitive receptors due to construction and operation noise and vibration from vehicles, equipment and plant.	Possible	Minor	Moderate	Compliance with EP (Noise) Policy. Double glazing at the nearest residence to Campoona Shaft. Compliance with Traffic Management Procedure. Locate noisy equipment at the greatest practical distance from sensitive receptors. Monitoring of noise and vibration impacts by complaints register. Maintain vehicle fleet in accordance with manufacturer's requirements. Ensure noise reduction devices such as mufflers are fitted and operating effectively.	Unlikely	Insignificant	Low
C_20	Production of noise and vibration associated with blasting resulting in disturbance to sensitive receptors and property.	Possible	Minor	Moderate	Complete oxidation of the rocks has occurred to depths of at least 60 m reducing the need for blasting. That oxidation has developed a deep clay-rich lateritic soil profile that will act to absorb vibrations caused by blasting. Blasting Management Plan with clear notification to surrounding land users and an exclusion zone will be used. Pit walls will be pre-split where practical to do so. Blasting activities will comply with AS 2187.2-2006 with respect to human comfort levels for vibration. Compliance with ground vibration overpressure limits. Monitoring of noise and vibration impacts by complaints register.	Unlikely	Rare	Insignificant



6.3.2.8 Justification for acceptance of residual risk

The noise assessment is conservative and provides a high level of confidence that the mine is able to operate at the site within the requirements of the Noise EPP and not cause nuisance noise to any existing sensitive receivers. The residual risk after implementation of management and control measures is considered unlikely, and the risk rated low to insignificant (Appendix C).

6.3.2.9 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-9). The outcomes related to vibrations will be considered further during development of the PEPR and establishment of a blasting plan.

Table 6-9: Environmental outcomes and measurement criteria – noise

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_20	Noise from construction, operation and closure activities meets the noise goals in the Environment Protection (Noise) Policy, as defined by the Cleve District Council Development Plan at the date the Mining Lease was granted.	Noise generated from the lease during construction, operation and closure activities, measured at sensitive receivers in accordance with the Environment Protection (Noise) Policy 2007, does not exceed the following noise limit (averaged over 15 minutes), at those sensitive receivers: - 52 dB(A) between the hours of 7am and 10pm and 45 dB(A) between the hours of 10pm and 7am within a Primary Production Zone (as delineated in the Cleve District Council Development Plan at the time of Lease grant). The above noise levels may only be exceeded if the Director of Mines: - is satisfied, on the basis of information provided to him by an acoustic engineer, that the noise will not cause an adverse impact at the sensitive receiver due to the existing influence of ambient noise, or the limited duration and/or frequency of occurrence of the activity; and - provides prior approval for the exceedance (Co, O)	All noise complaints acknowledged in 48 hours and closed out within 14 days to the satisfaction of the complainant or as agreed with the Director of Mines.
	No adverse public nuisance impact to sensitive receptors from vibrations or air overpressure caused by blasting.	Vibration levels as a result of blasting activities are less than 5mm/s peak particle velocity at the nearest sensitive receptor for 95 per cent of blasts per year, with a maximum of 10 mm/s peak particle velocity for any one blast, in accordance with Australian Standard AS2187.2.2006 Use of explosives. Air overpressure levels as a result of blasting activities are less than 115 dB(Lin Peak) at the nearest sensitive receptor for 95 per cent of blasts per year, with a maximum of 120 dB (Lin Peak) for any one blast, in accordance with Australian Standard AS2187.2.2006 Use of explosives. (O)	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.



Should community feedback demonstrate that it is required, total noise levels in dB measured as 24 hr continuous monitoring will be undertaken at sensitive receptors to assess if mining operations exceed the EPA Noise Policy of <52 dBA during the day and <45 dBA during night time operations.

6.3.3 Dust and air quality

The generation of dust and impacts to air quality associated with the proposed ML have been modelled using local meteorological information and CALPUFF which is a model that predicts pollution dispersion (Appendix S).

Mining is not expected to occur during summer or winter and so the Project will interact with local air quality for approximately half of the year only.

Even under a worst-case scenario that includes no air quality controls and bad weather, modelling predicts that air quality at the proposed ML complies with the environmental standards and goals identified by the EPA and with National guidelines.

6.3.3.1 Context and views of affected parties

The proposed ML is located in an area dominated by agricultural land uses and subsequently air quality concerns are predominantly related to particulate matter (dust).

There are no known significant anthropogenic industrial sources of air pollution within the vicinity of the proposed site. There are unsealed roads surrounding the Project site which are used by local residents accessing the surrounding towns and residences. These roads are suitable for light vehicle and semi-trailer traffic but not designed for road train truck haulage.

The local agricultural activities in the area may result in dust material being disturbed by activities such as ploughing, seeding, grain cropping and stock grazing in the greater project area. These activities have the potential to generate localised dust emissions. Vehicle and equipment use on the local surrounding unsealed roads would also contribute to the particulate matter emissions in the local air shed. The climate coupled with a typically very low annual rainfall means there would be limited natural dust suppression when these activities are occurring.

6.3.3.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to air quality include the following:

- *Environment Protection Act 1993.*
- *Environment Protection (Air Quality) Policy 1994.*
- *National Environment Protection (Ambient Air Quality) Measure (NEPM (AAQ))* goals to assess the impact of site operations and other existing sources on ambient air quality at sensitive receptors.
- *Guidelines for Separation Distances* (EPA 2007).
- *EPA Guideline: Air quality impact assessment using design ground level pollutant concentrations (DGLCs)* (EPA 2006).

The adopted goals for this air quality assessment are presented in Table 6-10.



Table 6-10: Air quality goals

Pollutant	Average period	Goal	Exceedances allowed per year	Source
TSP	Annual	90 µg/m ³	n/a	NHMRC
PM ₁₀	24 hour	50 µg/m ³	5	NEPM
PM _{2.5}	24 hour Annual	25 µg/m ³ 8 µg/m ³	n/a	NEPM NEPM
Dust deposition	24 hour	4 g/m ² /month	n/a	NERDDC

6.3.3.3 Potential construction operation and closure impact/events

During construction, operation and rehabilitation there could be an increase in dust generation and an impact on air quality as a result of:

- Vehicle movements on unpaved roads.
- Wind-blown dust from the pit, stockpiles and freshly exposed areas onsite.
- Blasting and drilling.
- Handling, transfer and storage of materials.
- Heavy earthwork operations such as excavation and earth moving activities.
- Development of haul and access roads and use of unpaved roads between Campoona Shaft and Sugarloaf processing facility.
- Construction of workshops, process plant, equipment laydown areas and other infrastructure.
- Operation of plant equipment, such as the crushing plant.

The impact of dust on nearby receptors that may be susceptible to changes in air quality have been identified as:

- Residential properties and communities.
- Agricultural crops surrounding the proposed ML.
- Native flora and fauna present in the area around the proposed ML.

The potential impacts could therefore be:

- Decrease in air quality resulting in human health impacts at neighbouring sensitive receptors from mining operation dust.
- Human health impacts from contamination of rainwater tanks with dust from mining operations.
- Decrease in ambient air quality resulting in public nuisance at sensitive receptors as a result of mining operations.
- Reduced native plant growth or abundance resulting from increased dust deposition resulting from mining operations.
- Reduced agricultural crop growth rates/yields from increased dust deposition on leaves.



6.3.3.4 Construction phase emissions

The potential air quality effects resulting from particulate discharges to the air from activities at the sites have been assessed using a standard atmospheric dispersion modelling approach. CALPUFF, an advanced integrated Gaussian puff modelling system for predicting atmospheric pollution dispersion has been used. The model inputs and assumptions are described in Appendix S.

The maximum ground level concentrations (GLCs) at a sensitive receiver during construction are described in Table 6-11.

Table 6-11: Construction phase maximum predicted GLCs at a sensitive receptor

Pollutant	Average period	Maximum Predicted GLC ($\mu\text{g}/\text{m}^3$)	Location (UTM Coordinates)	Background GLC ($\mu\text{g}/\text{m}^3$)	Accumulative GLC ($\mu\text{g}/\text{m}^3$)	Goals
TSP	24 hours	28	638510, 6289525	42	70	90
PM ₁₀	24 hours	16	638510, 6289525	14	30	50
PM _{2.5}	24 hours	2.2	638510, 6289525	7.0	9.2	25
	1year	0.10		7.0	7.1	8

6.3.3.5 Operational phase emissions

The maximum ground level concentrations (GLCs) at a sensitive receiver during full scale operations are described in Table 6-12.

Table 6-12: Operational phase maximum predicted GLCs at a sensitive receptor

Pollutant	Average period	Maximum Predicted GLC ($\mu\text{g}/\text{m}^3$)	Location (UTM Coordinates)	Background GLC ($\mu\text{g}/\text{m}^3$)	Accumulative GLC ($\mu\text{g}/\text{m}^3$)	Goals
TSP	24 hours	40	638510,6289525	42	82	90
PM ₁₀	24 hours	32	638510,6289525	14	46	50
PM _{2.5}	24 hours	3.6	638510,6289525	7.0	11	25
	1year	0.19		7.0	7.2	8

It should be noted that the air assessment included a number of worst case elements:

- A conservative approach to the calculation of the rate at which material will be mined has been utilised.
- All mining activities have been conservatively modelled as occurring simultaneously and constantly (except for blasting). Utilisation factors have been used for bulldozing and grading to better represent their assumed usage.
- Wind erosion of stockpiles and exposed area a constant emission source regardless of wind conditions.
- Blasting has been input into the model as a daily event. Blast frequency as detailed in the mine schedule, is expected to occur once per week after the pit has reached a depth of approximately 60 m bgl.
- No control mechanisms have been included on drilling.
- No control mechanisms have been included on trucks dumping excavated materials.
- Emission sources within the excavation pit have been assigned a National Pollutant Inventory (NPI) pit retention factor; however, their base elevations do not take account of the depth of the pit floor below ground level.
- Background TSP and PM_{2.5} concentrations were conservatively derived from the background PM₁₀ concentration.



The modelling assessment concludes that 24-hour average particulate matter emissions during full scale mining from the sites during construction and operations comply with the model assessment criteria at nearby sensitive receptors.

At mine closure the site will be rehabilitated and returned to agricultural land, therefore dust levels are not expected to be above background levels.

6.3.3.6 *Control and management strategies*

The following management measures will be adopted for the project during full scale operation:

Construction

- Limit vehicle movements to designated entries and exits, haulage routes and parking areas.
- Use a water cart or sprinklers to maintain damp conditions in high activity areas.
- Visually monitor dust and where necessary implement the following measures:
 - Apply water to exposed surfaces that are causing dust generation when necessary.
 - Pre-moisten material before excavating or clearing to reduce dust generation.
 - Appropriately cover loads of fill on trucks transporting material to and from the construction site or water the surface to produce a natural crust. Securely fix tailgates of road transport trucks prior to loading and immediately after unloading.
 - Prevent where possible, or remove, mud and dirt being tracked onto sealed road surfaces.
- Where practicable, avoid or minimise dust generating activities (particularly clearing and excavating) during dry and extremely windy conditions.
- Limit the area and duration of exposed or unconsolidated areas. For example, stage vegetation stripping or grading where possible and, where practicable, apply vegetation mulch to soil stockpiles or surfaces left standing for extended periods.
- Implement revegetation activities as soon as practicable after construction activities are completed within a disturbed area.
- Maintain and regularly service construction plant and equipment.

Operation

- Use a water cart or sprinklers to maintain damp conditions in high activity areas.
- Compact or cover high traffic areas around the site with road base and/or bitumen-based polymer in accordance with fit-for-purpose design.
- Impose speed restrictions to the proposed ML of 40 km/hr on haul roads.
- If appropriate incorporate sprinkler systems on temporary stockpiles and ROM stockpile.
- Where practicable and consistent with management of materials, stockpile coarser material on the outer edges of stockpiled material.

Procedures/plans will be developed and implemented to address dust and general air quality issues on site during construction and operation. They will include management requirements such as reporting and cessation of works in the event of extreme wind conditions.



6.3.3.7 Evaluation of residual risks

Table 6-13 summarises the source, pathway and receptors of risks and impacts as they relate to air quality and dust. The full Risk Assessment can be found in Appendix Q. The impact assessment predicts that outright compliance with all air quality assessment criteria has been demonstrated.

Table 6-13: Risk assessment of impacts on dust and air quality

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_16	Dust generated by mining operations causes human health and nuisance impacts at sensitive receptors.	Possible	Minor	Moderate	Manage staged vegetation clearance and ground disturbance. Design the trafficable and working areas to be as small as possible. Design of mine haulage, access roads and other trafficable and working areas on site to incorporate sealing with compacted material and/or bitumen-based polymer (as appropriate for design specification) and implement vehicle speed restrictions and restrict traffic to dedicated formed roads. Implement dust suppression measures: - Use a water cart to spray when required to minimise dust. - Incorporate cover system on trucks transport ore to processing facility at MPL (Sugarloaf). - Stabilisation of the trench between annual excavator campaigns - Stabilisation and progressive rehabilitation of external slopes of the WRSFs. - Consider sprinklers on ROM stockpile. - Planting and embankments used as windbreaks to shield working areas from prevailing winds - Install and monitor dust deposition equipment to determine if mining activities are within acceptable levels. - Cessation of works in the event of extreme weather and wind conditions.	Unlikely	Minor	Low



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ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_17	Dust generated by mining operations causes contamination of rainwater tanks and impacts on human health.	Possible	Minor	Moderate	Manage staged vegetation clearance and ground disturbance. Design the trafficable and working areas to be as small as possible. Use a water cart or sprinklers to spray when required to minimise dust. Provide and fit filters to rainwater tanks if concerns are raised by nearby residents appropriate.	Unlikely	Minor	Low
C_18	Reduced native plant growth or or abundance or reduced agricultural crop resulting from increased dust deposition resulting from mining operations.	Possible	Minor	Moderate	Manage staged vegetation clearance and ground disturbance. Design the trafficable and working areas to be as small as possible. Use a water cart to spray when required to minimise dust. Design of mine haulage, access roads and other trafficable and working areas on site to incorporate sealing with compacted material and/or bitumen-based polymer (as appropriate for design specification) and implement vehicle speed restrictions and restrict traffic to dedicated formed roads. Implement dust suppression measures. Incorporate cover system on trucks.	Unlikely	Minor	Low
C_19	Combustion products affecting air quality for nearby sensitive receptors.	Possible	Insignificant	Low	Fuel combustion facilities for power generation, pumps, mining equipment and vehicles to meet EPA requirements, Australian standards and SA regulations (as appropriate). Equipment and vehicles to be maintained and serviced in accordance with manufacturer's requirements.	Unlikely	Insignificant	Low



6.3.3.8 Justification for acceptance of residual risk

As a result of the proposed dust control measures, the residual risk to the community and sensitive receptors has been significantly reduced with the occurrence of any health impacts being considered unlikely and the residual risk low.

6.3.3.9 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-14):

Table 6-14: Environmental outcomes and measurement criteria – air quality

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_16 C_17 C_19	No adverse public health and/or nuisance impacts to local residents from dust generated by mining operations.	Compliance with the National Environment Protection (Ambient Air Quality) Measure 2003 and Environment Protection (Air Quality) Policy 2016: PM10 24 hour concentration of 50 ug/m3 Annual average concentration of 25 ug/m3 and 24 hour and annual average PM2.5 24 hour concentration of 25 ug/m3 Annual average concentration of 8 ug/m3 (Co, O, Cl)	For health purposes, a TARP will be implemented which will include continuous PM10 and PM2.5 monitoring. For amenity or nuisance purposes, a live streaming camera will be mounted at a strategic location to visually monitor potentially dust generating activities which will provide instantaneous feedback to operators and transparent information for government regulators and the nearest sensitive receptor. Dust deposition levels of less than 4 g/m2/month. <i>Note, this leading indicator is a measurement criteria for potential vegetation impacts (see below) but can also be a useful leading indicator for nuisance impacts.</i>
		All dust complaints recorded immediately and closed out within 14 days to the satisfaction of the complainant or as agreed with the Director of Mines. (Co, O)	No increasing trend in community complaints regarding dust.
C_18	No loss of abundance or diversity of native vegetation on or off the lease via dust impacts or unauthorised clearance.	Compliance with the EPA adopted criteria for annual average dust deposition to exceed 4 g/m2/month and no more than 2 g/m2/month above background. No unauthorised clearance of vegetation. (O)	The extent of retained vegetation and evidence of potential dust impacts, or lack thereof, will be confirmed annually by an experienced ecologist.

The PEPR will include a monitoring program which would include as a minimum:

- The dust particulate monitor and deposition gauges as well as the online streaming camera will be located in the direction of the nearest sensitive and, where appropriate, in a background location.
- All monitoring locations shall be determined in consultation with the SA EPA. A complaints register will be established to record and respond to any issues raised by the local community relating to dust emissions from construction and operations.



6.3.4 Topography and landscape

The ML site at Campoona Shaft is on a small landholding of approximately 68 ha that will include the development of a pit and WRSFs. These will be constructed progressively and planted to blend in with the landscape during mining. At completion, these will be reshaped to ensure that any new landforms mimic the topography.

6.3.4.1 Context and views of affected parties

The local topography is generally characterised by a network of gentle hills and shallow valleys.

With excavation, new landforms (WRSFs) and the mine pit, it is anticipated that DSD, EPA and DEWNR have an interest in the topography being managed through the project lifecycle.

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to topography and landscape include the following:

- *Environment Protection Act 1993*
- *Mining Act 1971*
- *Natural Resources Management Act 2004*
- *Development Act 1993*
 - *Development Plan: Cleve Council (DCC 2013).*

6.3.4.2 Potential construction operation and closure impact/events

During full scaled operations, the addition of the open pit, temporary stockpiles, and WRSFs will alter the existing vista and have the potential to impact the rural farm amenity of the local region.

As these impacts relate to visual amenity, they have already been discussed above and are not assessed further here.

6.3.5 Geohazards

The mineralisation in the Campoona area occurs as highly graphitic schist within low-grade graphitic protogneisses.

Static testing was undertaken to evaluate the potential of geological materials present on site to leach metals and/or generate acid. Drainage quality from the site is likely to be non-acid metalliferous drainage (Appendix M).

6.3.5.1 Context and views of affected parties

There is no processing at the mine site. Ore will be temporarily stockpiled (separately) onsite and then transported to the neighbouring MPL (Sugarloaf) for processing. Waste rock generated through mining will be stored in the Western WRSF and in the eastern WRSF, both located close to the pit.

The mineralisation in the Campoona area occurs as highly graphitic schist within low-grade graphitic protogneisses. Late-stage north-west trending cross faulting, often associated with amphibolite intrusions, has segmented the graphite units (AMC 2013).

Fibrous material has not been encountered in the ML Campoona Shaft during exploration. The type of rocks and their alteration are not conducive to acicular mineral formation (W. Bollenhagen, Pirie Resources, pers. comm. 2015).

Static testing was undertaken to evaluate the potential of geological materials present on site to leach metals and/or generate acid. Complete oxidation occurs to depths of approximately 60 m bgl and there is strong to moderate oxidation persisting to 100 m below surface (Pirie Resources pers. comm.). Additionally, there is sufficient time to commence any investigations before complete oxidation is reached (circa 4 years). Considering the geological setting, sulphur content and the volume of materials at the site, the likelihood of AMD is low.



The report concluded that drainage quality from the site is likely to be non-acid metalliferous drainage.

6.3.5.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to topography and landscape include the following:

- *Natural Resources Management Act 2004*
- *Mining Act 1971*
- *Environment Protection Act 1993.*

6.3.5.3 *Potential construction operation and closure impact/events*

Acid mine drainage (AMD) is not anticipated to be a significant issue. Testing of a range of representative samples of waste rock and low grade has been undertaken. The results indicate that some of the waste rock adjacent to low grade ore zones from deeper in the open cut mine are low capacity PAF.

Site drainage is efficient, and even after large rain events, there is little evidence of run-off leaving site. Although unlikely to occur, there is the potential for run-off from the Western WRSF to eventually report to Salt Creek, and it is considered that there is a low risk of contamination from acid rock drainage in surface water from stockpiles. Control and management strategies have been developed as a precautionary approach.

6.3.5.4 *Control and management strategies*

The likelihood and consequence of acid rock drainage contaminating surface water that leaves site may be significantly reduced by implementing the following control and management strategies:

- Design the Western WRSF to include an area for encapsulating potential acid forming material (if applicable).
- Collect drainage from ore stockpile area and low grade stockpiles.
- Implement a grade control program to undertake assessment of potentially acid forming (PAF) material during mining activities will be developed and implemented.
- Refine the Conceptual Acid and Metalliferous Drainage Management Plan (Appendix O).



6.3.5.5 Evaluation of residual risks

Table 6-15 summarises the source, pathway and receptors of risks and impacts as they relate to geohazards. The full Risk Assessment can be found in Appendix Q.

Table 6-15: Risk assessment of impacts from geohazards

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_24	Acid rock drainage into surface water from waste rock and stockpiles resulting in contamination of land and water resources.	Unlikely	Minor	Low	Every bench will be inspected by a geologist and an annual report collated. All blast holes will be geologically logged. Any visible sulphides will be assayed and PAF material excavated separately and encapsulated in the W-WRSF. Collect drainage from ore stockpile area and low grade stockpiles. Separate PAF and non-acid forming (NAF) materials and encapsulate any PAF material preferentially in the middle of the Western WRSF. Develop and implement a program to undertake grade control monitoring of potentially acid forming material during mining activities 60bgl. Refine Conceptual Acid and Metalliferous Drainage Management Plan (CAMDMP; Appendix O).	Rare	Minor	Low



6.3.5.6 Justification for acceptance of residual risk

The strategy is to selectively place the PAF materials (weathered sediment and other) preferentially in the middle of the waste rock dump for encapsulation by NAF materials. Acidic drainage resulting from oxidation of acid from rock material is therefore limited and accordingly is not anticipated to be a significant issue.

The proposed permanent placement and capping control and management measures are considered reasonable to manage potential impacts relating to ARD. On this basis the potential for ARD drainage is considered to be low.

6.3.5.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-16).

Table 6-16: Environmental outcomes and measurement criteria – geochemistry

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_24	No long term impact on local environmental values as a result of deterioration of surface water quality due to contamination during operations.	Audits and inspection records demonstrate that waste rock containing PAF is placed in the W-WRSF as specified in the PEPR (O).	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment.

6.3.6 Surface water hydrology

There are no significant watercourses in the vicinity of the proposed ML however it is surrounded to the south and west by a network of ephemeral surface water flow paths.

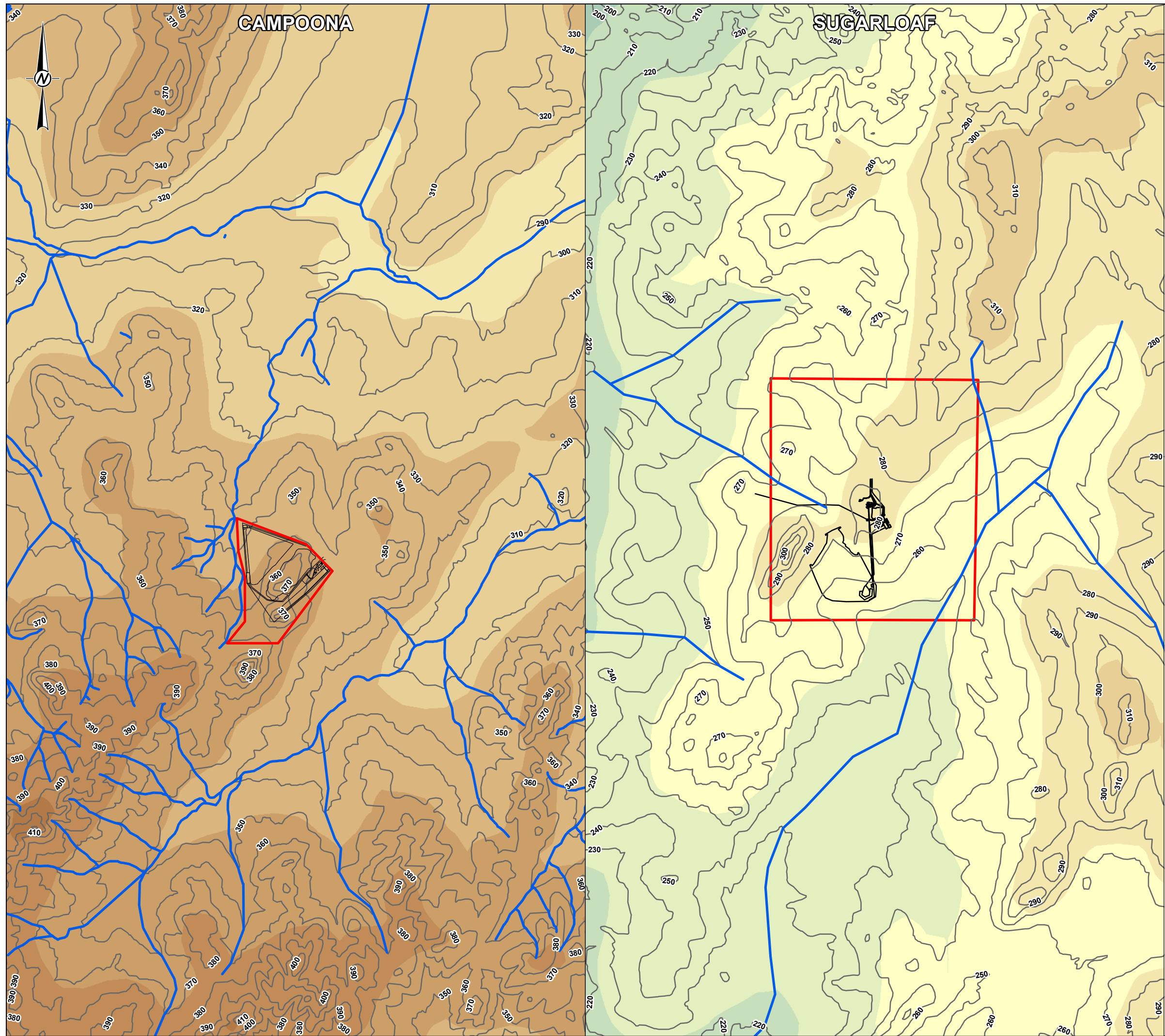
Run-off is generally conveyed off-site in a northerly direction. The available topographic information suggests the ML is not significantly impacted by upslope run-off (Figure 6-3). Pirie Resources has implemented three layers of water quality protection prior to any water being released from the WRSFs. Although the risk has been deemed low given the existing low run-off, surface water controls have been designed to ensure ongoing surface water quality is managed in the unlikely event it is released offsite.

6.3.6.1 Context and views of affected parties

It is a requirement for mines and other industries in South Australia to manage surface water drainage and to adhere to water quality standards. The standard industry approach of compiling historic rainfall data to create a design storm event for the recommended ARI of 1 in 100 was used to establish the site specific extreme storm conditions. This approach is commonly used to define the extent of alteration to existing drainage channels and the design of infrastructure and flood protection mechanisms for the proposed ML (1 in 100-year rainfall event).

Stream flow data are also commonly used in mine sites for the accurate design of infrastructure size. However, for ungauged, ephemeral streams such as those near the Campoona Shaft mine site, stream flow data do not exist.

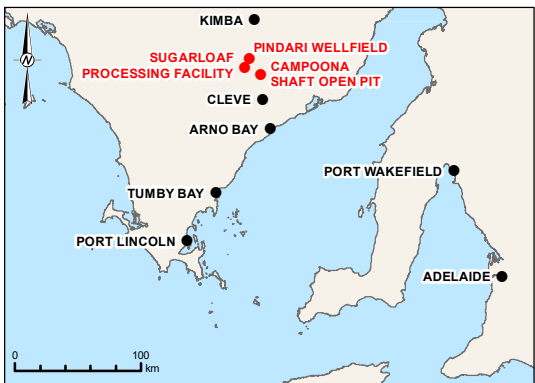
The site does not have significant offsite run-off, with little evidence of rainfall run-off even after large rainfall events.



CAMPOONA PROJECT
MINING LEASE PROPOSAL

REGIONAL SURFACE WATER
ENVIRONMENT

LOCATION MAP



LEGEND

Surface Elevation (m)	
77 - 100	Campoona ML and Sugarloaf MPL
101 - 125	Infrastructure Footprint
126 - 150	Flow Paths
151 - 175	Surface Contour (10m interval)
176 - 200	
201 - 225	
226 - 250	
251 - 275	
276 - 300	
301 - 325	
326 - 350	
351 - 375	
376 - 400	
401 - 425	
426 - 450	

NOTES

1. Township data sourced from MapInfo StreetPro.
2. Site layout data sourced from Archer Exploration Ltd.

0 200 400 800 1,200 1,600 2,000
Metres

REFERENCE SCALE: 1:35,000 (AT A3)
PROJECTION: GDA 1994 MGA Zone 53

PROJECT: 127663057
DATE: 2015-11-25
PREPARED: MS / SS / KB
REVIEW: BMC
APPROVED: LVC

FIGURE
6.3





6.3.6.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to surface water include the following:

- *Mining Act 1971*
- *Natural Resources Management Act 2004*
- *Environment Protection Act 1993*
- *Environment Protection (Water Quality) Policy 2003*
- *Environment Protection Authority, Bunding and Spill Management*, August 2012
- Australian Standard 1940-2004: *The storage and handling of flammable and combustible liquids*
- Australian Standard 1962-2006: *Steel tanks for flammable and combustible liquids*.

6.3.6.3 Potential construction operation and closure impact/events

The proposed ML is not located close to any significant watercourses. As such, there are no alterations to flow regimes, or any watercourse diversions associated with this project.

Mining is not proposed during winter when most of the rain in the region falls. It has also been assumed that the WRSFs will shed run-off in all directions. Water quality controls have therefore been conceptually designed to capture and clean this water prior to release back to the environment.

The main interactions with surface water run-off from the proposed activities are from the WRSF and the ROM stockpile. However, it is possible that a spill or leak may occur, contaminating the surface water, from any of the following sources:

- Chemical use and/or storage.
- Fuel use and/or storage.

6.3.6.4 Control and management strategies

Potentially impacted run-off from the proposed Amenity Mound (eastern WRSF) will first be directed via diversion drains to a settlement pond for removal of suspended sediment. The run-off will then be conveyed towards an evaporation pond located in the north-western corner of the site (Figure 6-4).

Potentially impacted run-off from the proposed ROM stockpile and Western WRSF will also be conveyed via diversion drains to a settlement pond and then towards a second evaporation pond located in the eastern corner of the site.

Potentially impacted run-off from the proposed pit will likely be conveyed to the proposed sediment basin / evaporation pond adjacent to the Amenity Mound.

Culverts and ramps will be provided for vehicular access where bunds or drain crossings are required. Since disturbed areas generally produce more run-off than natural surfaces, the proposed development at ML Campoona Shaft may impact the existing surface water drainage regime at each specific location. However, the proposed evaporation ponds will significantly mitigate potential increases in the amounts of run-off discharging from both sites and diversion drains will be designed to minimise erosion potential. Based on a design ARI of 100 years or less, construction of the proposed diversion drains and bunds is unlikely to require significant excavations or large quantities of fill. The detailed designs for these features will be produced in later stages of the Project.



Where a proposed diversion drain is located along the perimeter of the site, an adjacent bund will be provided to minimise the risk of uncontrolled discharge to the downstream environment. A bund will also be provided near the southern perimeter of the site to divert clean surface water run-off flowing on to the site from a small upslope area, around the proposed pit.

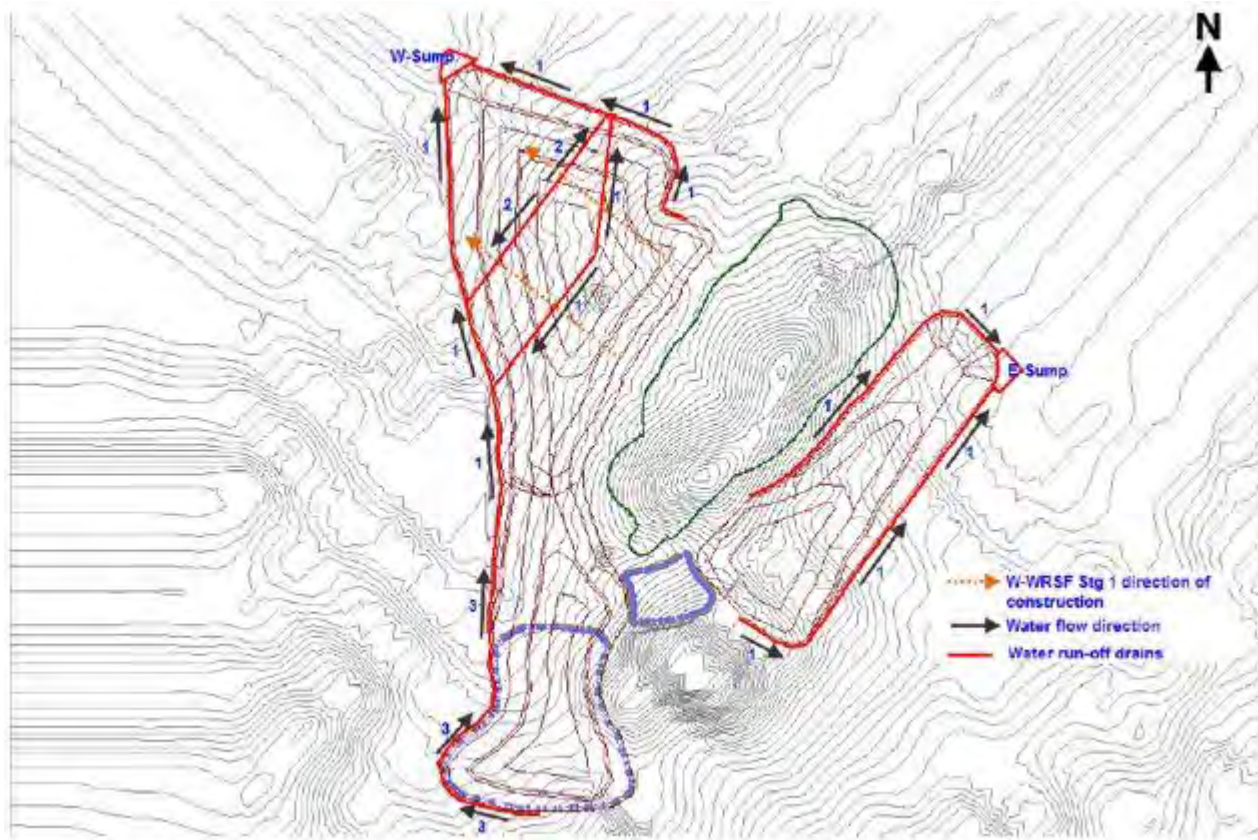


Figure 6-4: Surface water controls at ML Campoona Shaft



6.3.6.5 Evaluation of residual risks

Table 6-17 summarises the source, pathway and receptors of risks and impacts as they relate to surface water. The full Risk Assessment can be found in Appendix Q.

Table 6-17: Risk assessment of impacts on surface water

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_10	Reduced flow to the ephemeral creek through altered drainage paths impacting water availability for other users.	Unlikely	Minor	Low	Although the site is unlikely to contribute significant volumes to the adjacent ephemeral creek, all water from WRSFs will be captured and reused for dust suppression activities. Undertake detailed topographic assessment during PEPR development to delineate the catchment and derive estimated design peak discharges to finalise the surface water control infrastructure.	Unlikely	Minor	Low
C_11	Contamination of surface water and loss of environmental values as a result of release of sediment laden water from site operations.	Possible	Minor	Moderate	Run-off from site and in particular WRSFs and stockpiles to be collected in diversion channels and directed through sediment traps prior to being reused for dust suppression. Diversion of upslope surface water run-off where applicable, noting that this is minimal. Design of roads to incorporate appropriate drainage (where practicable). Controlled application of rainwater collected from the pit for dust suppression. Undertake visual inspections of surface water control systems immediately after rainfall events and remediate incidents by diverting flows appropriately and/or treating surface water (if required). A surface water quality monitoring program consistent with the risks will be developed and implemented during operations. Developed Sediment Erosion and Drainage Management Procedures (SEDMP).	Unlikely	Minor	Low



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ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_12	Contamination of surface water and loss of environmental values from spills or leakages of stored fuel and chemicals.	Possible	Minor	Moderate	Design fuel, oil and chemical storage and bunds in accordance with EPA and Australian Standards. Maintain fuel, oil and chemical storage areas during operations. Undertake regular inspections of areas to ensure integrity of bunded and spill containment areas and correct use of storage and distribution areas. Develop and implement chemical and fuel management procedures including emergency response and clean up requirements. Management of waste management facility in accordance with design and operating procedures. Implementation of a surface water monitoring program consistent with risks.	Unlikely	Minor	Low



6.3.6.6 Justification for acceptance of residual risk

The external slopes of the WRSFs will be established with flat concave slopes and armoured with non-acid forming rock which will reduce the potential for erosion. The installation of upslope surface water run-off diversion and sediment control systems will further reduce the potential for uncontrolled sediment discharge from the site.

With the implementation of the above control and management measures it is unlikely that erosion, sediment discharge and any impact on off-site areas would occur.

6.3.6.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-18).

Table 6-18: Environmental outcomes and measurement criteria – surface water

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_10	No long term impact on local environmental values as a result of deterioration of flow volumes	The frequency of water flows in the ephemeral creek will be monitored prior to the W-WRSF being constructed (Co, O). Volume of water captured by interceptor trenches for reuse on site will be recorded (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.
C_11	No long term impact on local environmental values as a result of deterioration of surface water quality	Water quality (in accordance with the Australian and New Zealand Guideline for Fresh and Marine Water Quality for Protection of Aquatic Ecosystems and Stock Watering guidelines, ANZECC /ARMCANZ 2000) in ephemeral creek will be monitored during peak flow periods (O).	Inspection and maintenance of drainage containment system after rain events that generate run-off confirms no loss of containment.
C_12	No long term impact on local environmental values as a result of deterioration of surface water quality	Water quality (in accordance with the Australian and New Zealand Guideline for Fresh and Marine Water Quality for Protection of Aquatic Ecosystems and Stock Watering guidelines, ANZECC /ARMCANZ 2000) in ephemeral creek will be monitored during peak flow periods (O).	Inspection and maintenance of drainage containment system after rain events that generate run-off confirms no loss of containment.

6.3.7 Groundwater hydrology

Pirie Resources has undertaken exploration drilling at the ML Campoona Shaft. Based on drilling records for the 2012 exploration program and observations made by Pirie Resources, a total of 64 exploration drill holes (reverse circulation and diamond cored) were drilled at the site. Of the 64 drill holes, 48 were drilled past 50 m bgl and only three yielded observable amounts of water. All three boreholes were outside of the pit footprint.

Although drilling results have not consistently found groundwater, it is assumed that the main water bearing unit in the Project area is likely to be the fractured rock basement. The transmissivity and storativity of the fractured rock aquifers is likely to be low.



6.3.7.1 Context and views of affected parties

As with any open cut, groundwater conditions can be affected by mining operations, which in turn may affect adjacent groundwater environments. However, none of these are noted in close proximity to the graphite deposits in question.

In the Project area, the majority of the water for agricultural use is sourced from the harvesting of surface water resources and SA Water mains supply.

6.3.7.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to groundwater include the following:

- *Mining Act 1971*
- *Natural Resources Management Act 2004*
- *Environment Protection Act 1993.*

6.3.7.3 Potential construction operation and closure impact/events

Based on drilling results, the probability of groundwater conditions posing constraints on mining is low, and it is extremely likely that the pit will be dry during operations.

As with any open cut mine, groundwater conditions can be affected by mining operations, which in turn may affect adjacent groundwater environments; however, none of these are noted in close proximity to the Campoona Graphite Project. Groundwater contamination could occur through such events as fuel and chemical spills, explosives residues, AMD in the pit and potential leakage from water storages. Contaminated water has the potential to enter the aquifer. The likelihood of groundwater contamination occurring is unlikely due to the limited groundwater and fractured nature described above. The consequence is considered to be minor as there no current users for environmental or agricultural purposes. Given the limited information available on groundwater, impact events affecting groundwater have been assessed below.

Groundwater is highly saline in the proposed ML area, with 41,800 mg/L TDS reported. Survey results indicated that there was no groundwater being used by adjacent landowners.

There is no identified interaction between groundwater and flora or fauna at the proposed ML (Appendix G).

6.3.7.4 Control and management strategies

Due to the unlikely event of groundwater being in pit or saline groundwater requiring disposal, limited impacts are envisaged. An AMD management plan will be implemented.



6.3.7.5 Evaluation of residual risks

Table 6-19 summarises the source, pathway and receptors of risks and impacts as they relate to groundwater. The full Risk Assessment can be found in Appendix Q.

Table 6-19: Risk assessment of impacts on groundwater

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_08	Contamination of groundwater resources from in pit mining activities.	Unlikely	Minor	Low	Spill control and management. Management of all explosives lubricants, fuels in the pit in accordance with relevant legislation. All waste disposed of in accordance with the Waste Management procedures. Pit water (incident rainfall) collected in sumps will be tested post winter and after significant rainfall events for the life of mine to demonstrate appropriate water quality that enables reuse in dust suppression.	Unlikely	Minor	Low
C_09	Contamination of groundwater via a pit lake with connection to an aquifer.	Unlikely	Minor	Low	Monitor incident rainfall in the pit Use pit water for dust suppression during mining campaigns. No aquifers present.	Unlikely	Minor	Low



6.3.7.6 Justification for acceptance of residual risk

With the described control measures in place, the residual risks for the potential impacts associated with groundwater for the proposed ML are classified as low. This assessment is credible as:

- There are no aquifers that will be impacted by mining at ML Campoona Shaft.
- The groundwater quality is saline and there are no identified beneficial users.

6.3.7.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-20).

Table 6-20: Environmental outcomes and measurement criteria – groundwater

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_08 C_09	No adverse impact to groundwater quality caused by mining operations.	Audits and inspection records demonstrate that waste rock containing PAF is stored and correctly placed in the W-WRSF as specified in the PEPR. An annual internal audit of the spills register demonstrates that all spills of fuels, lubricant or other contaminate have been remediated in accordance with EPA requirements and that all spills greater than 20 L reported to appropriate regulator (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.3.8 Vegetation

The mine site occurs in an area largely cleared of remnant vegetation in order to accommodate agricultural activities. Isolated small patches of predominantly degraded mallee vegetation are scattered across the landscape within and surrounding the proposed ML. Pirie Resources has undertaken three seasonal surveys in the broader project region and specifically at the proposed ML site.

The mine infrastructure necessitating topsoil and associated vegetation removal within the proposed ML includes the open pit and waste disposal areas. The clearing will remove individual plants from the broader population of plants within and surrounding the proposed ML.

The surveys and subsequent impact assessment has highlighted that the project has limited on-site impact risks. Residual risk to regional species and populations were also deemed low.

6.3.8.1 Context and views of affected parties

Campoona Shaft proposed ML is a highly modified landscape that has been extensively used for agriculture and there are no EPBC- listed species on site. There are a limited number of state-based species that Pirie Resources has managed through adjusting the location of the WRSFs.

6.3.8.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to vegetation include the following:

- *National Parks and Wildlife Act 1972.*
- *Native Vegetation Act 1991.*
- *Natural Resources Management Act 2004.*
- *Environment Protection and Biodiversity Conservation Act 1999.*
- *Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the Clearance of Native Vegetation Associated with the Minerals and Petroleum Industry (DWLBC 2005).*



6.3.8.3 Potential construction, operation and closure impact/events

There is limited native vegetation on site. Although the mine infrastructure footprint has been minimised, minor clearance is required. It is expected that one individual (*Goodenia benthamiana*) listed under the *National Parks and Wildlife Act 1972* will be lost as a result of mining at Campoona Shaft. Further, there is the potential for loss of *Davesia pectinata* through access and transport infrastructure upgrades; however, these are widespread in the region.

Although the mine infrastructure footprint has been minimised, minor clearance is required. It is expected that less than 1 ha of degraded vegetation will be lost at ML Campoona Shaft. A contribution to the Native Vegetation Fund is envisaged. Whilst the vegetation is degraded, Pirie Resources is willing to negotiate the SEB contribution between \$500 and \$3500 for the hectare loss.

It is considered possible that without dust mitigation and control measures, the level of dust deposition could have a negative effect on plant growth rates. Given there is minimal vegetation on site and adjacent to the site, this is considered unlikely. However, given the fragmentation of vegetation in the region, the consequence is considered minor.

With little change to the catchment or impact of flows to the ephemeral stream, there is limited impact pathway to offsite vegetation through altered water availability.

A fire originating from operations on the proposed mining lease, whilst considered rare, could have major consequences and controls are addressed in the risk assessment.

6.3.8.4 Control and management strategies

The clearing of native vegetation and occasional loss of individuals cannot be practically avoided however the impact and consequences may be reduced by implementing the following control and management strategies:

- Implement induction procedure for site personnel to indicate areas of approved clearance/protection.
- Design and layout of project components to areas that will require limited land clearance.
- Implement a program for stage clearance ensuring clearance only occurs prior to and within designated clearance area.
- Progressively rehabilitate disturbed areas where practicable.
- Prepare and implement a mine rehabilitation and closure plan.
- Establish significant environmental benefit for the project.

Dust will be managed in accordance with the control and management strategies identified in Section 6.4.3.



6.3.8.5 Evaluation of residual risks

Table 6-21 summarises the source, pathway and receptors of risks and impacts as they relate to vegetation. The full Risk Assessment can be found in Appendix Q.

Table 6-21: Risk assessment of impacts on vegetation

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_01	Vegetation clearance and degradation through construction of the mine infrastructure	Likely	Minor	Low	Develop and implement mitigation measures that consider minimising the development footprint and vegetation removal to within the fenced boundary. Demarcate areas with natural vegetation with bunding to prevent accidental losses.	Unlikely	Insignificant	Low
C_02	Loss of individuals from threatened flora populations through construction of the mine infrastructure.	Unlikely	Minor	Moderate	Minimise the development footprint and vegetation removal to within the fenced boundary. Demarcate areas with natural vegetation with bunding to prevent accidental losses.	Unlikely	Insignificant	Low



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C_03	Airborne dust resulting in reduced plant growth (offsite) through construction and operation of the mine infrastructure.	Unlikely	Minor	Low	Implementation of a program for staged clearance; ensuring clearance occurs immediately prior to development and within designated areas. Restrict traffic to established site roads. High traffic areas around the site will be graded, compacted or covered with road base and/or bitumen-based polymer in accordance with fit for purpose design. Dust suppression using water will be undertaken during construction and operation. Monitor dust deposition impacts on vegetation.	Unlikely	Minor	Low
C_04	Loss of vegetation outside the mining lease as a result of fires originating from construction and mining operations	Unlikely	Major	High	Compliance with AS 5062-2006. Fire protection of mobile and transportable equipment. Provide emergency response capability at mine. Liaise with local emergency services and nearby farming operations.	Rare	Major	High



6.3.8.6 Justification for acceptance of residual risk

The proposed control and management measures are likely to reduce the potential for long term consequence on the abundance of vegetation communities at the regional level and local level.

Pirie Resources has minimised the development footprint and designed the mining infrastructure to avoid vegetated areas as far as practicable. As such, the construction and operation works are designed to occur in the cleared and formerly farmed areas of each site.

Site clearance, although minimal, will require approval from DSD (delegate of the Native Vegetation Council). An offset project or payment into the NVC fund will be established as an SEB. Additionally, it is expected that vegetation adjacent to the active mine and processing areas will recover following completion of operations.

Given the predicted levels of dust deposition once the control and management strategies are implemented it is likely that impacts on vegetation growth rates or abundance from the increased dust emanating from mining activities will be insignificant. Increased dust is not likely to lead to long term changes in flora composition, as impacts are likely to be localised in nature and able to be rehabilitated.

6.3.8.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-22).

Table 6-22: Environmental outcomes and measurement criteria – vegetation

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_01	No loss of abundance or diversity of native vegetation on the Land through; ■ clearance, ■ dust/contaminant deposition, ■ fire, ■ reduction in water supply, or ■ other damage, unless prior approval under the relevant legislation is obtained.	Review of vegetation clearance permits indicates clearance has been authorised under the Native Vegetation Act 1991 as per the Native Vegetation Management and Monitoring Plan.	Not required
C_02	No loss of abundance or diversity of native vegetation on the Land through; ■ clearance, ■ dust/contaminant deposition, ■ fire, ■ reduction in water supply, or ■ other damage, unless prior approval under the relevant legislation is obtained.	Review of vegetation clearance permits indicates clearance has been authorised under the Native Vegetation Act 1991 as per the Native Vegetation Management and Monitoring Plan.	Not required
C_04	No loss of abundance or diversity of native vegetation on the Land through; ■ clearance, ■ dust/contaminant deposition, ■ fire, ■ reduction in water supply, or ■ other damage, unless prior approval under the relevant legislation is obtained.	No ML generated fires (Co, O).	On-site fire safety inspections at the end of spring.



6.3.9 Weeds

Pirie Resources has undertaken three seasonal surveys in the broader project region and specifically at the project sites and pipeline routes and identified that weed management will be required, with specific measures for Bridal Creeper. The residual risk of the Campoona Graphite Project proliferating weeds is deemed low as Pirie Resources has extensive weed control procedures on and off-site.

6.3.9.1 Context and views of affected parties

During the field studies completed in 2012, 2013 and 2014, a total of eleven introduced species were recorded within the proposed ML area.

Of these introduced species, only two are classified as declared weed species under either the State or Commonwealth legislation:

- Bridal creeper (*Asparagus asparagoides*) (Weed of National Significance WoNS).
 - This species is considered to be a major threat to native plant communities, agricultural and forestry industries and communities.
 - The berries are spread by birds, rabbits and foxes that feed on and later excrete the seeds. Movement of soil or dumping of garden rubbish containing Bridal Creeper seeds or roots can also spread the weed (CRC 2003 in Department of the Environment n.d.).
 - Landholders are required by law to control WoNS growing on their properties.
- *Cirsium* sp.
 - This species is a declared weed in South Australia.
 - Seed dispersal is aided by the consumption of the species sticky red berries by birds and foxes (CRC Weed Management, 2004; Department of Water, Land and Biodiversity Conservation, 2006).
 - Control of *Cirsium* sp. is not required within the Eyre Peninsula local government area (Biosecurity SA, 2012).

6.3.9.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to weeds and pathogens include the following:

- *Natural Resources Management Act 2004*.
- *Natural Resources Management Plan for the Eyre Peninsula Natural Resources Management Region, Volume 2: Caring for our Resources* (EPNRMB 2009).
- *State Biosecurity Policy 2013-16* (PIRSA undated).
- *The Australian Weed Strategy: A national strategy for weed management in Australia* (NRMMC 2007a).

6.3.9.3 Potential construction operation and closure impact/events

The proposed ML site layout has been designed to minimise disturbance to native vegetation, however there is likely to be a weed seed bank in the areas that are routinely cropped.

The establishment and operations of the mine will result in disturbance of soil including the topsoil and subsoil. These conditions provide a competitive advantage to weed species and result in the spread of weed species to cleared areas.

The movement of vehicles on the site could also result in spreading of weed species from one area of the site to another.



6.3.9.4 Control and management strategies

Establishment of weeds may be reduced by implementing the following control and management strategies:

- Site induction to include identification of weed species.
- Implementation of a program for staged clearance; ensuring clearance occurs immediately prior to development and within designated areas, protect topsoil stockpiles from weed infestation.
- Active management and control of weeds in newly cleared areas.
- Earth moving machinery and equipment is cleaned prior to entering and leaving the site.
- Inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak.
- Consultation with farmers to identify any further weed species and initiate shared programs of weed eradication in the region, particularly for *Asparagus asparagoides*.
- A wheel wash and vehicle inspection regime will be implemented at entry and exit points to the site, including installation of rumble grids in appropriate locations.
- Restrict traffic to established site roads.



6.3.9.5 Evaluation of residual risks

Table 6-23 summarises the source, pathway and receptors of risks and impacts as they relate to weeds. The full Risk Assessment can be found in Appendix Q.

Table 6-23: Risk assessment of impacts from weeds

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_05	Soil disturbance during construction and operation of mine site results in an increase in the abundance of weeds and impacts on agricultural production.	Possible	Insignificant	Moderate	Site induction to include identification of weed species. Implementation of a program for staged clearance; ensuring clearance occurs immediately prior to development and within designated areas. Develop and implement weed mitigation measures that consider: - Working with NRM for monitoring, mapping and controlling Bridal Creeper (<i>Asparagus asparagoides</i>) populations in the project areas; - Controlling new weeds that are introduced in the project areas; - Rehabilitating disturbed areas as soon as practical. - Inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak. - Protect topsoil stockpiles from weed infestation. - Consultation with farmers to identify any further weed species.	Unlikely	Insignificant	Low
C_06	Movement of vehicles, machinery and equipment onto the site results in introduction of new weeds and impacts on agricultural production.	Possible	Minor	Moderate	Earth moving machinery and equipment is cleaned prior to entering and leaving the site. Inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak. Protect topsoil stockpiles from weed infestation. Consultation with farmers to identify any further weed species. Conduct regular flora and fauna site walkovers to confirm no increase in invasive species and abundance. Restrict traffic to established site roads. Monitor vegetation impacts.	Unlikely	Minor	Low



6.3.9.6 Justification for acceptance of residual risk

The proposed control and management measures that include limiting the extent of clearance and vegetation disturbance and the regular monitoring program and eradication of emergent weeds will reduce the likelihood for significant increases in the density and distribution of weeds.

6.3.9.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-24).

Table 6-24: Environmental outcomes and measurement criteria – weeds

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_06 C_07	No introduction of new species of weeds, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the Mining Lease compared to adjoining land..	Quarterly inspection of cleared areas for weed establishment indicate no increase in weed abundance or presence of new weeds compared to control sites (O).	Inspection records for vehicles and machinery show that all have been certified as clean before operating on site.

6.3.10 Fauna

The historically cleared landscape associated with the Campoona Graphite Project limits the opportunity for risk pathways to fauna. No EPBC-listed species were recorded onsite and there is no suitable habitat for breeding that will be affected.

6.3.10.1 Context and views of affected parties

Fauna species diversity recorded in the project areas was 10 reptiles, 67 birds and nine mammals. No amphibian species was recorded in either project area.

- No fauna species listed as threatened under the EPBC Act was recorded in either survey.
- No reptile species protected by the NPW Act or EPBC Act was recorded during either survey.
- One species, Rainbow Bee-eater, listed as migratory under the EPBC Act, was recorded in November 2012. The project areas were found to potentially contain suitable breeding sites for this species but they were not deemed to represent significant breeding sites.

The project areas were found to support populations of the following state-listed (NPW Act) species:

- Purple-gaped Honeyeater (*Lichenostomus cratitius*), listed as rare and recorded in both the ML Campoona Shaft and Sugarloaf sites but not adjacent to the mine development footprint. Breeding activity outside both of the project sites is considered very likely for Purple-gaped Honeyeater given the presence of suitable mallee habitat.
- Diamond Firetail (*Steganopleura guttata*), listed as vulnerable, was recorded outside of the ML Campoona Shaft site at one site (White Road Creek).

6.3.10.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to fauna include the following:

- *National Parks and Wildlife Act 1972.*
- *Natural Resources Management Act 2004.*
- *Environment Protection and Biodiversity Conservation Act 1999.*



6.3.10.3 Potential construction operation and closure impact/events

Within a regional context, project related clearing represents a minor and almost undetectable habitat loss and will occur in an area that is already highly degraded and fragmented. The small area of degraded habitat that will be cleared does not represent significant habitat for any species of conservation significance and impacts are expected to be inconsequential. The habitat values of this vegetation have been assessed and there is a very low risk that its values could be greater than expected. Consequently, it is not considered that any significant fauna values will be impacted by the proposed mining operations and, as a result, no further assessment or outcome is required.

6.3.11 Pest species

Four feral species were recorded during the comprehensive survey work. These species all require management under the *Natural Resources Management Act 2004* and Pirie Resources will implement pest species management procedures.

6.3.11.1 Context and views of affected parties

Foxes, cats, rabbits and house mice were recorded during the field surveys. These species are already established in the area and have negatively impacted native flora and fauna.

In terms of potential impacts on pest species, the key stakeholders are NRM EP and farmers. No concerns have been raised by either stakeholder.

The community has not raised any concerns relating to pest species.

6.3.11.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to pest species include the following:

- *Natural Resources Management Act 2004.*
- *Natural Resources Management Plan for the Eyre Peninsula Natural Resources Management Region, Volume 2: Caring for our Resources* (EPNRMB 2009).
- *State Biosecurity Policy 2013-16* (PIRSA undated).
- *The Australian Pest Animal Strategy: A national strategy for the management of vertebrate pest animals in Australia* (NRMMC 2007b).

6.3.11.3 Potential construction operation and closure impact/events

Disturbance and mining activities within the site, including rehabilitation works could attract and provide suitable conditions for the further spread of feral animals including herbivorous pests such as rabbits. The destruction of native flora by these feral animals could result in decreased vegetation cover and limit the success of revegetation and rehabilitation of the site.

6.3.11.4 Control and management strategies

The impacts of introduced feral (pest) species can be reduced by implementing the following control and management strategies:

- Designing and locating roads and drainage to reduce the potential for water pooling and providing a source of drinking water.
- Undertaking inspection of mine site areas likely to harbor pest species.
- Implementation of a waste management plan to ensure no sources of food.
- Liaison with NRM Board in relation to control and eradication measures.
- Implementation of onsite eradication programs if required.



6.3.11.5 Evaluation of residual risks

Table 6-25 summarises the source, pathway and receptors of risks and impacts as they relate to pest animals. The full Risk Assessment can be found in Appendix Q.

Table 6-25: Risk assessment of impacts from pests

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_07	Increases in feral animal populations through increased food and habitat associated with the mine operations and storage practices.	Occasional	Insignificant	Moderate	Pre-start inspections to ensure animals are not within the activity zone. Develop and implement feral animal mitigation measures that consider: - Managing waste disposal and eliminating available waste food stuffs, as a result of human activities, to exclude cats and other feral animals; and - Destroying foxes, cats, rabbits and house mice in a manner consistent with adjoining landholders (as required by local NRM under legislation).	Unlikely	Insignificant	Low



6.3.11.6 Justification for acceptance of residual risk

Introduced species are currently present in the proposed ML and adjoining areas. The proposed control and management measures will provide for the control of feral (pest) species and the density and distribution is unlikely to increase significantly or to an extent that cannot be managed.

6.3.11.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-26).

Table 6-26: Environmental outcomes and measurement criteria – pests

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_07	No introduction of new species of weeds, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species in the Land compared to adjoining land.	Annual review of quarterly records indicates that there has been no significant increase in the abundance of pest species from baseline (O).	No increasing trend of sightings of pest species.

6.3.12 Topsoil and subsoil

During operations, topsoil and subsoils will be stockpiled and stabilised so that the potential for soil erosion and mobilisation of sediments in any run-off is limited.

6.3.12.1 Context and views of affected parties

The thin soil veneer within the proposed ML consists of sands to sandy clay loams that have been degraded by land clearing, grazing and cultivation for over a hundred years.

The mining industry has made significant progress over the last decade in soil management; soil stripping is now a standard practice in the industry with topsoil being stored separately. Most mining companies treat topsoil as a valuable natural resource and will make every effort to protect it. Topsoil management ensures that soil fertility, stability and the native seed reserve (if present) are preserved.

6.3.12.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to topsoil and subsoils include the following:

- *Natural Resources Management Act 2004.*
- *Liquid Storage Guidelines: Bunding and spill management (EPA 2012).*
- *Site contamination: determination of background concentrations (EPA 2008).*
- *National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended 2013 (NEPM 1999).*

6.3.12.3 Potential construction operation and closure impact/events

During both the construction and operation phases of the project there is potential for soil erosion from mining activities. Erosion is the process of soil removal with particles transported by wind or water.

Slopes and soil stockpiles are particularly susceptible to erosion, especially during high rainfall events. The loss of topsoil from the stockpiles through erosion can result in reduced quantities available for rehabilitation.



There is also potential for onsite erosion to generate an increase in the sediment load of surface water run-off. This has been further addressed in Surface Water.

Compaction of soil associated with infrastructure, hardstand areas, haul roads and access roads has the potential to limit the effectiveness of revegetation unless mitigation measures are implemented.

If soil erosion and compaction is not properly managed it could result in damage to soil structure, increased sedimentation in waterways, reduced efficiency of site drainage system and loss of top soil.

6.3.12.4 Control and management strategies

The mine plan will confine the mine footprint to as small an area as practicable to enable the extraction and processing of ore, supporting infrastructure and the waste rock. A small mine footprint reduces both environmental impacts and cost of mining.

- 1) A soil management plan will be developed to include recovery of as much topsoil as practicable and to control land clearance.
- 2) The design of fuel, oil and chemical storage facilities and transfer points and associated retaining bunds will be in accordance with EPA Bunding and Spill Management guidelines.

The likelihood and consequence of soil erosion due to exposure of soils may be reduced by implementing the following control and management strategies:

- Staged clearing to remove topsoils and subsoil from only the required footprint of the project components and undertake progressive rehabilitation and stabilisation.
- Design to incorporate surface water drainage control measures to protect stockpiles and reduce erosion and sediment loss.
- Regular inspections and maintenance of sediment and erosion control devices.
- Operational activities to keep to established and designated track and work zones.

The likelihood and consequence of soil compaction may be reduced by implementing the following design and operational management measures:

- Ensuring all vehicles only use designated roads.
- Removal of hardstand areas post mining.
- Scarifying compacted areas.
- Spreading of topsoil.



6.3.12.5 Evaluation of residual risks

Table 6-27 summarises the source, pathway and receptors of risks and impacts as they relate to topsoil and subsoil. The full Risk Assessment can be found in Appendix Q.

Table 6-27: Risk assessment of impacts on topsoil and subsoil

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_13	Construction and operation of the mine causing soil erosion due to exposure and instability of soils which can impact water resources.	Likely	Minor	High	Minimise potential through staged clearing from only the required footprint and progressive rehabilitation. Strip topsoil and excavate subsoil only from those areas that will be disturbed by mining operations. Ensure stockpiles are appropriately surveyed and documented for management and rehabilitation purposes. Use erosion control techniques to protect stockpiles and minimise erosion and sediment loss. Select soil stockpile locations avoiding working areas, areas of natural drainage and on-site traffic routes. Regular inspections and maintenance of sediment and erosion control devices Operational activities will keep to established and designated roads and work zones.	Possible	Minor	Moderate
C_14	Construction and operation of the mine causing soil compaction resulting in poor revegetation.	Possible	Minor	Moderate	Removal of hardstand areas. Scarifying of compacted areas. Spreading of topsoil.	Unlikely	Minor	Low



6.3.12.6 Justification for acceptance of residual risk

Minimising land clearance, separate stockpiling of topsoil and subsoil, progressive rehabilitation, revegetation and other proposed control and management measures will reduce the potential for loss of soil quality. On this basis that impact is considered to be insignificant and the residual impact low.

The removal of hardstand and other trafficked and compacted areas through implementation of the proposed management and control measures will minimise the impacts.

6.3.12.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-28).

Table 6-28: Environmental outcomes and measurement criteria – topsoils

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_13	Existing soil quality and quantity is maintained.	Annual survey and photographic records of soil stockpiles (O).	Periodic inspection shows that separate topsoil and subsoil stockpiles are established and maintained.
C_14	Existing soil quality and quantity is maintained.	Vegetation is self-sustaining and comparable to undisturbed surrounding area (O).	Annual records indicate that compacted areas have been removed, or scarified and topsoil spread.

6.3.13 Heritage

The proposed ML lies within the traditional territory of the Barngarla people. Barngarla Nation is the registered claimant for a Native Title claim over the proposed lease areas. When Pirie Resources purchased the Wildhorse Plain EL 4693, it became a party to the existing Native Title Mining Agreement (NTMA).

There are no previously recorded sites of significance to Indigenous archaeology, anthropology, history or tradition in the proposed ML. Similarly, there are no pathways to impact upon European heritage.

6.3.13.1 Context and views of affected parties

There are a number of locations of State and Local Heritage significance to non-Indigenous cultural heritage located in the region although none are within the vicinity of the various project components. There are no previously recorded sites of significance to Indigenous archaeology, anthropology, history or tradition in the study area.

Ground disturbance activities have the potential to directly impact archaeological and/or anthropological sites of significance. However, the desktop review identified that the majority of the project footprint has minimal predictive archaeological sensitivity.

All Aboriginal archaeological sites, objects and remains in South Australia are protected by provisions of the *Aboriginal Heritage Act 1988*, regardless of whether they are located on freehold or crown land, which makes it an offence to collect, damage or destroy Aboriginal sites, objects or remains without the written authorisation of the Minister for Aboriginal Affairs based on consultation with the relevant Aboriginal community. Pirie Resources is committed to eliminating their risk of damaging or destroying any Aboriginal sites, objects or remains.



6.3.13.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to Indigenous and non-Indigenous cultural heritage values include the following:

- *Heritage Places Act 1993.*
- *Aboriginal Heritage Act 1988.*
- *Development Plan: Cleve Council (DCC 2013).*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984.*
- *Environment Protection and Biodiversity Conservation Act 1999.*

6.3.13.3 *Potential construction operation and closure impact/events*

Ground disturbance activities have the potential to directly impact archaeological sites of significance. Heritage desktop surveys over the proposed ML (see Appendix H) did not identify any previously recorded sites of significance to Indigenous archaeology, anthropology, history or tradition in the study area and the majority of the project footprint has minimal predictive archaeological sensitivity. No intact sites have been identified due to the severely degraded nature of the area as a consequence of agricultural enterprises and environmental processes and the likelihood of disturbing Aboriginal sites (without prior approval) is therefore considered unlikely in the proposed ML.

No European heritage sites have been identified within or around the proposed ML area.

6.3.13.4 *Control and management strategies*

While there is no legal obligation under the Aboriginal Heritage Act to undertake a survey, Pirie Resources will proactively educate all staff to raise awareness and manage ground disturbing activities to ensure any archaeological sites, objects and remains, are not damaged, collected or destroyed.

The following control and management strategies will be implemented:

- Undertake induction of personnel on responsibilities under the Act, procedures relating to ground disturbance and identified sites, and reporting requirements.
- Develop Aboriginal Heritage management procedures in consultation with Barngarla representatives with procedures to be implemented in the event a discovery is made. Protocol to also address statutory reporting requirements as per legislation.
- Restrict vehicle access to site access tracks and project roads to prevent damage to identified or unknown sites. Any Aboriginal Heritage sites will be clearly identified sites and, if required by the heritage management plan, designated as "no go" zones with prohibited access to these sites.
- Monitor the status of the heritage sites and implementation of the heritage management procedures.
- Establish and implement procedures should new sites be discovered during site works.



6.3.13.5 Evaluation of residual risks

Table 6-29 summarises the source, pathway and receptors of risks and impacts as they relate to heritage. The full Risk Assessment can be found in Appendix Q.

Table 6-29: Risk assessment of impacts on heritage

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_15	Disturbance to Aboriginal heritage sites through construction and operation of the mine infrastructure.	Unlikely	Moderate	Moderate	Develop Aboriginal heritage management procedures in conjunction with Barngarla representatives with procedures to be implemented in the event a discovery is made. Protocol to also address statutory reporting requirements as per legislation. Restrict vehicle access to site access tracks and project roads to prevent damage to identified or un-known sites. Clearly mark identified sites and, if required, designate as "no go" zones and prohibit access to these sites. Monitor the status of heritage sites and implementation of the Aboriginal Heritage Management procedures. Establish and implement procedures should new sites be discovered during site works. Undertake induction of personnel on responsibilities under the Act, procedures relating to ground disturbance and identified sites, and reporting requirements.	Unlikely	Minor	Low



6.3.13.6 Justification for acceptance of residual risk

Ongoing awareness and management of the risks will be required during construction and operation to ensure un-known sites are not impacted. The proposed management measure should mitigate significant impacts.

Disturbance of aboriginal heritage sites will be unlikely as site clearance of project components will have been undertaken and no-go zones will have been identified.

6.3.13.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-30).

Table 6-30: Environmental outcomes and measurement criteria – heritage

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_15	No disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation has been obtained.	Records show that if an Aboriginal site or artefact is discovered that work ceases and appropriate procedures are followed, including approval sought under the <i>Aboriginal Heritage Act 1988</i> as required (Co, O). Induction records indicate heritage requirements addressed (Co, O). No incident reports relating to disturbance of heritage sites (Co, O) Records indicate heritage management procedures in place (Co, O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.3.14 Conservation areas

There are no pathways for mining at ML Campoona Shaft to impact conservation areas.

The closest Heritage Scheme Agreement (HA 569) to any of the project areas is adjacent to the Pindari pipeline alignment between Jamieson Tank Road and Carappee Hill Road.

Another heritage agreement areas lies to the east of the eastern end of Jamieson Tank Road pipeline route (south of the road at Jamieson Tank, HA 877). The interaction between the project and conservation areas is accordingly considered in the management plan for the MPL (Water).

6.3.15 Waste disposal

The types of industrial and commercial waste which will be generated by the mine site includes, but is not limited to, putrescible waste, recyclables, waste oil, oil filters, oily rags, tyres, petrochemicals, chemical containers.

Due to the size and siting of the mine, no on-site landfill is required. All waste and recyclables will be removed from site by contractors and disposed of at a local EPA approved facility.

Neither pre-existing contamination, nor potential sources of pre-existing contamination have been identified within the proposed ML area.

6.3.15.1 Context and views of affected parties

Waste disposal is important in context of the TSF operations.

The risk of putrescible wastes attracting pest species has been considered in Section 6.4.11.



6.3.15.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to waste management include the following:

- *Hazardous Waste (Regulation of Exports and Imports) Act 1989.*
- *National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998.*
- *National Environment Protection (Used Packaging Materials) Measure 2011.*
- *Environment Protection Act 1993.*
- *Environment Protection (Waste to Resources) Policy 2010.*
- *Standard for the production and use of Waste Derived Fill (EPA 2013).*
- *Current criteria for the classification of waste including Industrial and Commercial Waste (Listed) and Waste Soil (EPA 2010).*
- *Guideline for stockpile management: Waste and waste derived products for recycling and reuse (EPA 2010).*
- *Liquid Storage Guidelines: Bunding and spill management (EPA 2012).*
- *Waste transport certificate_(EPA 2010).*
- *Waste tracking form_(EPA 2007).*

6.3.15.3 Potential construction operation and closure impact/events

Hazardous materials such as waste oils, waste grease and car batteries will be stored on-site prior to pick up. If these wastes are incorrectly stored, the risk of a leak or spill occurring will increase, resulting in potential soil contamination.

If not stored correctly, used tyres pose a risk to public health and safety. The intense radiant heat can inhibit fire-fighting efforts and the incomplete combustion of tyres can cause a health risk through the inhalation of particulates. Tyre fires are very difficult to extinguish and are dangerous to fire fighters. Environmental impacts to soil, watercourses and stormwater are likely, and clean-up costs can be extremely high.

Stockpiling of wastes (including tyres) for long periods of time can provide ideal habitat for pest species (including mosquitos). Putrescible wastes such as food scraps may also attractive pest species is not properly disposed of. Refer to Section 6.4.11 for detail on the potential impacts of pest plants and animals.

6.3.15.4 Control and management strategies

Consumption of resources and materials is minimised as far as reasonably practicable. Waste management will be considered as a life cycle response from purchasing of the product up until when the product is no longer required to ensure all waste products are handled in a way that minimizes impact on the environment. In order to limit the amount of waste that requires to be sent to landfill it is important that when purchasing products, preference is given to:

- Products which are reusable.
- Products which are recyclable.
- Suppliers which recycle their products and packaging.
- Suppliers who offer return of unused product.
- Suppliers who offer to collect used products or empty containers.
- Suppliers of products with packaging minimisation programs.



All remaining wastes and recyclables will be disposed at off-site facilities, and landfill will be disposed of at EPA approved facilities.

During operations at the proposed ML, waste will be managed in accordance with a waste management plan. Further, Pirie Resources will:

- Ensure appropriate litter and rubbish bins/skips are available on site.
- Ensure rubbish bins and recyclable waste is removed by contractors as regularly as possible to minimise the risk of soil contamination and pest attraction.
- Store hazardous wastes on-site such as waste oils and used car batteries according to EPA bunding guidelines prior to off-site disposal.
- Store used tyres requiring disposal as per the South Australian Fires services guidelines (Czerwinski 2005).
- Undertake monthly site inspections at Pirie Resources site to ensure correct storage of all waste awaiting disposal and a regular turnaround of waste.

Waste tracking forms or waste transport certificates (as applicable) will be required for all waste removed from site.



6.3.15.5 Evaluation of residual risks

Table 6-31 summarises the source, pathway and receptors of risks and impacts as they relate to waste. The full Risk Assessment can be found in Appendix Q.

Table 6-31: Risk assessment of impacts from waste

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_25	Soil or water contamination due to incorrect waste disposal and contamination from sewage.	Possible	Minor	Moderate	Controls in place such as bunding, skips and all facilities designed, constructed and maintained in accordance with the relevant legislation.	Unlikely	Minor	Low
C_26	Incorrect storage of tyres causing fire.	Possible	Moderate	High	Considering the location of the potential storage areas along with correct storage and a regular turnaround of waste.	Rare	Moderate	Moderate
C_27	Incorrect storage of waste increasing pest species.	Possible	Moderate	High	Ensure litter and rubbish bins are available on site. Ensure correct storage of all wastes awaiting disposal, and regular turnaround of waste.	Rare	Moderate	Moderate



6.3.15.6 Justification for acceptance of residual risk

A moderate residual risk remains for fires from incorrect tyre storage as the consequence remains as moderate due to the impact a fire could cause, but it is likely that a fire would be able to be controlled on site before impacting neighbouring properties and/or residents. With the proposed strategies the likelihood has been reduced to rare.

With the described control measures in place, the residual risks for all of the other potential impacts associated with waste disposal on the proposed ML are classified as low. As all waste will be disposed of off-site, this eliminates the impact of contamination due to incorrect disposal. Bunding of all hazardous waste products also reduces the risk of contamination. Regular inspection of the site will ensure all control measures are in place and the waste management plan has been correctly implemented. All mine generated waste will have been removed post-closure, the potential impacts associated with their storage and disposal will have been eliminated.

6.3.15.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-32).

Table 6-32: Environmental outcomes and measurement criteria – waste

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_25	No contamination and pollution is caused by waste products and their disposal.	An annual audit of the waste disposal records of the volumes of putrescible and hazardous waste taken off-site demonstrate that the disposal of all potentially polluting waste has been taken to an approved EPA site and in accordance with the Waste Management Plan (O).	NA
C_26	No impacts to off-site property or public safety resulting from on-site fires.	An annual audit of the records from monthly inspections of the waste/recycling storage locations show all waste is stored correctly and processing of waste items is in accordance with the approved Waste Management Plan and Fire Management Plan (O).	NA
C_27	No introduction of new pest animal species or sustained increase in abundance of existing pest animal species in the proposed ML caused by mining operations.	An annual audit of the records from monthly inspections of the waste/recycling storage locations show all waste is stored correctly and processing of waste items is in accordance with the approved Waste Management Plan (O).	NA

6.3.16 Traffic and transport

The proposed ML is located west of the Cleve-Kimba Road in Campoona on the Elson-Campoona Road. Elson-Campoona Road is a two-way unsealed rural road which carries less than 50 vehicles a day based on the surrounding land use (Appendix J). Traffic impacts were considered negligible.

There are a number of unsealed minor roads which surround the proposed ML under the control of DC Cleve, which are used for local traffic, grain haulage and school bus routes.



Whilst transport is relevant to other parts of the Campoona Graphite Project, the impact and controls are only described here as the ML Campoona Shaft is the main source of vehicle movements.

6.3.16.1 Context and views of affected parties

The construction stage for full scale operations will require transportation of construction equipment and materials, with parking for construction staff provided on each site. It is estimated that 50-60 people will be required during the 10-month construction phase.

Operation of the proposed development will include transport of materials from the mine to the processing facility on the road network between the sites. Transport of ore is likely to utilise covered B-Double vehicles to transport between the sites.

During the small-scale start-up operation, a 1,000 tonne process stockpile will be developed at Sugarloaf. The process stockpile will be topped up one day per week requiring approximately 4 trips on that one day.

As production ramps to full scale the number of truck trips between the proposed ML and MPL (Sugarloaf) could range as follows (based on 50 tonnes per truck):

- Approximately 4 per day (road train) for 70,000 tpa capacity.
- Up to 8 per day (road train) for 140,000 tpa capacity.

In summary, the traffic generated by the ML at Campoona Shaft at full scale production would be 56 per day during construction and 32-37 during operation.

Ongoing maintenance requirements of the road network will be under agreement with the DC Cleve.

6.3.16.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to traffic include the following:

- *National Transport Commission (Road Transport Legislation - Australian Road Rules) Regulations 2006*
- *Australian Code for the Transport of Dangerous Goods by Road & Rail* (National Transport Commission 2011)
- *Road Traffic Act 1961.*
- *Dangerous Substances Act 1979.*
- *Dangerous Substances Regulations 2002*
- *Local Government Act 1999.*
- *Roads (Opening and Closing) Act 1991.*
- *Occupational Health Safety and Welfare Act 1989.*

6.3.16.3 Potential construction operation and closure impact/events

Against existing traffic volumes in the vicinity of the site, approximately an additional 10 vehicle movements in the peak hour and 30 trips daily (operation) would be generated as a result of the proposed development.

It is GTA's opinion that this level of traffic could not be expected to compromise the operation of the surrounding road network and there is adequate capacity to accommodate the traffic generated by the proposal. The traffic volumes on all roads are very low currently and the additional traffic would not impact the capacity or safe operation of these roads based on the traffic volume.

The impacts of traffic are considered to have negligible risk. However, additional safeguards will be implemented, and these controlling strategies are described below.



6.3.16.4 *Control and management strategies*

It is assumed that all road rules will be followed.

Pirie Resources will ensure that:

- Site induction procedures, and training regarding local conditions will be implemented if necessary, for all external driver to ensure safety standards and company expectations are met.
- All vehicle operators have appropriate licences.
- Liaison with local farmers will be undertaken to work with them to ensure stock movements can be safely facilitated during mine construction and operations.
- Negotiation with the District Council of Cleve for maintenance and upgrades of roads will be undertaken as required.



6.3.16.5 Evaluation of residual risks

Table 6-33 summarises the source, pathway and receptors of risks and impacts as they relate to waste. The full Risk Assessment can be found in Appendix Q.

Table 6-33: Risk assessment of impacts from traffic and transport

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_28	Reduced road safety for the community particularly the Kimba Cleve Highway through increased vehicle use.	Possible	Minor	Moderate	A traffic communication protocol between local farmers and Pirie Resources will be established; truck movements will occur outside of sensitive times such as during school bus operations. A traffic communication protocol between local farmers and Pirie Resources to inform Pirie Resources of any planned stock crossings of roads. Establish a Community Complaints Procedure to ensure ongoing community feedback and issue redress by Pirie Resources. No truck movements during school bus operational times	Unlikely	Minor	Low



6.3.16.6 Justification for acceptance of residual risk

With the described control measures in place, the residual risks for potential impacts associated with increase vehicle use from the proposed ML are classified as low.

6.3.16.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-34).

Table 6-34: Environmental outcomes and measurement criteria – traffic

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_28	No reduction in community safety through traffic and transport relating to Pirie Resources construction and operation.	Independent investigation of any accidents confirming Pirie Resources took all reasonable measures to prevent the accident (Co, O).	Not required

6.3.17 Public safety

The proposed ML is located only 15 km from the town of Cleve. As part of the Work Health and Safety Act, Pirie Resources will ensure the safety of its staff, contractors and visitors of the Project through safety inductions, personal protective equipment and safe work procedures etc. However, due to the mines locality to residential areas, Pirie Resources must consider the potential impacts associated with public safety. Public safety receptors are those individuals who are impacted by Pirie Resources' operation or those who legally or illegally gain or attempt to gain access to the mine site.

6.3.17.1 Context and views of affected parties

Unauthorised public access during operations and post-closure (prior to relinquishment of lease) has the potential to impact upon public safety.

6.3.17.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to public safety include the following:

- Mining Act 1971.
- Work Health and Safety Act 2012.

6.3.17.3 Potential construction operation and closure impact/events

Unauthorised access to the mine operation by a member of the public, who is neither trained nor inducted, can potentially lead to injury or death. Potential hazards include, falls into the open pit, collision with heavy vehicles and access to the explosives stored on-site.

Fire originating from the mining operation has the potential to cause a risk to public safety if not managed correctly. There are several potential ignition sources from the mining operation including hot works such as welding, cutting and grinding, explosives, vehicle fires and smoking. Incorrect storage of waste materials such as tyres can also pose a fire hazard (address in Section 6.4.15).

Local emergency services would need to be called on to assist in the unlikely event of a major safety incident occurring at the site.

6.3.17.4 Control and management strategies

The mine site will be enclosed by a security fence which complies with Australian Standards (AS1725-2003). Further, boom gates will be installed at the main entrance, and adequate warning signs will be installed.



The surface explosives magazine will be fenced in a separate security compound and restricted to authorised persons holding SafeWork SA Blasting permits or permits to handle explosives.

The Campoona Shaft site facility will be equipped with onsite First Aid facilities which will help minimise pressure to the health service providers and local emergency services in the region.

The likelihood and consequence of impacting emergency services may be reduced by implementing the following control and management strategies:

- Provide emergency response capability at mine and implement appropriate staff training.
- Liaise with local emergency services and other quarrying/mining operations at a local and regional level to identify synergies.
- Maintain emergency response capability during mining operations (including training, mock incidents).
- Maintain ongoing support of community services such as hospitals.
- Review procedures and undertake ongoing liaison with local emergency services and nearby quarrying/mining operations.

Emergency response procedures would still include calling emergency services to assist where required should a major safety incident occur.

Considering the size and expected location of the construction and operations workforce, the impact of the ML Campoona Shaft is considered negligible.



6.3.17.5 Evaluation of residual risks

Table 6-35 summarises the source, pathway and receptors of risks and impacts as they relate to public safety. The full Risk Assessment can be found in Appendix Q.

Table 6-35: Risk assessment of impacts from public safety

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
C_32	Unauthorised access to the mine resulting in injury or death.	Unlikely	Catastrophic	Extreme	Include fencing, bunding and site security such as cameras. Regularly inspect fences. Audit magazine records and issue non-cutable keys for the magazine.	Rare	Major	High
C_33	Reduced public safety from fire originating from the mine site.	Possible	Major	Extreme	Considering the location of the potential storage areas along with correct storage and a regular turnaround of waste.	Unlikely	Moderate	Moderate
C_34	Incorrect storage of waste increasing pest species.	Possible	Moderate	High	Ensure litter and rubbish bins are available on site. Ensure correct storage of all wastes awaiting disposal, and regular turnaround of waste.	Rare	Moderate	Moderate
C_35	Injury or death of people from blasting fly rock.	Unlikely	Major	High	Work with Council and surrounding landowners to temporarily exclude road access and limit farm area access during blasting periods. Blast management procedures will be established, in accordance with SafeWorkSA.	Unlikely	Minor	Low
C_36	Blasting (fly rock) causing third party property issues on roads and adjoining properties.	Unlikely	Major	High	Work with Council and surrounding landowners to temporarily exclude road access and limit farm area access during blasting periods. Blast management procedures will be established, in accordance with SafeWorkSA. Blasting Management Plan with clear notification to surrounding land users and an exclusion zone will be used. Pit walls will be pre-split where practical to do so.	Unlikely	Minor	Low



6.3.17.6 Justification for acceptance of residual risk

With all of the above control measures in place the likelihood of the impacts occurring has been reduced as much as possible to rare or unlikely. As deliberate access to the open pit could be disastrous with the possibility of serious injury, the consequence is therefore still considered major and subsequently a high residual risk remains.

Fire is an inherent risk to public safety and therefore a moderate residual risk is acceptable as no further reasonable controls can be implemented.

6.3.17.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-36).

Table 6-36: Environmental outcomes and measurement criteria – public safety

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_32 C_35	No public injuries and or deaths from unauthorised entry to the mine site that could have been reasonably prevented by the lessee.	All injuries or deaths from unauthorised entries to the mine site are investigated and investigations demonstrate all reasonable and practical measures were in place to prevent entry (and injury, if applicable) (Co, O).	Any security issues will be reported within 24 hours
C_33	No public injuries or deaths from fire originating from the mine site that could have been reasonably prevented.	Independent investigation of any public injuries or deaths resulting from fires originating from the mine site demonstrate they could not have been reasonably prevented. (Co, O).	Any security issues will be reported within 24 hours
C_34	No increase in pest species as a result of the Project	Routine work inspections demonstrate hygienic waste management practices followed (O).	Quarterly waste management records; complaints register.
C_35 C_36	No adverse impacts to: - Public safety, - Human comfort, - Third party property (including stock), - Adjacent land use, - Aircraft, or - Other receptors, from airblast, flyrock and vibration caused by blasting.	Compliance with the Blasting Management Plan. (O)	Monthly safety reporting including incidents and near miss reporting.

6.3.18 Closure outcomes for ML Campoona Shaft

Closure criteria presented have been discussed with stakeholders but are preliminary. Closure criteria will be reviewed throughout the life of the mine. They will also be reviewed and revised to incorporate the results of trials and investigations, regulatory requirements, stakeholder consultation and any changes in mine operations or approaches to rehabilitation.

Closure outcomes have been identified in the Table 6-37. To assist with differentiating construction and operational impacts from closure impacts, the nomenclature of closure impacts is environmentally-related



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Table 6-37: Closure outcomes for ML Campoona Shaft

Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
PS1	Injuries or deaths as a result of accidents arising from public access to the pit wall.	■ Fencing intact, mine access gates padlocked and abandonment bund to restrict public access to pit area. ■ Warning signs and information.	Assumes perimeter fencing and warning signs are maintained post-closure.	N/A	■ No injuries and/or death resulting from unauthorised entry to site that could have been reasonably prevented. ■ Public access to pit is restricted and mechanisms for restricted access remain in place.	■ Emergency access and egress track installed. ■ Safety audit demonstrates control measures meet health and safety requirements.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.
PS2	Pit wall in stability causes damage to Elson-Campoona Road.	■ Annual geotechnical assessment of northern high wall during operations. ■ Regular updates to MCP. ■ Management measures including stabilisation engineering and highwall reprofiling if required.	Geotechnical investigation undertaken is limited for conceptual mine planning.	Further geotechnical investigations during the life of mine may require changes to control measures.	■ Pit walls are geotechnically stable.	■ Geotechnical assessment undertaken by a suitably qualified engineer demonstrates stable slopes and high walls are designed to withstand the maximum credible earthquake. ■ Abandonment bund meets specification (DOIR (1997) and permitter fence is installed.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
PS3	Breach of abandonment bund around pit results in reduction in pit wall stability with impacts on public safety.	- Final landform design will consider slope stability. - Geotechnical slope assessment will be undertaken at closure - Abandonment bund meets specification (DOIR (1997) and permitter fence is installed.	- Geotechnical investigation undertaken is limited for conceptual mine planning - Assumes perimeter fencing and warning signs are maintained post-closure	Further geotechnical investigations during the life of mine may require changes to control measures.	- Pit walls are geotechnically stable. - Abandonment bund is installed.	- Geotechnical assessment undertaken by a suitably qualified engineer demonstrates stable slopes and high walls are designed to withstand the maximum credible earthquake. - Abandonment bund meets specification (DOIR (1997) and permitter fence is installed.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.
WP1	Weed infestation and plant disease across the site post-closure.	- Any imported material will be certified before use as clean fill. - Ensure correct plant hygiene procedures are utilised during rehabilitation or import of clean fill/topsoil material is certified. - Implement vehicle and equipment wash down procedures to minimise risk of pathogen importation.	N/A	N/A	Vegetation is self-sustaining and comparable to the surrounding areas.	Ecosystem function analysis confirms revegetated areas will meet the critical thresholds for sustainability	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
V1	Increased dust emissions impacting vegetation health.	■ Maintain vegetation cover on the landforms. ■ Revegetation undertaken during seasons conducive to successful vegetation establishment. ■ Any temporary stockpiled materials will be protected or wetted to prevent dust. ■ Vehicle movement around the site during rehabilitation will comply with existing speed limit and controls. ■ Rehabilitation species may be selected for drought tolerance. ■ Use established seeding techniques and soil conservation techniques. ■ Seedling protection to be undertaken.	Revegetation occurs in favourable growing seasons and develops to be self-sustaining.	Seasonal variation and results of progressive rehabilitation.	■ Vegetation is resilient, self-sustaining and reflective of the regional landscape and native vegetation values in closure domains identified for native vegetation as final land use.	■ Progressive rehabilitation occurs on areas no longer required for mining. ■ Ecosystem function analysis confirms revegetated areas will meet the critical thresholds for sustainability.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
V2	Revegetation on rehabilitated areas is unsuccessful resulting in loss of ecological values.	■ Species selection for rehabilitation will be chosen based on ability to achieve post-closure objective of self-sustaining vegetation. ■ Revegetation undertaken during seasons conducive to successful vegetation establishment. ■ Rehabilitation species may be selected for drought tolerance. ■ Use established seeding techniques and soil conservation techniques. ■ Seedling protection to be undertaken.	Revegetation species are similar to species within the surrounding area.	Results of progressive rehabilitation trials will confirm which species will be used in revegetation.	■ Vegetation is resilient, self-sustaining and reflective of the regional landscape and native vegetation values in closure domains identified for native vegetation as final land use.	■ Progressive rehabilitation occurs on areas no longer required for mining. ■ Ecosystem function analysis (EFA) monitoring for native vegetation.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
S1	Site contamination post closure impacts on public health and/or vegetation.	- Identify areas with potential for contamination (e.g., fuel storage and workshop areas). - Ensure infrastructure, chemicals and wastes are removed from site following mine closure. - Assess any residual contamination and remediate the site.	Existing contamination within the project area is based on desktop assessment. Will require assessment of existing contamination, on-going record management of spills and leaks during mine life and a site contamination assessment at closure.	N/A	No adverse impact on soil quality caused by project activities.	Site contamination assessment demonstrates compliance with National Environment Protection Measure (NEPM) land use guidelines.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
S2	Contamination and deterioration of land resources as a result of seepage from the WRSF	■ Encapsulate and separate disposal within the WRSF. ■ Cover materials will be considered to reduce contact with water.	Detailed design will be undertaken as part of the PEPR	WRSF will need to be suitably designed to contain PAF material and minimise risk of AMD.	■ The WRSF is geotechnically and geochemically stable ■ Resilient, self-sustaining vegetation of regional relevance and provenance.	■ Audit demonstrates the WRSF is constructed and closed as per approved design. ■ Ecosystem function analysis confirms revegetated areas will meet the critical thresholds for sustainability. ■ Domain audit demonstrates infrastructure and equipment is removed/safe.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
GW1	Groundwater contamination due to pit lake water quality.	■ Pit lake expected to only be ephemeral and of terminal sink nature. ■ Undertake sufficient data collection and modelling to understand status of pit lake post closure. ■ Implementation of a groundwater monitoring program of water levels and quality in monitoring bores for a period of up to three years post-closure to confirm pit lake is acting as a terminal sink.	Pit lake expected to only be ephemeral and of terminal sink nature. Groundwater is saline and has no current or proposed end use value.	Groundwater assumptions have been based on desktop assessment.	■ Water quality in pit void does not degrade surrounding surface or ground water values quality or impact fauna that may use them. ■ Resilient, self-sustaining vegetation of regional relevance and provenance in upper benches.	■ EFA monitoring. ■ Groundwater levels and quality do not significantly differ from reference sites.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
GW2	Toxicity to GDEs, including wetlands and creeks due to pit lake water quality.	■ Pit lake expected to only be ephemeral and of terminal sink nature. ■ Implementation of a groundwater monitoring program of water levels and quality in monitoring bores for a period of up to three years post-closure to confirm pit lake is acting as a terminal sink.	Pit lake expected to only be ephemeral and of terminal sink nature. Highly disturbed ecological landscape with no significant GDEs within the project area or nearby.	Flora and fauna survey to identify existing vegetation limited to one spring survey.	■ Water quality in pit void does not degrade surrounding surface or ground water values quality or impact fauna that may use them.	■ Groundwater levels and quality around pit void do not significantly differ from reference sites.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.
GW3	Change in local or regional water quality and quantity.	■ Undertake sufficient data collection to assess current status and trends in local and regional groundwater. ■ Undertake sufficient data collection and modelling to understand status of pit lake post closure.	Pit lake expected to only be ephemeral and of terminal sink nature. Implementation of a groundwater monitoring program of water levels and quality in monitoring bores for a period of up to three years post-closure to confirm pit lake is acting as a terminal sink.	Groundwater assumptions have been based on desktop assessment. No modelling of lake water balance or pit/groundwater interaction undertaken.	■ Water quality in pit void does not degrade surrounding surface or ground water values quality or impact fauna that may use them. ■ Resilient, self-sustaining vegetation of regional relevance and provenance in upper benches.	■ Ecosystem function analysis confirms revegetated areas will meet the critical thresholds for sustainability. ■ Groundwater levels and quality around pit void do not significantly differ from reference sites.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
SW1	Erosion of surface soils results in sedimentation on adjoining land.	■ Design of surface drainage features to minimise erosion potential. ■ Limit exposed surfaces. Progressive rehabilitation during mine life. ■ Sound design and understanding of the geotechnical properties.	No site-based soils assessment undertaken at site.	Soil assessment to be undertaken as part of PEPR preparation.	■ No adverse impacts to offsite stormwater due to sediment release.	■ Ecosystem function analysis confirms revegetated areas will meet the critical thresholds for sustainability.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.
SW2	Increased sediment load impacting surface water quality.	■ Progressive rehabilitation during mine life. ■ Sound design and understanding of the geotechnical properties.	No site-based soils assessment undertaken at site.	Soil assessment to be undertaken as part of PEPR preparation.	■ No adverse impacts to offsite stormwater due to sediment release.	■ ☐ Ecosystem function analysis confirms revegetated areas will meet the critical thresholds for sustainability.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria (Closure)	Draft leading indicator criteria
SW3	Toxicity (acute and/or chronic) to wildlife due to pit lake water quality.	■ Pit lake expected to only be ephemeral and of terminal sink nature.	Highly disturbed ecological landscape with no significant endemic fauna nearby. Highly saline waters of ephemeral nature greatly limits attractiveness and opportunity for aquatic wildlife habitat.	N/A	■ Water quality in pit void does not degrade surrounding surface or ground water values quality or impact fauna that may use them.	■ Surface water and groundwater assessment demonstrates compliance with relevant Environment Protection Policy (EPP) criteria.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



6.3.19 Summary table of impact outcomes with leading indicators

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_20	Noise from construction, operation and closure activities meets the noise goals in the Environment Protection (Noise) Policy, as defined by the Cleve District Council Development Plan at the date the Mining Lease was granted.	Noise generated from the lease during construction, operation and closure activities, measured at sensitive receivers in accordance with the Environment Protection (Noise) Policy 2007, does not exceed the following noise limit (averaged over 15 minutes), at those sensitive receivers: - 52 dB(A) between the hours of 7am and 10pm and 45 dB(A) between the hours of 10pm and 7am within a Primary Production Zone (as delineated in the Cleve District Council Development Plan at the time of Lease grant). The above noise levels may only be exceeded if the Director of Mines: - is satisfied, on the basis of information provided to him by an acoustic engineer, that the noise will not cause an adverse impact at the sensitive receiver due to the existing influence of ambient noise, or the limited duration and/or frequency of occurrence of the activity; and - provides prior approval for the exceedance (Co, O)	All noise complaints acknowledged in 48 hours and closed out within 14 days to the satisfaction of the complainant or as agreed with the Director of Mines.
C_16 C_17 C_19	No adverse public health and/or nuisance impacts to local residents from dust generated by mining operations.	Compliance with the National Environment Protection (Ambient Air Quality) Measure 2003 and Environment Protection (Air Quality) Policy 2016: PM10 24 hour concentration of 50 ug/m3 Annual average concentration of 25 ug/m3 and 24 hour and annual average PM2.5 24 hour concentration of 25 ug/m3 Annual average concentration of 8 ug/m3 (Co, O, CI) All dust complaints recorded immediately and closed out within 14 days to the satisfaction of the complainant or as agreed with the Director of Mines. (Co, O)	For health purposes, a TARP will be implemented which will include continuous PM10 and PM2.5 monitoring. For amenity or nuisance purposes, a live streaming camera will be mounted at a strategic location to visually monitor potentially dust generating activities which will provide instantaneous feedback to operators and transparent information for government regulators and the nearest sensitive receptor. Dust deposition levels of less than 4 g/m2/month. <i>Note, this leading indicator is a measurement criteria for potential vegetation impacts (see below) but can also be a useful leading indicator for nuisance impacts.</i>



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Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_18	No loss of abundance or diversity of native vegetation on or off the lease via dust impacts or unauthorised clearance.	Compliance with the EPA adopted criteria for annual average dust deposition to exceed 4 g/m ² /month and no more than 2 g/m ² /month above background. No unauthorised clearance of vegetation. (O)	The extent of retained vegetation and evidence of potential dust impacts, or lack thereof, will be confirmed annually by an experienced ecologist.
C_10	No long term impact on local environmental values as a result of deterioration of flow volumes	The frequency of water flows in the ephemeral creek will be monitored prior to the W-WRSF being constructed (Co, O). Volume of water captured by interceptor trenches for reuse on site will be recorded (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.
C_11	No long term impact on local environmental values as a result of deterioration of surface water quality	Water quality (in accordance with the Australian and New Zealand Guideline for Fresh and Marine Water Quality for Protection of Aquatic Ecosystems and Stock Watering guidelines, ANZECC /ARMCANZ 2000) in ephemeral creek will be monitored during peak flow periods (O).	Inspection and maintenance of drainage containment system after rain events that generate run-off confirms no loss of containment.
C_12	No long term impact on local environmental values as a result of deterioration of surface water quality	Water quality (in accordance with the Australian and New Zealand Guideline for Fresh and Marine Water Quality for Protection of Aquatic Ecosystems and Stock Watering guidelines, ANZECC /ARMCANZ 2000) in ephemeral creek will be monitored during peak flow periods (O).	Inspection and maintenance of drainage containment system after rain events that generate run-off confirms no loss of containment.
C_04	No loss of abundance or diversity of native vegetation on the Land through; ■ clearance, ■ dust/contaminant deposition, ■ fire, ■ reduction in water supply, or ■ other damage, unless prior approval under the relevant legislation is obtained.	No ML generated fires (Co, O).	On-site fire safety inspections at the end of spring.
C_06 C_07	No introduction of new species of weeds, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the Mining Lease compared to adjoining land..	Quarterly inspection of cleared areas for weed establishment indicate no increase in weed abundance or presence of new weeds compared to control sites (O).	Inspection records for vehicles and machinery show that all have been certified as clean before operating on site.



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Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
C_13	Existing soil quality and quantity is maintained.	Annual survey and photographic records of soil stockpiles (O).	Periodic inspection shows that separate topsoil and subsoil stockpiles are established and maintained.
C_14	Existing soil quality and quantity is maintained.	Vegetation is self-sustaining and comparable to undisturbed surrounding area (O).	Annual records indicate that compacted areas have been removed, or scarified and topsoil spread.
C_32 C_35	No public injuries and or deaths from unauthorised entry to the mine site that could have been reasonably prevented by the lessee.	All injuries or deaths from unauthorised entries to the mine site are investigated and investigations demonstrate all reasonable and practical measures were in place to prevent entry (and injury, if applicable) (Co, O).	Any security issues will be reported within 24 hours
C_33	No public injuries or deaths from fire originating from the mine site that could have been reasonably prevented.	Independent investigation of any public injuries or deaths resulting from fires originating from the mine site demonstrate they could not have been reasonably prevented. (Co, O).	Any security issues will be reported within 24 hours
C_34	No increase in pest species as a result of the Project	Routine work inspections demonstrate hygienic waste management practices followed (O).	Quarterly waste management records; complaints register.
C_35 C_36	No public safety or third party property incidents as a result of blasting	Records demonstrate compliance with the blasting management plan (O).	Complaints register Safety reporting that includes all incidents and procedure following

6.4 MPL Sugarloaf Impact and Risk Assessment

The Campoona Graphite Project is a small-scale campaign mining operation proposed in a sparsely populated highly modified landscape cleared for broad acre farming.

Whilst mining will occur on the Mining Lease at Campoona, processing and tailings storage is proposed at the historically cleared Pirie Resources-owned Sugarloaf property, using a mixture of existing improvements and upgraded facilities on site. This section details the risks and management plan associated with processing on the proposed MPL (Sugarloaf).

This section details the risks and interactions of the project with:

- Visual amenity
- Noise
- Dust and air quality
- Topography and landscape
- Geohazards
- Surface water
- Groundwater
- Vegetation
- Weeds
- Fauna
- Pest species
- Topsoil and subsoil
- Heritage
- Public safety.

Traffic and transport risks or interactions have been addressed in the previous section.



Closure impacts and outcomes of the MPL Sugarloaf are then discussed.

6.4.1 Visual amenity

The Campoona Graphite Project sites (ML Campoona Shaft, MPL Sugarloaf and MPL Water) are all within a highly modified landscape that has been historically cleared to facilitate broad acre farming.

Pirie Resources has changed the location of the TSF to ameliorate community concerns and will be contouring the landscape at closure replicate the existing topography. Accordingly, visual amenity in the context of the MPL (Sugarloaf) activities, as well as its location and surrounding land use is not expected to have impact pathways.

6.4.1.1 Context and views of affected parties

The MPL (Sugarloaf) is approximately 499 ha of the greater Pirie Resources-owned 561 ha property. The property is open farmland and also surrounded by small hills. The site has existing farm sheds and structures which have been incorporated in to the proposal. The site entrance is on an unsealed road.

The community queried if there was anything that could be done to further limit potential visual impacts from the Sugarloaf processing facility and the variety and species of trees that will be used during screening and rehabilitation. The ability for the community to see the processing facility prompted Pirie Resources to redesign the layout and locality of infrastructure. An existing view of the proposed MPL (Sugarloaf) is provided in Figure 6-5.



Figure 6-5: Existing visual amenity of MPL (Sugarloaf) looking north from Harris Road (top) and eastward from Cut Line Road (bottom)



6.4.1.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to visual amenity include the following:

- *Mining Act 1971*
- *Development Act 1993*
 - *Development Plan: Cleve Council (DCC 2013).*

6.4.1.3 *Potential construction operation and closure impact/events*

Sensitive viewpoints and receptors affected by the proposed MPL are limited to passing traffic. As there are no residences in close proximity, no specific receptors have been identified.

As identified during community consultation, the processing site, temporary stockpiles, and TSF at MPL Sugarloaf will alter the existing landscape and have the potential to impact the rural farm amenity of the local region and these changes are shown in Figure 6-6.



Figure 6-6: Potential change to visual amenity at MPL (Sugarloaf) looking north from Harris Road (top) and eastward from Cut Line Road (bottom)



6.4.1.4 Control and management strategies

Pirie Resources has responded to community feedback and located the processing plant using the natural topography to prevent public views. As processing is shielded by the topography, there are no expected lighting impacts.

Temporary changes in the background colour of the landscape as a result of the earth moving activities and TSF operation is expected. The colours are expected to be consistent with those created through soil preparation for planting new crops.

Whilst the landform will change because of the TSF, there was general acceptance or tolerance of the changes.

Comparing the landforms between Figure 6-5 and Figure 6-6 demonstrates that the visual amenity outcomes are expected to reflect the land use preferences in closure.

Pirie Resources' control and management strategies at MPL (Sugarloaf) reduce the potential impacts:

- Optimise the footprint of the TSF.
- Placement of mine infrastructure determined (as far as practicable) to minimise visual impact in terms of location.
- Colour buildings neutral so as to not stand out but blend with the surrounds.
- Project design incorporates requirement to minimise land disturbance.
- Design of the TSF to incorporate elements that assist with progressive rehabilitation and vegetation (e.g. through final slopes and progressive rehabilitation).



6.4.1.5 Evaluation of residual risks

Table 6-38 summarises the source, pathway and receptors of risks and impacts as they relate to amenity. The full Risk Assessment can be found in Appendix Q.

Table 6-38: Risk assessment of impacts on visual amenity at the processing facility at proposed MPL (Sugarloaf)

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_27	Reduced visual amenity for local community due to changes to landscape, largely through construction of the TSF.	Possible	Minor	Moderate	The site for the full scale Sugarloaf facility was moved approximately 150m southeast, behind the crest and down the hill, to reduce potential visual impact from the Darke Peak direction. Establish a Community Complaints Procedure to ensure ongoing community feedback and issue redress by Pirie Resources.	Unlikely	Minor	Low
S_28	Reduced visual amenity for the local community from operation and rehabilitation.	Unlikely	Minor	Low	Placement of infrastructure determined (as far as practicable) to minimise visual impact. Project design incorporates requirement to minimise land disturbance (i.e. retention and creation of contours). Design TSF to incorporate elements that assists with progressive rehabilitation and vegetation.	Unlikely	Insignificant	Low
S_29	Adverse impact on topography and landscape reducing visual amenity for the local community.	Unlikely	Minor	Low	Placement of infrastructure determined (as far as practicable) to minimise visual impact. Project design incorporates requirement to minimise land disturbance (i.e. retention and creation of contours). Design WRSFs to incorporate elements that assist with progressive rehabilitation and vegetation. Location and revegetation of soil stockpiles and WRSFs to provide a visual barrier from public roads.	Unlikely	Insignificant	Low



6.4.1.6 Justification for acceptance of residual risk

The construction of the TSF will change the landscape. However, at completion, the structures will be of similar elevations to the existing natural landscape and will be contoured and rehabilitated.

As both Harris Road and Cut Line Road are unsealed rural roads that carry less than 50 vehicles a day, the impacts to amenity are considered low risk.

Pirie Resources' vision for the project is to return the land in a state that is compatible with the current farming practice. To that end, the WRSF and TSF are considered likely to be suitable for grazing.

6.4.1.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-39):

Table 6-39: Environmental outcomes and measurement criteria – visual amenity

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_27 S_28 S_29	No long term adverse visual impact to nearby residents from the tailings storage facilities.	Audit demonstrates rehabilitated structures at mine completion are in accordance with approved Closure Management Plan (O, CI)	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.4.2 Noise

Modelling was undertaken based on the likely noise levels of equipment to predict noise levels associated with construction and full scale operation at the processing facility (MPL Sugarloaf). During full scale production processing will occur continuously (i.e. 24 hours/day). Noise predictions of the construction and operation have been made using the Conservation of Clean Air and Water in Europe (CONCAWE) noise propagation model in SoundPLAN.

The model used conservative assumptions, such as the unlikely scenario of all equipment operating simultaneously.

The model outputs identify that the project complies with EPA-derived noise limits at all sensitive receivers. Irrespective of this, Pirie Resources has committed to noise management measures to further reduce noise generated by the project.

6.4.2.1 Context and views of affected parties

Key stakeholders in relation to noise and vibration include EPA, DSD and SafeWork SA (ground vibration), DPTI (transport noise), as well as the adjacent community.

Noise differences (measured in dB) can be noticed with a 5 dB change. A 3 dB change is barely perceptible, with a 1 dB different imperceptible. An increase of 10 dB is considered to be twice as loud, while a 20 dB increase is four times as loud. The noise level generated by a conversation within a metre of each person is in the range of 60 dB to 65 dB.

The two main noise measures used are dB(A) L_{eq} , which is the equivalent continuous noise level for describing the general noise level for noise that may fluctuate over time, and dB(A) L_{max} , which is the maximum sound level expected.



Based on the council zoning, the EPA has indicated the following noise limits will be applied when measured and adjusted at noise sensitive receivers (such as nearby residences) in accordance with the Environment Protection (Noise) Policy:

- 52 dB(A) between the hours of 7 am and 10 pm and
- 45 dB(A) between the hours of 10 pm and 7 am.

The noise criteria were established with reference to the relevant legislation and guidelines, consistent with leading practice in South Australia to ensure that the construction and operations do not unreasonably interfere with the acoustic amenity at the noise sensitive receivers.

6.4.2.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to noise include the following:

- *Environment Protection Act 1993.*
- *Environment Protection (Noise) Policy 2007.*
- *Guidelines for Separation Distances (EPA 2007).*
- The SA Department of Planning, Transport and Infrastructure's (DPTI) *Road Traffic Noise Guidelines (RTNG)* has been adopted to establish the project specific noise criteria for the road traffic noise from the proposed access road.
- Australian and New Zealand Minerals and Energy Council (ANZMEC) *Guidelines for blast overpressure and ground vibration for residential receivers (ANZMEC 1995)*

6.4.2.3 *Potential construction operation and closure impact/events*

Noise predictions were conducted to determine noise levels from the project at noise sensitive receivers in the vicinity and compared against the established noise criteria. Importantly, the assessment considered an unlikely worst case scenario for site operations in that:

- The plant was closest to receptors.
- Weather conditions were conducive to noise propagation.
- All equipment was operated simultaneously.

It is not expected that the predicted effects would be realised in real operational terms.

6.4.2.4 *Construction noise*

Construction works are not proposed to occur after 10pm or before 7am on any day.

The following equipment is likely to be used during construction works at the processing facility. Sound power levels for equipment can be found in Appendix C:

■ Bulldozers	■ Compaction rollers
■ Excavators	■ Cranes
■ Trucks	■ Forklifts
■ Prime movers	■ Concrete mixer trucks
■ Graders	■ Generator
■ Front end loaders	■ Generator for welding



General power tools and hand tools may also be used, although these are not expected to be significant sources of noise compared to the large plant and equipment listed above.

Table 6-40 summarise the noise modelling predictions, at various distances from the source.

Table 6-40: Predicted construction activity noise levels – proposed MPL for full scale production (Sugarloaf)

Criterion (dB(A))	Predicted Noise Level (dB(A)) at Various Setback Distances	
	4200 m	4600 m
	45	45
Site preparation and earthworks	27	25
Foundation works and building constructions	26	23
Equipment installation and construction	29	26

Based on the expected equipment and their predicted noise generation, the model shows that construction noise at the processing facility does not unduly affect noise amenity at any sensitive receivers.

6.4.2.5 Operational noise

Operational noise predictions are relevant to the processing facility. Again the predictive modelling has used conservative assumptions including the following:

- All equipment will be operating at the same time and continuously.
- All fixed plant and equipment is located outside, without any attenuation from buildings or structures (e.g., sheds or enclosures, except for the power generation units as required to achieve the specified sound power levels).
- The mobile equipment onsite is located nearest to the noise sensitive receivers and at the highest point of the area under consideration.
- The operation has the worst-case meteorological conditions that would provide conditions that are the most conducive for noise propagation in accordance with the Noise Policy default conditions.

Table 6-41 summarises the noise modelling predictions at various distances from the noise sources at Sugarloaf.

Table 6-41: Predicted operational activity noise levels – proposed MPL Sugarloaf

Residence	Distance from site (m)	Daytime (7am to 10pm)		Night-time (10pm to 7am)	
		Criterion (dB(A))	Predicted Noise Level (dB(A))	Criterion (dB(A))	Predicted Noise Level (dB(A))
Noise sensitive receivers closest to Sugarloaf processing facility					
Elliot Residence*	4,050	47	32	45	32
Harris Residence	4,240	47	30	45	30
Residence #4	8,925	47	16	45	15
Residence #8	5,425	47	25	45	25
Residence #10	8,735	47	39	45	39

*Noise level scaled off noise contours presented in Appendix C



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As with construction, the noise generated at the processing facility at MPL (Sugarloaf) will achieve daytime and night-time Policy goal noise levels. Refer to Figure 6-7.

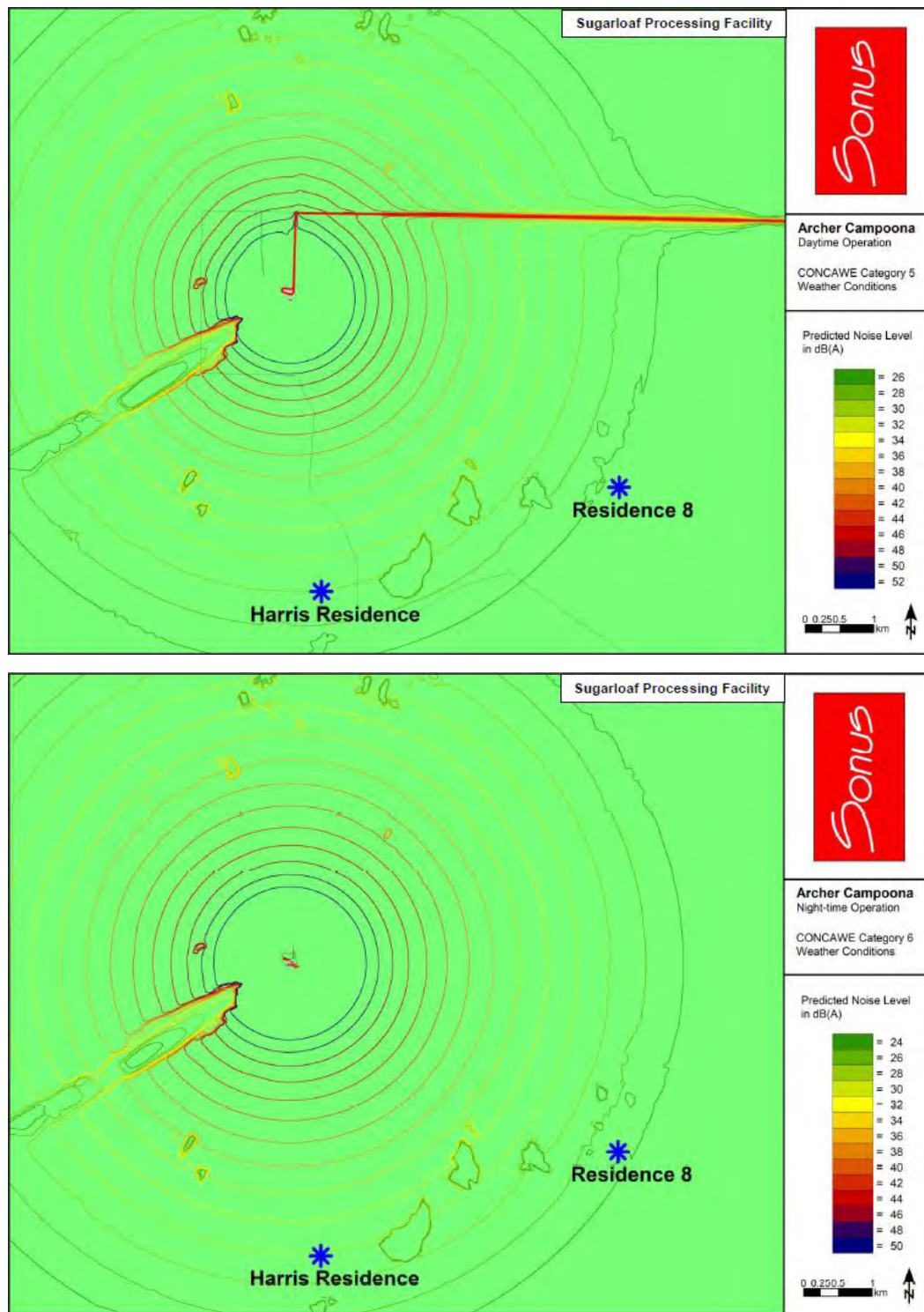


Figure 6-7: Noise predictions at the processing facility during daytime (time) and night-time (bottom) operations



6.4.2.6 *Control and management strategies*

General measures

- Continual training of staff on site to good work practices and behaviours to control noise emissions from site.

Mobile plant

- To remove the annoying tonal characteristic of reversing beepers on mobile equipment, all mobile equipment is to be fitted with broadband reversing beepers.
- Use low noise equipment and plant or noise reducing kits where possible.
- Avoid unnecessary revving of engines and switch off equipment when not required.
- Keep internal haul routes well maintained and avoid steep gradients.
- Minimise drop height of materials (lowered and placed rather than dropped).
- Keep equipment enclosure panels closed.
- Regular maintenance of equipment and plant.

Process plant and stationary equipment

- Consider low noise options or acoustic enclosures for compressors to limit the sound power to 100 dB(A).
- Regular maintenance of the equipment and plant.



6.4.2.7 Evaluation of residual risks

The results of risk levels determined in accordance with the risk assessment process are outlined in Table 6-42. More detail can be found in Appendix Q.

Table 6-42: Risk assessment of impacts from noise generated during construction and operation

	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_26	Disturbance to sensitive receptors due to noise from vehicles, equipment and plant operation during construction and operation.	Possible	Minor	Moderate	Compliance with EP (Noise) Policy. Compliance with Traffic Management Procedure. Locate noisy equipment at the greatest practical distance from sensitive receptors. Monitoring of noise and vibration impacts by complaints register. Maintain vehicle fleet in accordance with manufacturer's requirements. Ensure noise reduction devices such as mufflers are fitted and operating effectively.	Unlikely	Insignificant	Low



6.4.2.8 Justification for acceptance of residual risk

The noise assessment concluded that the mine and processing facility is able to operate at the site within the requirements of the Noise EPP and will not cause nuisance noise to any existing sensitive receivers. The residual risk after implementation of management and control measures is considered unlikely, and the risk low to insignificant.

6.4.2.9 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-43):

Table 6-43: Environmental outcomes and measurement criteria – noise

	Outcomes	Measurement criteria	Leading indicator criteria
S_26	No adverse public nuisance impact to sensitive receptors from noise emanating from the MPL.	Noise generated from the lease during construction, operation and closure activities, measured at sensitive receivers in accordance with the Environment Protection (Noise) Policy 2007, does not exceed the following noise limit (averaged over 15 minutes), at those sensitive receivers: - 52 dB(A) between the hours of 7am and 10pm and 45 dB(A) between the hours of 10pm and 7am within a Primary Production Zone (as delineated in the Cleve District Council Development Plan at the time of Lease grant). (Co, O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

If required, total noise levels in dB measured as 24 hr continuous monitoring will be undertaken at sensitive receptors to show that mining operations do not exceed the EPA Noise Policy of <52 dBA during the day and <45 dBA during night time operations.

6.4.3 Dust and air quality

The generation of dust and impacts to air quality associated with the Campoona Graphite Project have been modelled using local meteorological information, and CALPUFF, a model that predicts pollution dispersion (Appendix S).

Full scale production under a worst-case scenario that includes no controls and bad weather, the modelling predicts that air quality at the MPL Sugarloaf complies with the environmental standards and goals identified by the EPA and National guidelines.

In addition, Hydrogen Fluoride (HF) emissions were modelled using AERMOD. The results indicated that the Campoona stack is unlikely to cause any exceedences of the EPA ambient air quality standards for HF (Appendix K).

6.4.3.1 Context and views of affected parties

The proposed MPL Sugarloaf is located in an area dominated by agricultural land uses and subsequently air quality concerns are predominantly related to particulate matter (dust).

There are no known significant anthropogenic industrial sources of air pollution within the vicinity of the proposed site. There are unsealed roads surrounding the MPL (Sugarloaf) site which are used by local



residents accessing the surrounding towns and residences. These roads are suitable for light vehicle and semi-trailer traffic but not designed for road train truck haulage.

The local agricultural activities in the area may result in dust material being disturbed by activities such as ploughing, seeding, grain cropping and stock grazing in the greater project area. These activities have the potential to generate localised dust emissions. Vehicle and equipment use on the local surrounding unsealed roads would also contribute to the particulate matter emissions in the local air shed. The climate coupled with a typically very low annual rainfall means there would be limited natural dust suppression when these activities are occurring.

6.4.3.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to air quality include the following:

- *Environment Protection Act 1993.*
- *Environment Protection (Air Quality) Policy 1994 (EP Policy).*
- *Environment Protection (Air Quality) Policy 2016*
- *National Environment Protection (Ambient Air Quality) Measure (NEPM (AAQ))* goals to assess the impact of site operations and other existing sources on ambient air quality at sensitive receptors.
- *Guidelines for Separation Distances (EPA 2007).*
- *EPA Guideline: Air quality impact assessment using design ground level pollutant concentrations (DGLCs) (EPA 2006) EPA. 2006.*

The adopted standards/goals for this air quality assessment are presented in Table 6-44.

Table 6-44: Air quality goals

Pollutant	Average period	Goal	Exceedances allowed per year	Source
TSP	Annual	90 µg/m ³	n/a	NHMRC
PM ₁₀	24 hour	50 µg/m ³	5	NEPM
PM _{2.5}	24 hour Annual	25 µg/m ³ 8 µg/m ³	n/a	NEPM NEPM
Dust deposition	24 hour	4 g/m ² /month	n/a	NERDDC

6.4.3.3 Potential construction operation and closure impact/events

The potential air quality effects resulting from particulate discharges to the air from activities at the sites have been assessed using a standard atmospheric dispersion modelling approach. CALPUFF, an advanced integrated Gaussian puff modelling systems for predicting atmospheric pollution dispersion has been used and the model inputs and assumptions are described in Appendix S.

During construction, operation and rehabilitation there could be an increase in dust generation and an impact on air quality as a result of:

- Vehicle movements on unpaved roads.
- Wind-blown dust from stockpiles and freshly exposed areas onsite.
- Handling, transfer and storage of materials.
- Heavy earthwork operations such as excavation and earth moving activities.
- Construction of workshops, process plant, equipment laydown areas and other infrastructure.
- Operation of plant equipment, such as the crushing plant.



During operation, there will be HF emissions from the processing plant. The vapour will have no odour (odour threshold for HF is around 0.1 mg/m³). The EPA ambient air quality standards specify a maximum of 0.003 mg/m³ averaged over 24 hours with the emissions from the CUF expected to be around a third of that limit. Given the concentration and distance to the nearest receptor, odour impacts are considered to be highly unlikely.

The impact of dust on nearby receptors that may be susceptible to changes in air quality have been identified as:

- Residential properties and communities.
- Agricultural crops surrounding the proposed MPL (Sugarloaf).
- Native flora and fauna present in the area around the proposed MPL (Sugarloaf).

The potential impacts could therefore be:

- Decrease in air quality resulting in human health impacts at neighbouring sensitive receptors from mining operation dust.
- Human health impacts from contamination of rainwater tanks with dust from mining operations.
- Decrease in ambient air quality resulting in public nuisance at sensitive receptors as a result of mining operations.

6.4.3.4 Construction phase emissions

The maximum ground level concentrations (GLCs) at a sensitive receiver during construction are described in Table 6-45:

Table 6-45: Construction phase maximum predicted GLCs at a sensitive receptor

Pollutant	Average period	Maximum Predicted GLC (µg/m ³)	Location (UTM Coordinates)	Background GLC (µg/m ³)	Accumulative GLC (µg/m ³)	Goals
TSP	24 hours	28	638510,6289525	42	70	90
PM ₁₀	24 hours	16	638510,6289525	14	30	50
PM _{2.5}	24 hours	2.2	638510,6289525	7.0	9.2	25
	1year	0.10		7.0	7.1	8

6.4.3.5 Operational phase emissions

The maximum ground level concentrations (GLCs) at a sensitive receiver during operations are described in Table 6-46.

Table 6-46: Operational phase maximum predicted GLCs at a sensitive receptor during full scale production

Pollutant	Average period	Maximum Predicted GLC (µg/m ³)	Location (UTM Coordinates)	Background GLC (µg/m ³)	Accumulative GLC (µg/m ³)	Goals
TSP	24 hours	40	638510,6289525	42	82	90
PM ₁₀	24 hours	32	638510,6289525	14	46	50
PM _{2.5}	24 hours	3.6	638510,6289525	7.0	11	25
	1year	0.19		7.0	7.2	8

The modelling assessment concludes that 24-hour average particulate matter emissions from the sites during construction and operations comply with the model assessment criteria at nearby sensitive receptors.

It should be noted that the air assessment included a number of worst case elements:



- A conservative approach to the calculation of the rate at which material will be mined has been utilised.
- Wind erosion of stockpiles and exposed area a constant emission source regardless of wind conditions.
- No control mechanisms have been included on trucks dumping excavated materials.
- Background TSP and PM_{2.5} concentrations were conservatively derived from the background PM₁₀ concentration.

Results from modelling of HF emissions are shown in Table 6-47. The AERMOD results indicated that the Sugarloaf stack operating at the EPP 2016 emission limit for HF is unlikely to cause any exceedences of the EPA ambient air quality standards for HF (not one exceedence was predicted from 8760 hourly tests).

Table 6-47: Operational HF emissions

Classification	Averaging Time	Max. Concentration	AERMOD results
Bioaccumulation – classification assumed for the 3 standards following EPA Victoria ¹	24 hours	3 µg/m ³	Maximum grid result: 0.33 µg/m ³ Maximum result from 'Top 100 table': 1.14 µg/m ³
	7 days	2 µg/m ³	AERMOD-predicted maximum monthly average HF GLC: 0.10 µg/m ³
	90 days	1 µg/m ³	AERMOD-predicted annual average HF GLC: 0.04 µg/m ³

6.4.3.6 Control and management strategies

The following management measures will be adopted for the project:

Construction

- Limit vehicle movements to designated entries and exits, haulage routes and parking areas.
- Use a water cart or sprinklers to maintain damp conditions in high activity areas.
- Visually monitor dust and where necessary implement the following measures:
 - Apply water to exposed surfaces that are causing dust generation when necessary.
 - Pre-moisten material before excavating or clearing to reduce dust generation.
 - Appropriately cover loads of fill on trucks transporting material to and from the construction site or water the surface to produce a natural crust. Securely fix tailgates of road transport trucks prior to loading and immediately after unloading.
 - Prevent where possible, or remove, mud and dirt being tracked onto sealed road surfaces.
- Where practicable, avoid or minimise dust generating activities (particularly clearing and excavating) during dry and extremely windy conditions.
- Limit the area and duration of exposed or unconsolidated areas. For example, stage vegetation stripping or grading where possible and, where practicable, apply vegetation mulch to soil stockpiles or surfaces left standing for extended periods.
- Proceed with revegetation activities as soon as practicable after construction activities are completed within a disturbed area.
- Maintain and regularly service construction plant and equipment.

¹ Government of Victoria, *State Environment Protection Policy (Air Quality Management)*, 2001.



Operation

- Use a water cart or sprinklers to maintain damp conditions in high activity areas.
- Compact or cover high traffic areas around the site with road base and/or bitumen-based polymer in accordance with fit-for-purpose design.
- Impose speed restrictions to the MPL of 40 km/hr on haul roads.
- Incorporate fabric covers or sprinkler systems on the ROM stockpile.
- Where practicable and consistent with management of materials, stockpile the coarser material on the outer edges of stockpiled material.
- Develop and implement procedures/plans to address dust and general air quality issues on site during construction and operation. These will include management requirements such as reporting and cessation of works in the event of extreme wind conditions.
- Connect all vessels within the concentrate leach circuit to a venturi scrubber system to capture and neutralize HF vapours present in off-gas with hydrated lime slurry prior to discharge to atmosphere.
- Stack geometric and emissions parameters for HF will be confirmed during detailed design and by stack testing prior to its commissioning.



6.4.3.7 Evaluation of residual risks

The results of risk levels determined in accordance with the risk assessment process are presented in Table 6-48. Further information can be found in Appendix Q.

Table 6-48: Risk assessment of impacts on dust and air quality

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_20	Dust affecting air quality and general ambient air quality at nearby sensitive receptors through construction and operation of the MPL infrastructure.	Possible	Minor	Moderate	Manage staged vegetation clearance and ground disturbance for all infrastructure needs, including trenching the water pipelines associated with MPL (Water) on MPL (Sugarloaf). Design the trafficable and working areas to be as small as possible. Design of mine haulage, access roads and other trafficable and working areas on site to incorporate sealing with compacted material and/or bitumen-based polymer (as appropriate for design specification) and implement vehicle speed restrictions and restrict traffic to dedicated formed roads. Implement dust suppression measures. Use a water cart or sprinklers when required to minimise dust. Stabilisation and progressive rehabilitation the external slopes of the TSF. Consider sprinklers on ROM stockpile Planting and embankments used as windbreaks to shield working areas form prevailing winds. Cessation of works in the event of extreme weather and wind conditions.	Unlikely	Minor	Low



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S_21	Dust generated during construction and operation affecting residential and agricultural water quality.	Possible	Minor	Moderate	Manage staged vegetation clearance and ground disturbance. Design the trafficable and working areas to be as small as possible. Use a water cart or sprinklers when required to minimise dust. Provide and fit filters to rainwater tanks where appropriate.	Unlikely	Minor	Low
S_22	Reduced native plant growth or abundance or reduced agricultural crop resulting from increased dust deposition from construction, operation and rehabilitation of the processing facility (e.g. material stockpiles, on site roads and traffic movements).	Possible	Minor	Moderate	Manage staged vegetation clearance and ground disturbance. Design the trafficable and working areas to be as small as possible. Use a water cart or sprinklers when required to minimise dust. Implement vehicle speed restrictions and restrict traffic to dedicated formed roads. Implement dust suppression measures. Incorporate cover system on trucks that leave site Stabilisation and progressive rehabilitation the external slopes of the TSF.	Unlikely	Minor	Low
S_23	Combustion products affecting air quality for surrounding sensitive receptors	Possible	Insignificant	Low	Fuel combustion facilities for power generation, pumps, mining equipment and vehicles to meet EPA requirements, Australian standards and SA regulations (as appropriate). Equipment and vehicles to be maintained and serviced in accordance with manufacturer's requirements.	Unlikely	Insignificant	Low
S_24 S_25	Hydrogen Fluoride emissions from the processing plant stack adversely impact public health	Possible	Moderate	High	All vessels within the concentrate leach circuit will be connected to a venturi scrubber system to capture and neutralize HF vapours present in off-gas with hydrated lime slurry prior to discharge to atmosphere.	Unlikely	Minor	Low



6.4.3.8 Justification for acceptance of residual risk

As a result of the proposed dust and HF control measures, the residual risk to the community and sensitive receptors has been significantly reduced with the occurrence of any health impacts being considered unlikely and the residual risk low.

6.4.3.9 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-49):

Table 6-49: Environmental outcomes and measurement criteria – air quality

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_20	No adverse public health and/or nuisance impacts to local residents from air emissions and dust generated by processing operations.	Review of PM ₁₀ measurements demonstrates mining operations compliance with NEPM 1998 <50 µg/m ³ /year, with <5 days exceedance/year (Co, O).	Quarterly compliance.
S_21 S_22	Reduced native plant growth or abundance or reduced agricultural crop resulting from increased dust deposition resulting from mining operations	No increasing trend in community complaints regarding dust (Co, O).	All community complaints from the public regarding dust arising from the lease area addressed within 48 hours and assessed against the NEPM criteria.
S_23	No adverse public health and/or nuisance impacts to local residents from air emissions and dust generated by processing operations.	Records demonstrate that all operational vehicles and equipment used on lease areas have appropriate emission control devices (according to vehicle specifications) prior to commencement of use and at scheduled maintenance times (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.
S_24 S_25	No adverse public health impacts from air emissions generated by processing operations.	Stack emission rate for HF does not exceed 50 mg/m ³ Sampling in every 12 hour period of tailings from the Concentrate Upgrade Facility demonstrates pH is within the level specified in the PEPR	Maintenance records demonstrate scrubber is performing in accordance with specifications detailed in the PEPR Material balance in the CUF neutralisation circuit demonstrates neutralisation of HF

A monitoring program would consist of:

- One PM₁₀ monitor (equipment type to be determined in consultation with SA EPA) located outside the processing shed, for occupational health and safety measures onsite, to limit exposure of PM₁₀ to mine workers.
- Appropriate air quality monitor (equipment type to be determined in consultation with SA EPA) located outside the MPL boundary to monitor dust at sensitive receptors.
- Monitoring will be undertaken on a quarterly basis to ensure levels are within the NEPM occupational guideline levels thereby confirming effective operation of control and management measures.



- Stack emissions will be monitored continuously for HF to demonstrate they are below 50 mg/m³.
- A complaints register will be established to record and respond to any issues raised by the local community relating to air emissions from construction and operations. Any complaints will be investigated and addressed.

6.4.4 Topography and landscape

The 499 ha MPL (Sugarloaf) is within a Pirie Resources-owned landholding of 561 ha and will include the development of a small-scale processing facility, as well as a cross valley TSF and embankment.

The processing facility footprint is small (approximately 50 m × 30 m) and is shielded by the natural topography and vegetation.

The TSF embankment will be progressively built to accommodate the tailings, and at completion, the embankment will be re-profiled to a maximum slope of 1V:5H, with the majority at 1V:7H with the intent to return it to grazing land.

6.4.4.1 Context and views of affected parties

The local topography is generally characterised by a network of gentle hills and shallow valleys.

With excavation and new landforms (TSF), it is anticipated that DSD, EPA and DEWNR will have an interest in the topography being managed through the project lifecycle.

Pirie Resources has modified the design to eliminate the visual appearance of the processing facility in response to community feedback.

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to topography and landscape include the following:

- *Natural Resources Management Act 2004*
- *Mining Act 1971*
- *Environment Protection Act 1993*
- *Development Act 1993*
 - *Development Plan: Cleve Council (DCC 2013).*

6.4.4.2 Potential construction operation and closure impact/events

The addition of the processing shed, temporary stockpiles, and the TSF will alter the existing vista and have the potential to impact the rural farm amenity of the local region.

As these impacts relate to visual amenity, they have already been discussed above and are not assessed further here.

6.4.5 Tailings Storage Facility

The proposed TSF will be located within the proposed MPL (Sugarloaf), on freehold agricultural cropping and livestock farming land owned by Pirie Resources. To optimise the location of the TSF, a number of environmental criteria were considered including water quality, groundwater levels, minimising the potential for dust and noise generation on sensitive receivers.

The TSF design inputs, tests and assumptions for full scale production have been described in Appendix N. Further testing of strength and permeability of the TSF basin floor, embankment foundation and foundation of the water storage pond are planned to further inform the PEPR development.



6.4.5.1 Context and views of affected parties

The proposed TSF will be located within MPL Sugarloaf, on freehold agricultural cropping and livestock farming land owned by Pirie Resources. Through discussions and presentations with DSD, Pirie Resources has incorporated advice relating to tailings management.

The TSF risk assessment was prepared under the ANCOLD guidelines by a set of suitably qualified experts and was peer reviewed. The modelling assumptions for the TSF have been stated in Appendix N. The key assumptions which have been used for the TSF modelling are as follows:

- Design criteria and assumptions adopted for the TSF are based on the South Australian Environment Protection Authority guidelines and the ANCOLD guidelines (as detailed in Appendix N).
- All stability analyses for the TSF were completed under the assumption that the tailings materials have no strength (conservative approach).
- Tailings will not be acid generating based on the results from drilling that has been completed on the resource and it is assumed that the ore and waste that will be removed is accurate. Geologists have characterised and sampled for AMD purposes all the various rock types within the block model. The samples used for the metallurgical test work for the economic determination of the viability of the ore body are representative; hence the tailings samples are representative for AMD purposes.
- That the testing to classify the tailings material properties is representative of the tailings material.

6.4.5.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to the TSF include the following:

- *Natural Resources Management Act 2004*
- *Mining Act 1971*
- *Australian National Committee On Large Dams (ANCOLD), "Guideline on Tailings Dams – Planning, Design, Construction, Operation and Closure", May 2012.*
- *Environment Protection Act 1993.*

6.4.5.3 Potential construction operation and closure impact/events

It should be noted that the use of the ANCOLD guidelines as the basis for design explicitly adopts a risk management approach, and this has been incorporated as an integral part of the design process.

The risks related to the TSF have been considered in relation to two fundamental potential impact events; discharge (failure to contain) of solids, and discharge (failure to contain) of water. It is noted that in most cases where the discharge of solids occurs, there will be some associated release of water. Risks identified are as follows:

- Discharge due to pipeline failure.
- Discharge of solids from embankment instability causing third party property damage, reduced public safety and flooding of surrounding low-lying areas.
- Discharge of solids from overfilling or overtopping of the storage.
- Discharge of solids due to flooding.
- Discharge of water from the stormwater bund.

Potential impacts to native vegetation from groundwater mounding caused by potential TSF seepage has not been considered, due to the location of the native vegetation within the proposed MPL and the existing cropping land on which it is designed. Accordingly, it is not deemed to be at risk.



The potential risk of fauna (including birds) injuries and/or deaths has focused on the potential of standing water bodies associated with the TSF.

In a source-pathway-receptor framework, the TSF can be viewed as a source of both hydrocarbons and calcium fluoride (refer Section 3.9.2.3 and Section 3.9.2.4). However, as established in Section 2.9, groundwater is not a receptor due to its low value (both quantity and quality). In addition, the low permeability behaviour of the tailings and the lack of driving head owing to the gravity decant facility result in low volumes of seepage. Hence, there is a low risk of contaminants causing environmental harm and these are not discussed further.

6.4.5.4 *Control and management strategies*

The control and management strategies to avoid discharge of solids and discharge of water include design, and operational controls:

Design

- The TSF has been designed to ANCOLD standards.
- The design has been internally peer reviewed.
- The TSF has been designed to account for 1:100-year rainfall.
- The design ensures that minimal water is retained on the TSF.
- A small saddle embankment will be constructed as a precaution against tailings and water flowing north out of the TSF.

Construction and Operation

- Construction of TSF will be controlled and audited by a suitably qualified engineer to ensure that construction meets design criteria.
- Rainwater will be diverted away from the TSF using diversion bunds, thereby limiting the catchment just to the TSF.
- As demonstrated in laboratory testing, the tailings have low permeability and naturally limit seepage; however, Pirie Resources will install monitoring bores around the TSF to observe any groundwater response to seepage and undertake seepage intervention measures such as extraction bores or interception trenches if required.
- Embankment lifts will be undertaken well ahead of storage volume reaching capacity.
- Tailings delivery pipeline will be established in a bunded pipeline corridor and equipped with leak detection equipment that will indicate when there is a pipeline leakage or failure.
- Although a low risk facility, Pirie Resources will undertake regular inspections and monitoring which will include:
 - Monitoring tailings levels and average beach slope.
 - Monitoring of operations to ensure slope stability.
 - Monitoring supernatant and storage pond water quality and levels.
 - Checking for fauna in the TSF and water ponds.
 - Inspecting the crests and slopes for signs of settling or failure.
 - Inspecting after heavy rainfall for signs of erosion on the embankment, storage pond and stormwater bund.
- Provide a sump for water recovery in the stormwater bunded area.



- Include soil management procedures and progressive rehabilitation of the TSF.
- Use bird deterrents on an as-needed basis.
- Audit at the end of the first year, and then every 5 years thereafter as recommended by ANCOLD for a low risk facility.



6.4.5.5 Evaluation of residual risks

Table 6-50: Risk assessment of impacts from TSF

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_12	Reduced public safety through discharge of tails and supernatant through failure of the TSF infrastructure	Possible	Minor	Moderate	The TSF has been designed to ANCOLD standards and internally peer reviewed. The TSF has been designed to account for 1:100-year rainfall and ensures that minimal water is retained on the TSF. A small saddle embankment will be constructed as a precaution against tailings and water flowing north out of the TSF. Construction of TSF will be controlled and audited by a suitably qualified engineer to ensure that construction meets design criteria. Rainwater will be diverted away from the TSF using diversion bunds, thereby limiting the catchment just to the TSF. As demonstrated in laboratory testing, the tailings have low permeability and naturally limit seepage, however Pirie Resources will install monitoring bores around the TSF to observe any groundwater response to seepage and undertake seepage intervention measures such as extraction bores or interception trenches if required. Embankment lifts undertake well ahead of storage volume reaching capacity. Tailings delivery pipeline will be established in a bundled pipeline corridor and equipped with leak detection equipment that will indicate when there is a pipeline leakage or failure. Monitoring tailings levels and average beach slope. Monitoring of operations to ensure slope stability. Monitoring supernatant and storage pond water quality and levels. Check for fauna in the TSF and water ponds Inspect the crests and slopes for signs of settling or failure.	Unlikely	Minor	Low



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					Inspect after heavy rainfall for signs of erosion on the embankment, storage pond and stormwater bund. Provide a sump for water recovery in the stormwater bund area.			
S_13	Contamination of soils through release of acid sulphides	Possible	Moderate	High	Limit seepage from the facility; Construction of TSF will be controlled and audited by a suitably qualified engineer to ensure that construction meets design criteria Rainwater will be diverted away from the TSF using diversion bunds, thereby limiting the catchment just to the TSF As demonstrated in laboratory testing, the tailings have low permeability and naturally limit seepage, however Pirie Resources will install monitoring bores around the TSF to observe any groundwater response to seepage and undertake seepage intervention measures such as extraction bores or interception trenches if required.	Unlikely	Moderate	Moderate
S_14	Contamination of surface water and loss of environmental values due to overflow from tailings storage facility.	Possible	Moderate	High	Tailings design to incorporate suitable freeboard in accordance with ANCOLD Guidelines that will ensure sufficient storage of tailings and incident rainfall to ensure that there will not be overtopping due to wave action even after a storm event. Embankment lifts undertake well ahead of storage volume reaching capacity. Tailings delivery pipeline will be established in a bunded pipeline corridor. Pipelines equipped with leak detection equipment that will indicate when there is a pipeline leakage or failure. The tailings storage will incorporate a low permeability cut-off trench and external downstream leak detection/collection system. Free water that accumulates around the decant area will be recovered and pumped to the process water dam for re-use. Establishment and implementation of a Tailings Operational and Management Plan.	Unlikely	Moderate	Moderate
S_15	The water bodies of the TSF attracting and entrapping fauna, including birds.	Unlikely	Moderate	Moderate	Check the TSF and water ponds for fauna and respond on an as-needs basis with bird deterrents if needed.	Unlikely	Minor	Low



6.4.5.6 Evaluation of residual risks

The TSF has been designed in accordance with the ANCOLD guidelines, which demonstrate leading practice within Australia. With the described control measures in place, the residual risks for all of the other potential impacts associated with the TSF are classified as low.

The TSF has been designed in accordance with ANCOLD guidelines and will be constructed, operated and maintained in accordance with an approved Tailings Operational and Management Plan. Monitoring during operations and rehabilitation will ensure that any breaches will be detected and resolved.

The available literature has shown that operations where bird fatalities have been recorded are from tailings dams where the mineral separation of process uses acutely toxic reagents such as sodium cyanide or sulphuric acid, or where the nature of the waste components (gangue minerals) associated. These are not proposed for the Campoona Graphite Project.

6.4.5.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-51).

Table 6-51: Environmental outcomes and measurement criteria – TSF

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_12	No adverse impact on public safety from failure of the TSF	Daily inspections are collated in quarterly report (O).	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment. Control room logs of on line monitoring of pipeline instrumentation demonstrate that all alerts are investigated and any resultant action carried out in accordance with the TSF 'Operation and Maintenance Manual'.
S13	Existing top and sub soil stockpile quality and quantity is maintained.	Daily inspections are collated in quarterly report (O).	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment. Control room logs of on line monitoring of pipeline instrumentation demonstrate that all alerts are investigated and any resultant action carried out in accordance with the TSF 'Operation and Maintenance Manual'.
S_14	No long term impact on local environmental values as a result of deterioration of surface water quality due to contamination.	An annual internal audit (intermediate and comprehensive) of the records from daily and weekly inspections of the tailings pipelines demonstrate that the TSF and associated infrastructure are operated in accordance with the TSF 'Operation and Maintenance Manual' and any resultant action carried out in accordance with the TSF 'Operation and Maintenance Manual' (O)	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment. Control room logs of on line monitoring of pipeline instrumentation demonstrate that all alerts are investigated and any resultant action carried out in accordance with the TSF 'Operation and Maintenance Manual'.
S_15	No fauna injuries and/or deaths from interactions with the TSF that could have been reasonably prevented.	All native fauna deaths or injuries on-site will be reported and an investigation will be undertaken to demonstrate it could not have reasonably been prevented (O).	Opportunistic observations of native fauna species recorded (fauna database) and collated annually for changes in populations and locations frequented within the ML.



6.4.6 Surface water hydrology

There are no significant watercourses in the vicinity of the processing facility or TSF at MPL (Sugarloaf). Whilst run-off is generally conveyed off-site in a north-easterly direction at the proposed ML (Campoonna), the drainage patterns at MPL (Sugarloaf) are less defined, and run-off is likely conveyed away in both north westerly, and south easterly directions (Figure 6-8).

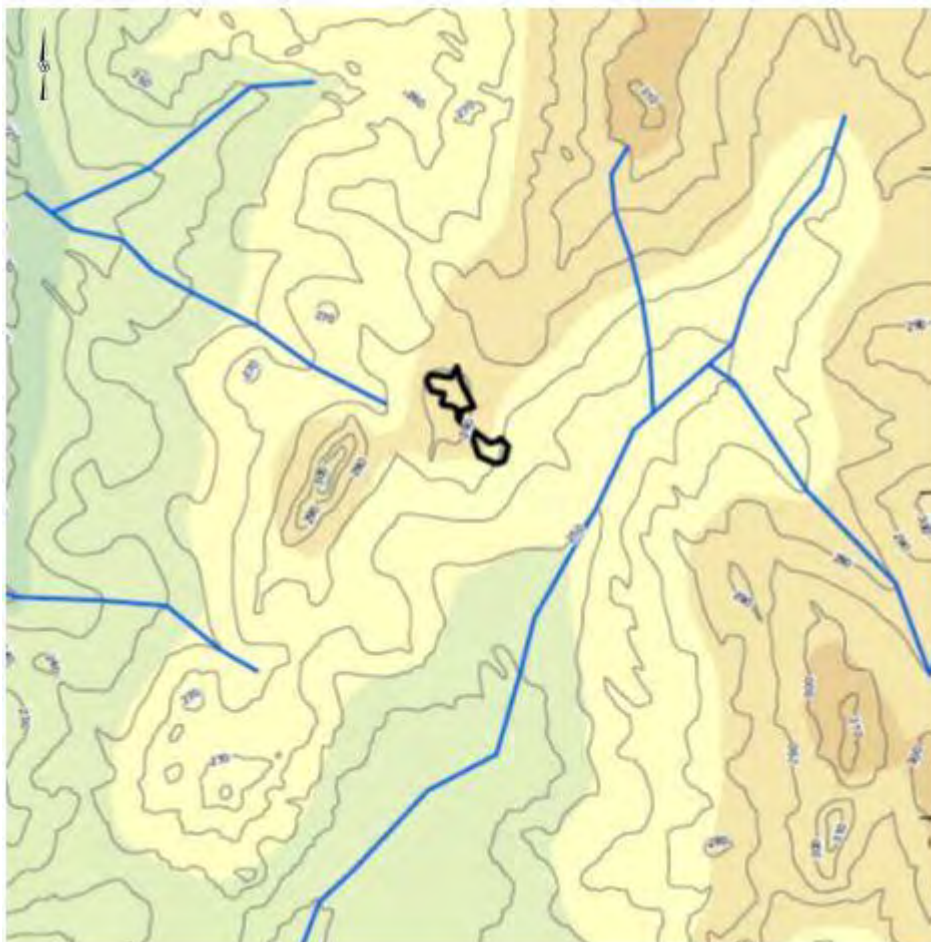


Figure 6-8: Surface water and flow paths near the MPL (Sugarloaf)

Stream flow data are commonly used in mine sites for the accurate design of infrastructure size. With only ephemeral streams near the MPL (Sugarloaf) site, stream flow data do not exist.

The site does not have significant offsite run-off, with little to no evidence of rainfall run-off even after large rainfall events. As such, there are no alterations to flow regimes, or any watercourse diversions associated with the MPL (Sugarloaf).

6.4.6.1 Applicable legislation and standards

It is a South Australia requirement to manage surface water drainage and to adhere to water quality standards. The standard industry approach of compiling historic rainfall data to create a design storm event for the recommended ARI of 1 in 100 was used to establish the site specific extreme storm conditions. This approach is commonly used to define the extent of alteration to existing drainage channels and the design of infrastructure and flood protection mechanisms for the proposed ML (1 in 100-year rainfall event). Applicable ARI's have been applied to other infrastructure related to associated risk levels and other applicable standards such as the ANCOLD Standards.



Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to surface water include the following:

- *Mining Act 1971.*
- *Natural Resources Management Act 2004.*
- *Environment Protection Act 1993.*
- *Environment Protection (Water Quality) Policy 2003.*
- Australian National Committee On Large Dams (ANCOLD), “*Guideline on Tailings Dams – Planning, Design, Construction, Operation and Closure*”, May 2012.
- Environment Protection Authority, *Bunding and Spill Management*, August 2012.
- Australian Standard 1940-2004: *The storage and handling of flammable and combustible liquids.*
- Australian Standard 1962-2006: *Steel tanks for flammable and combustible liquids.*

6.4.6.2 Potential construction operation and closure impact/events

The MPL Sugarloaf is not located close to any significant watercourses. As such, there are no alterations to flow regimes, or any watercourse diversions associated with this project. Similarly, the MPL is not significantly impacted by upslope run-off. As such, surface water management at Sugarloaf is focussed on the detention, treatment and, if necessary controlled discharge of potentially impacted internal run-off. A water balance for the TSF has been completed. The construction and operation of the TSF to accommodate full scale production results in a maximum loss of approximately 55 ha of local catchment (Figure 6-9), or approximately 10% of the site catchment for the life of operations.



Figure 6-9: Catchment area for the TSF at MPL (Sugarloaf)



The main interactions with surface water run-off from the proposed activities are therefore from the TSF and the infrastructure at the processing facility, including the ROM stockpile. However, it is possible that a spill or leak may occur, contaminating the surface water, from any of the following sources:

- Chemical use and/or storage.
- Fuel use and/or storage.
- Seepage from the tailings storage facility.
- Uncontrolled release of tailings and/or fluids, including through overtopping or pipeline breaks.

6.4.6.3 *Control and management strategies*

Bunds around the TSF will detain run-off from the TSF and divert this to settlement and evaporation ponds. The bunds will also serve to divert clean run-off from up-gradient (north-west) around the TSF. Overflow from the proposed evaporation pond will discharge to the downstream environment.

For water efficiency savings, water can be abstracted from the proposed evaporation pond to help meet the requirements of the adjacent processing plant.

Soil erosion and drainage management measures will be in place around all infrastructure to ensure offsite water quality is protected.



6.4.6.4 Evaluation of residual risks

Table 6-52: Risk assessment of impacts on surface water

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_09	Contamination of surface water and loss of environmental values as a result of release of sediment laden water from site operations.	Unlikely	Minor	Low	Diversion of upslope surface water run-off where applicable, noting that this is minimal. Design of roads to incorporate appropriate drainage (where practicable). Controlled application of rainwater collected from the pit for dust suppression. Undertake visual inspections of surface water control systems immediately after rainfall events and remediate incidents by diverting flows appropriately and/or treating surface water (if required). A surface water quality monitoring program consistent with the risks will be developed and implemented during operations. Soil erosion and drainage management measures in place around all infrastructure.	Unlikely	Minor	Low
S_10	Contamination of surface water and loss of environmental values from spills or leakages of stored fuel and chemicals.	Possible	Minor	Moderate	Design fuel, oil and chemical storage and bunds in accordance with EPA and Australian Standards. Maintain fuel, oil and chemical storage areas during operations. Undertake regular inspections of areas to ensure integrity of bunded and spill containment areas and correct use of storage and distribution areas. Develop and implement chemical and fuel management procedures including emergency response and clean up requirements. Management of waste management facility in accordance with design and operating procedures. Implementation of a surface water monitoring program consistent with risks.	Unlikely	Minor	Low



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ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_11	Contamination of surface water and loss of environmental values due to overflow from tailings storage facility	Possible	Moderate	High	Design to incorporate suitable freeboard in accordance with ANCOLD Guidelines that will ensure sufficient storage of tailings and incident rainfall to ensure that there will not be overtopping due to wave action even after a storm event. Embankment lifts undertake well ahead of storage volume reaching capacity. Tailings delivery pipeline will be established in a bundled pipeline corridor. Pipelines equipped with leak detection equipment that will indicate when there is a pipeline leakage or failure. The tailings storage will incorporate a low permeability cut-off trench and external downstream leak detection/collection system Free water that accumulates around the decant area will be recovered and pumped to the process water dam for re-use. Establishment and implementation of a Tailings Operational and Management Plan.	Unlikely	Moderate	Moderate



6.4.6.5 Justification for acceptance of residual risk

The external slopes of the TSF will be established with flat concave slopes and armoured with fresh rock which will reduce the potential for erosion. The installation of upslope surface water run-off diversion and sediment control systems will further reduce the potential for uncontrolled sediment discharge from the site.

With the implementation of the above control and management measures it is unlikely that erosion, sediment discharge and any impact on off-site areas would occur.

The TSF has been design with the general principle to control free draining liquids from the TSF during operation and minimise release by recycling as much water as possible.

The embankment has been classified to determine the hazard rating for uncontrolled releases in accordance with the ANCOLD's Guidelines on Tailings Dam Design, Construction and Operation (ANCOLD 1999). Design and operational criteria have included full containment of design storm plus a 1 m design wave run up protection.

6.4.6.6 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-53).

Table 6-53: Environmental outcomes and measurement criteria – surface water

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_09	No adverse impact to water quality caused by operations.	Water quality in overflow dam will be monitored during and immediately following high rainfall events (Co, O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.
S_10 S_11	No long term impact as a result of deterioration of surface water quality due to contamination.	Audits and inspection records demonstrate that waste is stored and correctly disposed and no evidence of waste disposed of on-site (O). Water quality in overflow dams will be monitoring during peak flow periods prior to being discharged on site (O).	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment.

6.4.7 Groundwater hydrogeology

Groundwater recharge is likely to occur in areas where basement rock aquifers outcrop and sub-crop in the hill country between the proposed ML and MPL (Sugarloaf). The estimated recharge rates are small and are likely to be at low end of the approximate range 0.5 to 5 mm / year; that is, 0.1% to 1% of the annual rainfall (350 mm) or even less.

Laboratory testing showed that tailings have low permeability and once placed over the footprint of the TSF, would limit seepage of water into the underlying natural soils.

6.4.7.1 Context and views of affected parties

Limited information is available on groundwater resources or their use in the Project area. This is likely to be due to the lack of availability of good quality groundwater. In the Project area, the majority of the water for agricultural use is sourced from harvesting surface water resources.



6.4.7.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to groundwater include the following:

- *Mining Act 1971*
- *Natural Resources Management Act 2004*
- *Environment Protection Act 1993*
- *Environment Protection (Water Quality) Policy 2003*
- *National Environment Protection (Assessment of Site Contamination) Measure 1999* (as amended 2013).

6.4.7.3 *Potential construction operation and closure impact/events*

Modelling showed an increase in the groundwater level underlying the TSF with seepage rate expected to be between 0.15 and 0.21 L/s. This may cause some mounding over the life of the mine and needs to be considered. Seepage and permeability of the TSF is going to be explored further to inform the PEPR.

There is no identified interaction between groundwater and flora or fauna at the project sites (Appendix G).

6.4.7.4 *Control and management strategies*

To monitor and control seepage within the TSF, a number seepage interception measures have been proposed:

- Install monitoring bores around the TSF to demonstrate that seepage is aligned with the model outcomes.
- Develop a seepage response plan that may include installation of dewatering bores, excavation of a trench outside the downstream toe or the installation of a blanket drain.



6.4.7.5 Evaluation of residual risks

Table 6-54: Risk assessment of impacts on groundwater

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_08	Seepage from operation of the processing facility including tailings storage causing mounding of local groundwater.	Likely	Minor	High	Install monitoring bores around the TSF to demonstrate that seepage is aligned with the model outcomes Develop a seepage response plan that may include installation of dewatering bores, excavation of a trench outside the downstream toe or the installation of a blanket drain.	Possible	Minor	Moderate



6.4.7.6 Justification for acceptance of residual risk

With the described control measures in place, the residual risks for the potential impacts associated with groundwater for the proposed ML are classified as low. These risks are credible as:

- The groundwater quality is poor, and similar to seawater in much of the site.
- There are no current (or likely) environmental or agricultural users of the groundwater.

6.4.7.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-55).

Table 6-55: Environmental outcomes and measurement criteria – groundwater

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_08	No adverse impact to groundwater quality caused by processing operations.	Monthly monitoring of groundwater bores Monthly seepage monitoring at TSF (O) An annual internal audit of the spills register demonstrates that all spills of fuels, lubricant or other contaminate have been remediated in accordance with EPA requirements and that all spills greater than 20 L reported to appropriate regulator (O).	Quarterly correlation between monitoring and modelling results.

6.4.8 Vegetation

Pirie Resources has undertaken three seasonal surveys in the broader project region and specifically at the project sites. As the sites are cleared of vegetation to enable cropping, the surveys and subsequent impact assessment has highlighted that the project has limited on-site impact risks. Residual risk to regional species and populations were also deemed low.

6.4.8.1 Context and views of affected parties

The proposed MPL Sugarloaf is on a highly modified landscape that has been extensively used for agriculture. Survey work was undertaken on a regional level, and surveys undertaken specifically on the MPL Sugarloaf site.

No EPBC listed species were found on site, nor any state threatened species. As such, loss of listed vegetation at the Sugarloaf site is not anticipated.

Although outside of any anticipated construction and operational areas, Sugarloaf Hill was surveyed. All vegetation communities within the Sugarloaf Hill have been greatly impacted by livestock grazing and weed infestations of the understorey and mid-storey layers. The Sugarloaf Hill property is actively grazed. As such, most of the vegetation communities within the study area are degraded.

6.4.8.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to vegetation include the following:

- *Environment Protection and Biodiversity Conservation Act 1999.*
- *Native Vegetation Act 1991.*
- *National Parks and Wildlife Act 1972.*
- *Natural Resources Management Act 2004.*



- *Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the Clearance of Native Vegetation Associated with the Minerals and Petroleum Industry (DWLBC 2005).*

6.4.8.3 Potential construction operation and closure impact/events

There is limited native vegetation on site. Although the infrastructure footprint has been minimised, minor clearance is required, which equates to less than 1 ha. A contribution to the Native Vegetation Fund of between \$500 and \$3,500 is anticipated to redress the vegetation loss.

6.4.8.4 Control and management strategies

The clearing of native vegetation and occasional loss of individuals cannot be practically avoided however the impact and consequences may be reduced by implementing the following control and management strategies:

- Induction of site personnel to indicate areas of approved clearance/protection.
- Design and layout of project components to areas that will require limited land clearance.
- Implementation of a program for stage clearance ensuring clearance only occurs prior to and within designated clearance area.
- Progressive rehabilitation of disturbed areas where practicable.
- Development and implementation of a native vegetation management plan and mine rehabilitation and closure plan.
- Establishment of significant environmental benefit for the project.



6.4.8.5 Evaluation of residual risks

Table 6-56: Risk assessment of impacts on vegetation

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_01	Vegetation clearance and degradation associated with construction and TSF operation causing a decline in local biodiversity.	Likely	Minor	Low	Develop and implement mitigation measures that consider minimising the development footprint and vegetation removal to within the boundary. Demarcate areas with natural vegetation with bunding to prevent accidental losses.	Unlikely	Insignificant	Low
S_02	Airborne dust from construction resulting in reduced plant (crop) growth (offsite).	Unlikely	Minor	Low	Implementation of a program for staged clearance; ensuring clearance occurs immediately prior to development and within designated areas. Restrict traffic to established site roads. High traffic areas around the site will be graded, compacted or covered with road base and/or bitumen-based polymer in accordance with fit for purpose design. Dust suppression using water will be undertaken during construction and operation. Monitor dust deposition impacts on vegetation.	Unlikely	Minor	Low
S_03	Loss of vegetation including crops from fires as a result of construction and mining operations.	Unlikely	Major	High	Compliance with AS 5062-2006. Fire protection of mobile and transportable equipment. Provide emergency response capability at mine. Liaise with local emergency services and nearby farming operations.	Unlikely	Minor	Low
S_04	Altered hydrological regimes impacting water availability for vegetation.	Unlikely	Minor	Low	The TSF included a detailed Water Balance and only removes 10% of the catchment from the project site for the duration of the mining operation.	Unlikely	Minor	Low



6.4.8.6 Justification for acceptance of residual risk

The proposed control and management measures should reduce the potential for long term consequence on abundance of vegetation communities at the regional level and local level.

Pirie Resources has minimised the development footprint and designed the mining infrastructure to avoid these areas. As such, the construction and operation works are designed to occur in the cleared and formerly farmed areas of each site.

Site clearance will require approval from DSD (delegate of the Native Vegetation Council). An offset project or payment into the NVC fund will be established as an SEB. Additionally, it is expected that vegetation in the affected areas will recover following completion of operations.

6.4.8.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-57).

Table 6-57: Environmental outcomes and measurement criteria – vegetation

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_01 S_04	No loss of abundance or diversity of native vegetation on the Land through; ■ clearance, ■ dust/contaminant deposition, ■ fire, ■ reduction in water supply, or ■ other damage, unless prior approval under the relevant legislation is obtained.	Review of vegetation clearance permits indicates clearance has been authorised under the Native Vegetation Act 1991 as per the Native Vegetation Management and Monitoring Plan.	Not required
S_02 S_03	No neighbouring losses of agricultural crops from dust surrounding the MPL.	Complaints-based. TEOMs at sensitive receptors (O)	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.4.9 Weeds

Pirie Resources has undertaken three seasonal surveys in the broader project region and specifically at the project sites and pipeline routes and identified that weed management will be required, with specific measures for Bridal Creeper. The residual risk of the Campoona Graphite Project proliferating weeds is deemed low as Pirie Resources has extensive weed controlling procedures on and off-site.

6.4.9.1 Context and views of affected parties

During the Campoona field studies completed in Spring 2012, 2013 and 2014, a total of six introduced species were recorded within the MPL (Sugarloaf) area.

Of these introduced species, one is classified as a declared weed species under either the State or Commonwealth legislation:

- Bridal creeper (*Asparagus asparagoides*) (Weed of National Significance WoNS).
 - This weed is considered to be a major threat to native plant communities, agricultural and forestry industries and communities.



- The berries are spread by birds, rabbits and foxes that feed on and later excrete the seeds. Movement of soil or dumping of garden rubbish containing Bridal Creeper seeds or roots can also spread the weed (CRC 2003 in Department of the Environment n.d.).
- Landholders are required by law to control WoNS growing on their properties.

6.4.9.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to weeds and pathogens include the following:

- *Natural Resources Management Act 2004.*
- *Natural Resources Management Plan for the Eyre Peninsula Natural Resources Management Region, Volume 2: Caring for our Resources* (EPNRMB 2009).
- *State Biosecurity Policy 2013-16* (PIRSA undated).
- *The Australian Weed Strategy: A national strategy for weed management in Australia* (NRMMC 2007a).

6.4.9.3 *Potential construction operation and closure impact/events*

The landscape is dominated by weeds. Weeds are prevalent in native vegetation in both survey areas and dominate in many areas particularly within the MPL Sugarloaf site.

The establishment and operations of the mine will result in clearance of vegetation and disturbance of soil including the topsoil and subsoil. These conditions provide a competitive advantage to weed species and result in the spread of weed species to cleared areas. The movement of vehicles on the site could also result in spreading of weed species from one area of the site to another

6.4.9.4 *Control and management strategies*

Establishment of weeds may be reduced by implementing the following control and management strategies:

- Ensure site induction to include identification of weed species.
- Implement a program for staged clearance; ensuring clearance occurs immediately prior to development and within designated areas; protect topsoil stockpiles from weed infestation.
- Actively manage and control of weeds in newly cleared areas.
- Clean earth moving machinery and equipment prior to entering and leaving the site.
- Inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak.
- Consult with farmers to identify any further weed species and initiate shared programs of weed eradication in the region, particularly for *Asparagus asparagoides*.
- Implement a wheel wash and vehicle inspection regime at entry and exit points to the site, including installation of rumble grids in appropriate locations.
- Restrict traffic to established site roads.



6.4.9.5 Evaluation of residual risks

Table 6-58: Risk assessment of impacts from weeds

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_05	Soil disturbance during construction and operation of mine site results in an increase in the abundance of weeds and impacts on agricultural production.	Possible	Insignificant	Moderate	Site induction to include identification of weed species. Implementation of a program for staged clearance; ensuring clearance occurs immediately prior to development and within designated areas. Develop and implement weed mitigation measures that consider: - Working with NRM for monitoring, mapping and controlling Bridal Creeper (<i>Asparagus asparagoides</i>) populations in the project areas; - Controlling new weeds that are introduced in the project areas; - Rehabilitating disturbed areas as soon as practical. - Inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak. - Protect topsoil stockpiles from weed infestation. - Consultation with farmers to identify any further weed species.	Unlikely	Insignificant	Low
S_06	Movement of vehicles, machinery and equipment onto the site results in introduction of new weeds and impacts on agricultural production.	Possible	Minor	Moderate	Earth moving machinery and equipment is cleaned prior to entering and leaving the site. Inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak. Protect topsoil stockpiles from weed infestation. Consultation with farmers to identify any further weed species. Conduct regular flora and fauna site walkovers to confirm no increase in invasive species and abundance. Restrict traffic to established site roads. Monitor vegetation impacts.	Unlikely	Minor	Low



6.4.9.6 Justification for acceptance of residual risk

The proposed control and management measures that include limiting the extent of clearance and vegetation disturbance and the regular monitoring program and eradication of emergent weeds will reduce the likelihood for significant increases in the density and distribution of weeds.

6.4.9.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-59).

Table 6-59: Environmental outcomes and measurement criteria – weeds

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_05 S_06	No significantly increased abundance or introduction of new weeds or pests, nor sustained increase in abundance of existing weed or pest species on the MPL or adjoining land (caused by processing operations).	Inspection of cleared areas for weed establishment indicates no increase in weed density or distribution compared to control sites (O).	Inspection records for vehicles and machinery show that all have been certified as clean before operating on site.

6.4.10 Fauna

The historically cleared landscape associated with the Campoona Graphite Project limits the opportunity for risk pathways to fauna. No EPBC-listed species were recorded onsite at MPL (Sugarloaf) and there is no suitable habitat for breeding that will be affected.

6.4.10.1 Context and views of affected parties

Fauna species diversity recorded in the project areas was 10 reptiles, 67 birds and nine mammals. No amphibian species was recorded in either project area.

- No fauna species listed as threatened under the EPBC Act was recorded in either survey.
- No reptile species protected by the NPW Act or EPBC Act was recorded during either survey.
- One species, Rainbow Bee-eater, listed as migratory under the EPBC Act, was recorded in November 2012. The project areas were found to potentially contain suitable breeding sites for this species but they were not deemed to represent significant breeding sites.

The project areas were found to support populations of the following state-listed (NPW Act) species:

- Purple-gaped Honeyeater (*Lichenostomus cratitius*), listed as rare and recorded in both the Campoona and Sugarloaf sites. Breeding activity outside both of the project sites is considered very likely for Purple-gaped Honeyeater given the presence of suitable mallee habitat.

6.4.10.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to fauna include the following:

- *Environment Protection and Biodiversity Conservation Act 1999.*
- *National Parks and Wildlife Act 1972.*
- *Natural Resources Management Act 2004.*

6.4.10.3 Potential construction operation and closure impact/events

Within a regional context, project related clearing represents a minor and almost undetectable habitat loss and will occur in an area that is already highly degraded and fragmented. The small area of degraded habitat that will be cleared does not represent significant habitat for any species of conservation significance and



impacts are expected to be inconsequential. The habitat values of this vegetation have been assessed and there is a very low risk that its values could be greater than expected. Consequently, it is not considered that any significant fauna values will be impacted by the proposed mining operations and, as a result, no further assessment or outcome is required.

6.4.11 Pest species

Four feral species were recorded during the comprehensive survey work. These species all require management under the *Natural Resources Management Act 2004* and Pirie Resources will implement pest species management procedures.

6.4.11.1 Context and views of affected parties

Foxes, cats, rabbits and house mice were recorded during the field surveys. These species are already established in the area and have negatively impacted native flora and fauna.

The key stakeholders are NRM EP and farmers in terms of potential impacts on pest species. No concerns have been raised by either stakeholder.

The community has not raised any concerns relating to pest species.

6.4.11.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to pest species include the following:

- *Natural Resources Management Act 2004.*
- *Natural Resources Management Plan for the Eyre Peninsula Natural Resources Management Region, Volume 2: Caring for our Resources* (EPNRMB 2009).
- *State Biosecurity Policy 2013-16* (PIRSA undated).
- *The Australian Pest Animal Strategy: A national strategy for the management of vertebrate pest animals in Australia* (NRMMC 2007b).

6.4.11.3 Potential construction operation and closure impact/events

Disturbance and mining activities within the site, including rehabilitation works could attract and provide suitable conditions for the further spread of feral animals including herbivorous pests such as rabbits. The destruction of native flora by these feral animals could result in decreased vegetation cover and limit the success of revegetation and rehabilitation of the site.

6.4.11.4 Control and management strategies

The impacts of introduced feral (pest) species can be reduced by implementing the following control and management strategies:

- Designing and locating roads and drainage to reduce the potential for water pooling and providing a source of drinking water.
- Undertaking inspection of site areas likely to harbor pest species.
- Implementation of a waste management plan to ensure no sources of food.
- Liaison with NRM Board in relation to control and eradication measure.
- Implementation of eradication programs.



6.4.11.5 Evaluation of residual risks

Table 6-60: Risk assessment of impacts from pests

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_08	Clearance of vegetation and establishment of processing facility infrastructure causing increase in feral animal populations.	Possible	Minor	Moderate	Develop and implement feral animal mitigation measures that consider: - managing waste disposal and eliminating available waste food stuffs, as a result of human activities, to exclude cats and other feral animals; and - destroying foxes, cats, rabbits and house mice in a manner consistent with adjoining landholders (as required by local NRM under legislation).	Unlikely	Insignificant	Low



6.4.11.6 Justification for acceptance of residual risk

Introduced species are currently present in the MPL and adjoining areas. The proposed control and management measures will provide for the control of feral (pest) species and the density and distribution is unlikely to increase significantly or to an extent that cannot be managed.

6.4.11.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-61).

Table 6-61: Environmental outcomes and measurement criteria – pests

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_08	No sustained increase or introduction of new pest species on the mining lease compared to adjoining farms.	Annual review of records indicates that there has been no statistically significant in the abundance of pest species from baseline (O).	No trend of increased sightings of pest species.

6.4.12 Topsoil and subsoil

During operations, topsoil and subsoils will be stockpiled and stabilised so that the potential for soil erosion and mobilisation of sediments in any run-off is limited.

6.4.12.1 Context and views of affected parties

The thin soil veneer within the proposed MPL consists of sands to sandy clay loams that have been degraded by land clearing, grazing and cultivation for over a hundred years.

The mining industry has made significant progress over the last decade in soil management; soil stripping is now a standard practice in the industry with topsoil being stored separately. Most mining companies treat topsoil as a valuable natural resource and will make every effort to protect it. Topsoil management practice ensures that soil fertility, stability and the native seed reserve (if present) are preserved.

Discussions with DSD and EPA have highlighted the need to carefully manage tailings and nearby soils. There are small quantities of kerosene and diesel added to the ore and these are expected to remain in the flotation circuit.

Soils that meet the waste fill criteria are considered to be inert and are permitted for reuse by the SA Environment Protection Authority under the *Standard for Production and Use of Waste Derived Fill* without need for specific management measures, leachate assessment or engineered liners. In addition, the *National Environment Protection (Assessment of Site Contamination) Measure 1999* as amended 2013 includes screening levels for hydrocarbons fractions to address site contamination risk. The SA EPA allows retention of waste soils on site if they meet the NEPM.

6.4.12.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to topsoil and subsoils include the following:

- *National Environment Protection (Assessment of Site Contamination) Measure 1999* as amended 2013 (NEPM 1999)
- *Natural Resources Management Act 2004*
- *Environment Protection Act 1993*
- *Environment Protection (Waste to Resources) Policy 2010*
 - *Standard for Production and Use of Waste Derived Fill* (EPA 2013)



- *Liquid Storage Guidelines: Bunding and spill management* (EPA 2012)
- *Site contamination: determination of background concentrations* (EPA 2008)
- *EPA Guidelines for Environmental management of on-site remediation* (2008).

6.4.12.3 Potential construction and operation impact/events

General site impacts

During both the construction and operation phases of the project there is potential for soil erosion from mining activities.

Erosion is the process of soil removal with particles transported by wind or water. Erosion is particularly susceptible on slopes and soil stockpiles, especially during high rainfall events. The loss of topsoil from the stockpiles through erosion can result in reduced quantity available for rehabilitation. There is also potential for onsite erosion to generate an increase in the sediment load of surface run-off. This has been further addressed in Surface Water. If soil erosion is not properly managed, it could result in damage to soil structure; increased sedimentation in waterways; reduced efficiency of site drainage system and loss of top soil.

Compaction of soil associated with infrastructure, hardstand areas, haul roads and access roads has the potential to limit the effectiveness of revegetation unless mitigation measures are implemented.

Tailings

Contamination from the tails in the TSF has been considered. The SA EPA allows retention of waste soils on site if they meet the NEPM. Kerosene spans C₆ to about C₁₇ hydrocarbon chain and diesel is around C₉ to C₂₄. Ecological screening levels provided in the NEPM for hydrocarbons are as follows:

- C₆₋₁₀: 215 mg/kg for commercial and industrial land use which is the most relevant guideline in this setting (urban residential and public open space guideline is 180 mg/kg and 125 mg/kg for ecologically significant areas).
- C_{>10-16}: 1,700 mg/kg (commercial and industrial land use) and 300 mg/kg (urban residential and public open space).
- C_{>16-C₃₄}: 3,300 mg/kg (commercial and industrial land use) and 2,800 mg/kg (urban residential and public open space).

The evaluation of these concentrations against SA EPA-approved guidelines and industry standards in combination with the clay content of the tailings and natural retardation of chemical mobility this provides, lack of a driving head of hydrocarbon contaminants and the depth to groundwater (expected to be > 40 m below the base of the TSF), the dried tailings in the tailings storage facility and supernatant retained in the lined pond pose a negligible risk of adverse impact to the environment with respect to hydrocarbon reagents.

6.4.12.4 Control and management strategies

General site controls

The plant site will be as small an area as practicable to enable processing of ore, supporting infrastructure and placement of tails. A small mine footprint reduces both environmental impacts and cost of mining.

- 1) A soil management plan will be developed to include recovery of as much topsoil as practicable and to control land clearance.
- 2) The design of fuel, oil and chemical storage facilities and transfer points and associated retaining bunds will be in accordance with Australian Standards as described above and EPA Bunding and Spill Management guidelines.



The likelihood and consequence of soil erosion due to exposure of soils may be reduced by implementing the following control and management strategies:

- Staged clearing to remove topsoils and subsoil from only the required footprint of the project components and undertake progressive rehabilitation and stabilisation
- Design will incorporate surface water drainage control measures to protect stockpiles and reduce erosion and sediment loss
- Regular inspections and maintenance of sediment and erosion control devices
- Operational activities will keep to established and designated track and work zones.

The likelihood and consequence of soil compaction may be reduced by implementing the following design and operational management measures:

- Ensuring all vehicles only use designated roads
- Removal of hardstand areas post mining
- Scarifying compacted areas
- Spreading of topsoil.

Tailing controls

- Although a low risk facility, Pirie Resources will undertake regular inspections and monitoring which will include:
 - Monitoring tailings levels and average beach slope
 - Monitoring of operations to ensure slope stability
 - Monitoring supernatant and storage pond water quality and levels
 - Checking for fauna in the TSF and water ponds
 - Inspecting the crests and slopes for signs of settling or failure
 - Inspecting after heavy rainfall for signs of erosion on the embankment, storage pond and stormwater bund
- Provide a sump for water recovery in the stormwater bund area
- Include soil management procedures and progressive rehabilitation of the TSF.



6.4.12.5 Evaluation of residual risks

Table 6-62: Risk assessment of impacts on topsoil and subsoil

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_16	Soil erosion altering surface water flows due to exposure of soils during construction and operations	Likely	Minor	High	Minimise potential through staged clearing from only the required footprint and progressive rehabilitation. Strip topsoil and excavate subsoil only from those areas that will be disturbed by mining operations. Ensure stockpiles are appropriately surveyed and documented for management and rehabilitation purposes. Use erosion control techniques to protect stockpiles and minimise erosion and sediment loss. Select soil stockpile locations avoiding working areas, areas of natural drainage and on-site traffic routes. Regular inspections and maintenance of sediment and erosion control devices Operational activities will keep to established and designated roads and work zones	Possible	Minor	Moderate
S_17	Soil compaction for hardstand areas resulting in poor revegetation.	Unlikely	Minor	Moderate	Removal of hardstand areas. Scarifying of compacted areas. Spreading of topsoil.	Unlikely	Minor	Low



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ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_18	TSF failure through discharges or overfilling / overtopping of the storage resulting in impacts on soil quality.	Possible	Minor	Moderate	The TSF has been designed to ANCOLD standards and internally peer reviewed. The TSF has been designed to account for 1:100-year rainfall and ensures that minimal water is retained on the TSF. A small saddle embankment will be constructed as a precaution against tailings and water flowing north out of the TSF. Construction of TSF will be controlled and audited by a suitably qualified engineer to ensure that construction meets design criteria. Rainwater will be diverted away from the TSF using diversion bunds, thereby limiting the catchment just to the TSF. As demonstrated in laboratory testing, the tailings have low permeability and naturally limit seepage, however Pirie Resources will install monitoring bores around the TSF to observe any groundwater response to seepage and undertake seepage intervention measures such as extraction bores or interception trenches if required. Embankment lifts undertake well ahead of storage volume reaching capacity. Tailings delivery pipeline will be established in a bunded pipeline corridor and equipped with leak detection equipment that will indicate when there is a pipeline leakage or failure. Monitoring tailings levels and average beach slope Monitoring of operations to ensure slope stability Inspect the crests and slopes for signs of settling or failure. Provide a sump for water recovery in the stormwater bunded area.	Unlikely	Minor	Low



6.4.12.6 Justification for acceptance of residual risk

Minimising land clearance, the separate stockpiling of topsoil and subsoil, progressive rehabilitation, revegetation and the proposed control and management measures will reduce the potential for loss of soil quality. On this basis that impact is considered to be insignificant and the residual impact low.

The removal of hardstand and other trafficked and compacted areas through implementation of the proposed management and control measures will minimise the impacts.

6.4.12.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-63).

Table 6-63: Environmental outcomes and measurement criteria – topsoils

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_16 S_18	Existing top and sub soil stockpile quality and quantity is maintained.	Annual survey and photographic records of soil stockpiles (O). Water quality in overflow dam will be monitored during and immediately following high rainfall events (O). Water quality in interceptor trenches will be monitored for the life of mine to ensure water quality meets needs for re-use on site (O).	Weekly visual inspection shows that separate topsoil and subsoil stockpiles are established and maintained.
S_17	Existing top and sub soil stockpile quality and quantity is maintained so that vegetation is self-sustaining and comparable to undisturbed surrounding area.	Annual survey and photographic records of soil stockpiles (O). Records indicate that compacted areas have been removed, or scarified and topsoil spread (O).	Records indicate that compacted areas have been removed, or scarified and topsoil spread.

6.4.13 Heritage

The proposed MPL (Sugarloaf) area lies within the traditional territory of the Barngarla people. Barngarla Nation is the registered claimant for a Native Title claim over the proposed area. When Pirie Resources purchased the Wildhorse Plain EL 4693, it became a party to the existing Native Title Mining Agreement (NTMA).

6.4.13.1 Context and views of affected parties

There are a number of locations of State and Local Heritage significance to non-Indigenous cultural heritage located in the region although none are within the vicinity of the various project components. There are no previously recorded sites of significance to Indigenous archaeology, anthropology, history or tradition in the study area.

Ground disturbance activities have the potential to directly impact archaeological and/or anthropological sites of significance. However, the desktop review identified that the majority of the project footprint has minimal predictive archaeological sensitivity.



All Aboriginal archaeological sites, objects and remains in South Australia are protected by provisions of the *Aboriginal Heritage Act 1988*, regardless of whether they are located on freehold or crown land, which makes it an offence to collect, damage or destroy Aboriginal sites, objects or remains without the written authorisation of the Minister for Aboriginal Affairs based on consultation with the relevant Aboriginal community. Pirie Resources is committed to eliminating their risk of damaging or destroying any Aboriginal sites, objects or remains.

6.4.13.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to Indigenous and non-Indigenous cultural heritage values include the following:

- *Heritage Places Act 1993*
- *Aboriginal Heritage Act 1988*
- *Development Plan: Cleve Council (DCC 2013)*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *Environment Protection and Biodiversity Conservation Act 1999*

6.4.13.3 *Potential construction operation and closure impact/events*

Heritage desktop surveys over the proposed MPL (see Appendix H) did not identify any previously recorded sites of significance to Indigenous archaeology, anthropology, history or tradition in the study area. No intact sites have been identified due to the severely degraded nature of the area as a consequence of agricultural enterprises and environmental processes.

Ground disturbance activities have the potential to directly impact archaeological sites of significance. However, based on the heritage review, the majority of the project footprint has minimal predictive archaeological sensitivity. The likelihood of disturbing Aboriginal sites (without prior approval) is therefore considered unlikely in the proposed MPL Sugarloaf area.

No European heritage sites have been identified within or around the proposed MPL Sugarloaf area.

6.4.13.4 *Control and management strategies*

While there is no legal obligation under the *Aboriginal Heritage Act* to undertake a survey, Pirie Resources will proactively educate all staff to raise awareness and manage ground disturbing activities to ensure any archaeological sites, objects and remains, are not damaged, collected or destroyed.

The following control and management strategies will be implemented:

- undertake induction of personnel on responsibilities under the Act, procedures relating to ground disturbance and identified sites, and reporting requirements.
- develop Aboriginal heritage management procedures in consultation with Barngarla representatives with procedures to be implemented in the event a discovery is made. Protocol to also address statutory reporting requirements as per legislation.
- restrict vehicle access to site access tracks and project roads to prevent damage to identified or unknown sites. Any Aboriginal Heritage sites will be clearly identified sites and, if required by the heritage management plan, designated as "no go" zones with prohibited access to these sites.
- monitor the status of the heritage sites and implementation of the heritage management procedures.
- establish and implement procedures should new sites be discovered during site works.



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6.4.13.5 Evaluation of residual risks

Table 6-64: Risk assessment of impacts on heritage

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_19	Disturbance to Aboriginal heritage sites through construction activities.	Unlikely	Moderate	Moderate	Develop Aboriginal heritage management procedures in conjunction with Barngarla representatives with procedures to be implemented in the event a discovery is made. Protocol to also address statutory reporting requirements as per legislation. Restrict vehicle access to site access tracks and project roads to prevent damage to identified or un-known sites. Clearly mark identified sites and, if required, designate as "no go" zones and prohibit access to these sites. Monitor the status of heritage sites and implementation of the Aboriginal Heritage Management procedures. Establish and implement procedures should new sites be discovered during site works. Undertake induction of personnel on responsibilities under the Act, procedures relating to ground disturbance and identified sites, and reporting requirements.	Unlikely	Minor	Low



6.4.13.6 Justification for acceptance of residual risk

Ongoing awareness and management of the risks will be required during construction and operation to ensure unknown sites are not impacted. The proposed management measure should mitigate significant impacts.

Disturbance of aboriginal heritage sites will be unlikely as site clearance will have been undertaken of project components and no-go zones will have been identified.

6.4.13.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-65).

Table 6-65: Environmental outcomes and measurement criteria – heritage

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_19	No disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation has been obtained.	Records show that if an Aboriginal site or artefact is discovered that work ceases and appropriate procedures are followed approval sought under the <i>Aboriginal Heritage Act 1988</i> (Co, O). Induction records indicate heritage requirements addressed (Co, O). No incident reports relating to disturbance of heritage sites (Co, O). Records indicate heritage management procedures in place (Co, O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.4.14 Conservation areas

There are no pathways for the MPL Sugarloaf to impacts to conservation areas.

The closest Heritage Scheme Agreement (HA 569) to any of the project areas is adjacent to the Pindari pipeline alignment between Jamieson Tank Road and Carappee Hill Road.

Another heritage agreement areas lies to the east of the eastern end of Jamieson Tank Road pipeline route (south of the road at Jamieson Tank, HA 877). The interaction between the project and conservation areas is accordingly considered in the management plan for the MPL Water.

6.4.15 Waste disposal

The types of industrial and commercial waste which will be generated by the processing facility include, but is not limited to, putrescible waste, recyclables, waste oil, oil filters, oily rags, tyres, petrochemicals, chemical containers.

Due to the size and siting of the mine, no on-site landfill is required. All waste and recyclables will be removed from site by contractors and disposed of at a local EPA approved facility.

Neither pre-existing contamination, nor potential sources of pre-existing contamination have been identified within the proposed MPL Sugarloaf area.

6.4.15.1 Context and views of affected parties

The risk of putrescible wastes attracting pest species has been considered in Section 6.4.11.

Discussions with DSD and EPA have highlighted the need to carefully manage tailings and nearby soils. There are small quantities of kerosene and diesel added to the ore and these are expected to remain in the



flotation circuit. Soils that meet the waste fill criteria are considered to be inert and are permitted for reuse by the SA Environment Protection Authority under the Standard for Production and use of Waste Derived Fill without need for specific management measures, leachate assessment or engineered liners. In addition, the National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended 2013 includes screening levels for hydrocarbons fractions to address site contamination risk. The SA EPA allows retention of waste soils on site if they meet the NEPM.

6.4.15.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to waste management include the following:

- *Environment Protection Act 1993*
- *Liquid Storage Guidelines: Bunding and spill management* (EPA 2012).

6.4.15.3 *Potential construction operation and closure impact/events*

Hazardous materials such as waste oils, waste grease and car batteries will be stored on-site prior to pick up. If these wastes are incorrectly stored, the risk of a leak or spill occurring will increase, resulting in potential soil contamination.

If not stored correctly, used tyres pose a risk to public health and safety. The intense radiant heat can inhibit fire-fighting efforts and the incomplete combustion of tyres can cause a health risk through the inhalation of particulates. Tyre fires are very difficult to extinguish and are dangerous to fire fighters. Environmental impacts to soil, watercourses and stormwater are likely, and clean-up costs can be extremely high.

Stockpiling of wastes (including tyres) for long periods of time can provide ideal habitat for pest species (including mosquitos). Putrescible wastes such as food scraps may also attractive pest species is not properly disposed of. Refer to Section 6.5.10 for detail on the potential impacts of pest plants and animals.

Tailings

Contamination from the tails in the TSF has been considered. The SA EPA allows retention of waste soils on site if they meet the NEPM. Kerosene spans C₆ to about C₁₇ hydrocarbon chain and diesel is around C₉ to C₂₄. Ecological screening levels provided in the NEPM for hydrocarbons are as follows:

- C₆₋₁₀: 215 mg/kg for commercial and industrial land use which is the most relevant guideline in this setting (urban residential and public open space guideline is 180 mg/kg and 125 mg/kg for ecologically significant areas).
- C_{>10-16}: 1,700 mg/kg (commercial and industrial land use) and 300 mg/kg (urban residential and public open space).
- C_{>16-C34}: 3,300 mg/kg (commercial and industrial land use) and 2,800 mg/kg (urban residential and public open space).

The evaluation of these concentrations against SA EPA-approved guidelines and industry standards in combination with the clay content of the tailings and natural retardation of chemical mobility this provides, lack of a driving head of hydrocarbon contaminants and the depth to groundwater (expected to be > 40 m below the base of the TSF), the dried tailings in the tailings storage facility and supernatant retained in the lined pond pose a negligible risk of adverse impact to the environment with respect to hydrocarbon reagents.



6.4.15.4 Control and management strategies

Consumption of resources and materials is minimised as far as reasonably practicable. Waste management will be considered as a life cycle response from purchasing of the product up until when the product is no longer required to ensure all waste products are handled in a way that minimizes impact on the environment. In order to limit the amount of waste that requires to be sent to landfill it is important that when purchasing products, preference is given to:

- Products which are reusable
- Products which are recyclable
- Suppliers which recycle their products and packaging
- Suppliers who offer return of unused product
- Suppliers who offer to collect used products or empty containers
- Suppliers of products with packaging minimisation programs.

All remaining wastes and recyclables will be disposed at off-site facilities, and landfill will be disposed of at EPA approved facilities.

During operations at the MPL, waste will be managed in accordance with a waste management plan. Further, Pirie Resources will:

- Ensure appropriate litter and rubbish bins/skips are available on site.
- Ensure rubbish bins and recyclable waste is removed by contractors as regularly as possible to minimise the risk of soil contamination and pest attraction.
- On-site hazardous wastes such as waste oils and used car batteries will be stored as per EPA bunding guidelines prior to disposal.
- Used tyres requiring disposal will be stored as per EPA guidelines (EPA 2010) and the South Australian Fires services guidelines (Czerwinski 2005).
- Site inspections will be undertaken by Pirie Resources to ensure correct storage of all waste awaiting disposal and a regular turnaround of waste.
- Waste tracking forms will be required for all waste removed from site.



6.4.15.5 Evaluation of residual risks

Table 6-66: Risk assessment of impacts from waste

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_30	Soil or water contamination due to incorrect waste disposal and contamination from sewage.	Possible	Minor	Moderate	Controls in place such as bunding, skips and all facilities designed, constructed and maintained in accordance with the relevant legislation.	Unlikely	Minor	Low
S_31	Incorrect storage of tyres causing fire.	Unlikely	Minor	Low	Considering the location of the potential storage areas along with correct storage and a regular turnaround of waste.	Rare	Minor	Low
S_32	Incorrect storage increasing pest species.	Unlikely	Minor	Low	Ensure litter and rubbish bins are available on site. Ensure correct storage of all wastes awaiting disposal, and regular turnaround of waste.	Rare	Minor	Low



6.4.15.6 Justification for acceptance of residual risk

A moderate residual risk remains for fires from incorrect tyre storage as the consequence remains as moderate due to the impact a fire could cause, but it is likely that a fire would be able to be controlled on site before impacting neighbouring properties and/or residents. With the proposed strategies the likelihood has been reduced to rare.

With the described control measures in place, the residual risks for all of the other potential impacts associated with waste disposal on the proposed ML are classified as low. As all waste will be disposed of off-site, this eliminates the impact of contamination due to incorrect disposal. Bunding of all hazardous waste products also reduces the risk of contamination. Regular inspection of the site will ensure all control measures are in place and the waste management plan has been correctly implemented. All mine generated waste will have been removed post-closure, the potential impacts associated with their storage and disposal will have been eliminated.

6.4.15.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-67).

Table 6-67: Environmental outcomes and measurement criteria – waste

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_30	No contamination and pollution is caused by waste products and their disposal.	An annual audit of the waste disposal records of the volumes of putrescible and hazardous waste taken off-site demonstrate that the disposal of all potentially polluting waste has been taken to an approved EPA site and in accordance with the Waste Management Plan (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.
S_31	No impacts to off-site property or public safety resulting from on-site fires.	An annual audit of the records from monthly inspections of the waste/recycling storage locations show all waste is stored correctly and processing of waste items is in accordance with the approved Waste Management Plan and Fire Management Plan (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.
S_32	No introduction of new pest animal species or sustained increase in abundance of existing pest animal species in the proposed ML caused by processing operations.	An annual audit of the records from monthly inspections of the waste/recycling storage locations show all waste is stored correctly and processing of waste items is in accordance with the approved Waste Management Plan (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.4.16 Traffic and transport

The proposed MPL is bound by Jamieson Tank Road to the north, Cut-Line and Harris Roads to the West. These roads are two-way unsealed rural roads which carry less than 50 vehicles a day based on the surrounding land use.

There are a number of unsealed minor roads which surround the proposed MPL under the control of DC Cleve, which are used for local traffic, grain haulage and school bus routes.

6.4.16.1 Context and views of affected parties

The construction stage for full scale operations will require transportation of construction equipment and materials, with parking for construction staff provided on each site. It is estimated that 50-60 people will be required during the 10-month construction phase.



Operation of the proposed development will include transport of materials from the mine to the processing facility on the road network between the sites. Transport of ore is likely to utilise B-Double vehicles to transport between the sites.

The number of truck trips between the proposed ML at Campoona and MPL Sugarloaf could range as follows (based on 50 tonnes per truck):

- 4 per day (road train) for 70,000 tpa capacity.
- up to 8 per day (road train) for 140,000 tpa capacity.

In summary, the traffic generation Shaft would be 56 per day during construction, and 32-37 during operation respectively.

HF will be transported from the port to the CUF in 20 tonne isotankers – this term refers to a type of transport equipment, built to contain liquid and composed of a tank fixed in a frame, designed according to the ISO standards. An isotanker will need to be delivered to the CUF approximately every 48 hours. Transport and storage of HF is subject to existing regulations and reporting requirements. For this reason, separate regulation of these activities under the Mining Act is considered unnecessary.

6.4.16.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to traffic include the following:

- *Road Traffic Act 1961*
- *Dangerous Substances Act 1978*
- *Local Government Act 1999*
- *Roads (Opening and Closing) Act 1991*
- *Occupational Health Safety and Welfare Act 1989.*

6.4.16.3 *Potential construction operation and closure impact/events*

Against existing traffic volumes in the vicinity of the site, approximately 10 vehicle movements in the peak hour and 30 trips daily (operation) would be generated in addition to the existing traffic volumes as a result of the proposed development.

It is GTA's opinion that this level of traffic could not be expected to compromise the operation of the surrounding road network and there is adequate capacity to accommodate the traffic generated by the proposal. The traffic volumes on all roads are very low currently and the additional traffic would not impact the capacity or safe operation of these roads based on the traffic volume.

The impacts of traffic are considered to have negligible risk. However, additional safeguards will be implemented, and these controlling strategies are described below.

6.4.16.4 *Control and management strategies*

Pirie Resources will ensure that:

- site induction procedures, and training regarding local conditions if necessary, for all external driver to ensure safety standards and company expectations are met.
- all vehicle operators have appropriate licences.
- work with local farmers to ensure stock movements can be safely facilitated during mine construction and operations.
- negotiate with the District Council of Cleve for maintenance and upgrades of roads as required.



The traffic impact assessment and mitigation has been provided for the ML Campoona. There are no additional risks or management measures proposed.

6.4.17 Public safety

General

The proposed MPL Sugarloaf is located some 25 km from the town of Cleve. As part of the Work Health and Safety Act, Pirie Resources will ensure the safety of its staff, contractors and visitors of the Campoona Graphite Project through safety inductions, personal protective equipment and safe work procedures etc. However, due to the proximity to residential areas, Pirie Resources must consider the potential impacts associated with public safety. Public safety receptors are those individuals who are impacted by Pirie Resources' operation or those who legally or illegally gain or attempt to gain access to the mine site.

Hydrofluoric acid

Public exposure to HF could occur as a result of accidental spills or release during transport, storage or industrial use. A HF spill or leak can be a combination of vapour and liquid. In warmer weather, the liquid will vaporise rapidly due to its low boiling point.

In the event of a transport accident or spill, the contaminated area is required to be restricted to authorised personnel only, wearing suitable protective clothing and self-contained breathing apparatus.

In the event of a large spill in a populated area, the appropriate emergency services would decide on the need for evacuation or other management strategies to minimise the potential for exposure of the public to HF vapour or liquid. Appropriate techniques are used to limit the release of HF to the environment during the process of cleaning up the spill. The Australian Code for the Transport of Dangerous Goods by Road and Rail includes measures for the marking of dangerous goods and placard of vehicles so that emergency crews can respond appropriately.

Hazardous substances are moved on a daily basis around Australia without incident. As discussed above, strict requirements apply to these activities ensuring risks are reduced to as low as reasonably practicable. While the risk of a serious incident cannot be eliminated entirely, the likelihood is considered to be extremely rare.

6.4.17.1 Context and views of affected parties

Unauthorised public access during operations and post-closure (prior to relinquishment of least) has the potential to impact upon public safety.

6.4.17.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to public safety include the following:

- *Mining Act 1971.*
- *Work Health and Safety Act 2012.*

6.4.17.3 Potential construction operation and closure impact/events

Unauthorised access to the mine operation by a member of the public, who is neither trained nor inducted, can potentially lead to injury or death. Potential hazards include collision with heavy vehicles and access to the on-site processing equipment.

Fire originating from the mining operation has the potential to cause a risk to public safety if not managed correctly. There are several potential ignition sources from the mining operation including hot works such as welding, cutting and grinding, vehicle fires and smoking. Incorrect storage of waste materials such as tyres can also pose a fire hazard (addressed in Section 6.4.15).

Pressure could be put on local emergency services in response to a major safety incident occurring at the site.



Risks to workers at the processing plant are regulated through Occupational Health and Safety requirements. These requirements will be adequate to ensure there is a negligible risk to members of the public from spills and leaks within the CUF are not discussed here further. The controls are documented in Appendix K for reference.

6.4.17.4 *Control and management strategies*

The processing facility at MPL Sugarloaf will be enclosed by a security fence which complies with Australian Standards (AS1725-2003). Further, boom gates will be installed at the main entrance, and adequate warning signs will be installed.

The MPL Sugarloaf will be equipped with onsite First Aid facilities which will help minimise pressure to the health service providers and local emergency services in the region.

The likelihood and consequence of impacting emergency services may be reduced by implementing the following control and management strategies:

- Provide emergency response capability at mine and implement appropriate staff training.
- Liaise with local emergency services and other quarrying/mining operations at a local and regional level to identify synergies.
- Maintain emergency response capability during operations (including training, mock incidents)
- Maintain ongoing support of community services such as hospitals.
- Review procedures and undertake ongoing liaison with local emergency services and nearby quarrying/mining operations.

Considering the size and expected location of the construction and operations workforce, the impact of the Campoona Graphite Project is considered negligible.



6.4.17.5 Evaluation of residual risks

Table 6-68: Risk assessment of impacts from public safety

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
S_35	Unauthorised access to the mine resulting in injury or death.	Rare	Catastrophic	Extreme	Include fencing, bunding and site security such as cameras. Regularly inspect fences.	Rare	Major	High
S_36	Reduced public safety from fire originating from the mine site.	Possible	Major	Extreme	Considering the location of the potential storage areas along with correct storage and a regular turnaround of waste.	Unlikely	Moderate	Moderate
S_37	Incorrect storage increasing pest species.	Possible	Moderate	High	Ensure litter and rubbish bins are available on site. Ensure correct storage of all wastes awaiting disposal, and regular turnaround of waste.	Rare	Moderate	Moderate



6.4.17.6 Justification for acceptance of residual risk

With all of the above control measures in place the likelihood of the impacts occurring has been reduced as much as possible to rare. Fire is an inherent risk to public safety and therefore a moderate residual risk is acceptable as no further reasonable controls can be implemented.

6.4.17.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-69).

Table 6-69: Environmental outcomes and measurement criteria – public safety

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_35	No public injuries and or deaths from unauthorised entry to the mine site that could have been reasonably prevented by the lessee.	All unauthorised entries to the mine site are investigated and investigations demonstrate all reasonable and practical measures were in place to prevent entry (and injury, if applicable) (Co, O).	Any security issues will be reported within 24 hours
S_36	Reduced public safety from fire originating from the mine site resulting in injury and/or death.	No unplanned fires onsite, and ensure control measures are in place to manage potential offsite impacts (Co, O).	Any security issues will be reported within 24 hours
S_37	No increase in pest species as a result of the Project	Routine work inspections for hygienic waste management practice (O)	Quarterly waste management records; complaints register.

6.4.18 Closure outcomes for MPL Sugarloaf

Closure criteria presented have been discussed with stakeholders but are preliminary. Closure criteria will be reviewed throughout the life of the mine. They will also be reviewed and revised to incorporate the results of trials and investigations, regulatory requirements, stakeholder consultation and any changes in mine operations or approaches to rehabilitation.

Closure outcomes have been identified in Table 6-70.



Table 6-70: Closure outcomes for MPL Sugarloaf

Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
WP1	Weed infestation and plant disease across the site post-closure.	- Any imported material will be certified before use as clean fill. - Ensure correct plant hygiene procedures are utilised during rehabilitation or import of clean fill/topsoil material is certified. - Implement vehicle and equipment wash down procedures to minimise risk of pathogen importation.	N/A	N/A	Vegetation is self-sustaining and comparable to the surrounding areas.	Ecosystem function analysis confirms revegetated areas will meet the critical thresholds for sustainability	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
V1	Increased dust emissions impacting vegetation health.	■ Maintain vegetation cover on the landforms. ■ Revegetation undertaken during seasons conducive to successful vegetation establishment. ■ Any temporary stockpiled materials will be protected or wetted to prevent dust. ■ Rehabilitation species may be selected for drought tolerance. ■ Use established seeding techniques and soil conservation techniques. ■ Seedling protection to be undertaken.	Revegetation occurs in favourable growing seasons and develops to be self-sustaining.	Seasonal variation and results of progressive rehabilitation.	■ Vegetation is resilient, self-sustaining and reflective of the regional landscape and native vegetation values in closure. domains identified for native vegetation as final land use.	■ Progressive rehabilitation occurs on areas no longer required for mining. ■ Ecosystem function analysis confirms revegetated areas will meet the critical thresholds for sustainability.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
V2	Revegetation on rehabilitated areas is unsuccessful resulting in loss of ecological values	- Species selection for rehabilitation will be chosen based on ability to achieve post-closure objective of self-sustaining vegetation. - Revegetation undertaken during seasons conducive to successful vegetation establishment. - Rehabilitation species may be selected for drought tolerance. - Use established seeding techniques and soil conservation techniques. Seedling protection to be undertaken.	Revegetation species are similar to species within the surrounding area.	Results of progressive rehabilitation trials will confirm which species will be used in revegetation.	Vegetation is resilient, self-sustaining and reflective of the regional landscape and native vegetation values in closure domains identified for native vegetation as final land use.	- Progressive rehabilitation occurs on areas no longer required for mining. - Ecosystem function analysis (EFA) monitoring for native vegetation.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
S1	Site contamination post closure impacts on public health or vegetation	- Identify areas with potential for contamination (e.g., fuel storage and workshop areas). - Ensure all infrastructure, chemicals and wastes are removed from site following mine closure. - Assess any residual contamination and remediate the site.	Existing contamination within the project area is based on desktop assessment. Will require assessment of existing contamination, on-going record management of spills and leaks during mine life and a contamination assessment at closure.	N/A	No adverse impact on soil quality caused by project activities.	Site contamination assessment demonstrates compliance with National Environment Protection Measure (NEPM) land use requirements.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
S2	Contamination and deterioration of land resources from TSF seepage.	- Limit seepage from the facility. - Cover design using a mix of tailings, natural clayey sands and topsoils collected from the TSF area will be placed to promote grass growth will be placed over slopes and re-profiled to a water shedding design.	Detailed design will be undertaken as part of the PEPR	TSF will need to be suitably designed to contain PAF material and minimise risk of AMD seepage from TSF.	- The rehabilitated TSF is geotechnically and geochemically stable - Resilient, self-sustaining vegetation of regional relevance and provenance.	- An audit confirms that the TSF has been constructed in accordance with the approved design in the PEPR - Slumping and cracking occurs at rates which will not significantly affect the integrity of the cover system or long term stability or rehabilitation of the site. - Surface water assessment demonstrates compliance with relevant Environment Protection Policy (EPP) requirements. - Resilient, self-sustaining vegetation of regional relevance and provenance. - Domain audit demonstrates infrastructure and equipment is removed/safe.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
SW1	Erosion of surface soils.	■ Design of surface drainage features to minimise erosion potential. ■ Limit exposed surfaces.	N/A	N/A	■ No adverse impacts to offsite stormwater due to sediment release	■ Appropriately qualified environmental consultant to confirm final landform meets closure design requirements	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.
SW2	Increased sediment load.	■ Progressive rehabilitation during mine life. ■ Sound design and understanding of the geotechnical properties.	No site-based soils assessment undertaken at site.	Soil assessment to be undertaken as part of PEPR preparation	■ No adverse impacts to offsite stormwater due to sediment release	■ Appropriately qualified environmental consultant to confirm final landform meets closure design requirements outlined	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
SW3	Surface water contamination.	■ TSF design and cover designed by suitably qualified engineer in accordance with best practice. ■ Understanding of chemical composition of tailings.	Detailed design will be undertaken as part of the PEPR.	TSF will need to be suitably designed to contain PAF material and minimise risk of AMD seepage.	■ Seepage from TSF does not degrade surrounding surface or ground water values quality or impact fauna that may use them.	■ EFA monitoring. ■ Surface water and groundwater assessment demonstrates compliance with relevant Environment Protection Policy (EPP) requirements. ■ EFA monitoring.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.
VA1	Decreased visual amenity due to change in landform and lack of vegetation.	■ Maintain vegetation cover on the landforms. ■ Final revegetation plan will consider success of previous revegetation trails. ■ Revegetate progressively wherever practical.	Revegetation occurs in favourable growing seasons and develops to be self-sustaining. Final landform can be achieved.	Seasonal variation and results of progressive rehabilitation	■ The view of the site reflects surrounding agricultural landscape.	■ Site contours reflect surrounding terrain and landform. ■ Site revegetation is maintained and meets resilient, self-sustaining criteria. ■ Appropriately qualified environmental consultant to confirm final landform meets closure design criteria	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



6.4.19 Summary table of outcomes with leading indicators

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_20	No adverse public health and/or nuisance impacts to local residents from air emissions and dust generated by processing operations.	Review of PM ₁₀ measurements demonstrates mining operations compliance with NEPM 1998 <50 µg/m ³ /year, with <5 days exceedance/year (Co, O).	Quarterly compliance.
S_21 S_22	Reduced native plant growth or abundance or reduced agricultural crop resulting from increased dust deposition resulting from mining operations	No increasing trend in community complaints regarding dust (Co, O).	All community complaints from the public regarding dust arising from the lease area addressed within 48 hours and assessed against the NEPM criteria.
S_23	No adverse public health and/or nuisance impacts to local residents from air emissions and dust generated by processing operations.	Records demonstrate that all operational vehicles and equipment used on lease areas have appropriate emission control devices (according to vehicle specifications) prior to commencement of use and at scheduled maintenance times (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.
S_24 S_25	No adverse public health impacts from air emissions generated by processing operations.	Stack emission rate for HF does not exceed 50 mg/m ³ Sampling in every 12 hour period of tailings from the Concentrate Upgrade Facility demonstrates pH is within the level specified in the PEPR	Maintenance records demonstrate scrubber is performing in accordance with specifications detailed in the PEPR Material balance in the CUF neutralisation circuit demonstrates neutralisation of HF
S_12	No adverse impact on public safety from failure of the TSF	Daily inspections are collated in quarterly report (O).	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment. Control room logs of on line monitoring of pipeline instrumentation demonstrate that all alerts are investigated and any resultant action carried out in accordance with the TSF 'Operation and Maintenance Manual'.
S13	Existing top and sub soil stockpile quality and quantity is maintained.	Daily inspections are collated in quarterly report (O).	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment. Control room logs of on line monitoring of pipeline instrumentation demonstrate that all alerts are investigated and any resultant action carried out in accordance with the TSF 'Operation and Maintenance Manual'.



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Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_14	No long term impact on local environmental values as a result of deterioration of surface water quality due to contamination.	An annual internal audit (intermediate and comprehensive) of the records from daily and weekly inspections of the tailings pipelines demonstrate that the TSF and associated infrastructure are operated in accordance with the TSF 'Operation and Maintenance Manual' and any resultant action carried out in accordance with the TSF 'Operation and Maintenance Manual' (O)	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment. Control room logs of on line monitoring of pipeline instrumentation demonstrate that all alerts are investigated and any resultant action carried out in accordance with the TSF 'Operation and Maintenance Manual'.
S_15	No fauna injuries and/or deaths from interactions with the TSF that could have been reasonably prevented.	All native fauna deaths or injuries on-site will be reported and an investigation will be undertaken to demonstrate it could not have reasonably been prevented (O).	Opportunistic observations of native fauna species recorded (fauna database) and collated annually for changes in populations and locations frequented within the ML.
S_10 S_11	No long term impact on local environmental values as a result of deterioration of surface water quality due to contamination.	Audits and inspection records demonstrate that waste is stored and correctly disposed and no evidence of waste disposed of on-site. Water quality in overflow dams will be monitoring during peak flow periods prior to being discharged on site	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment.
S_08	No adverse impact to groundwater quality caused by mining operations.	Monthly monitoring of groundwater bores Monthly seepage monitoring at TSF An annual internal audit of the spills register demonstrates that all spills of fuels, lubricant or other contaminate have been remediated in accordance with EPA requirements and that all spills greater than 20 L reported to appropriate regulator.	Quarterly correlation between monitoring and modelling results.
S_05 S_06	No significantly increased abundance or introduction of new weeds or pests, nor sustained increase in abundance of existing weed or pest species on the MPL or adjoining land (caused by processing operations).	Inspection of cleared areas for weed establishment indicates no increase in weed density or distribution compared to control sites (O).	Inspection records for vehicles and machinery show that all have been certified as clean before operating on site.
S_08	No sustained increase or introduction of new pest species on the mining lease compared to adjoining farms.	Annual review of records indicates that there has been no statistically significant in the abundance of pest species from baseline.	No trend of increased sightings of pest species.



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Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
S_16 S_18	Existing top and sub soil stockpile quality and quantity is maintained.	Annual survey and photographic records of soil stockpiles. Water quality in overflow dam will be monitored during and immediately following high rainfall events. Water quality in interceptor trenches will be monitored for the life of mine to ensure water quality meets needs for re-use on site.	Weekly visual inspection shows that separate topsoil and subsoil stockpiles are established and maintained.
S_17	Existing top and sub soil stockpile quality and quantity is maintained so that vegetation is self-sustaining and comparable to undisturbed surrounding area.	Annual survey and photographic records of soil stockpiles. Records indicate that compacted areas have been removed, or scarified and topsoil spread.	Records indicate that compacted areas have been removed, or scarified and topsoil spread.
S_35	No public injuries and or deaths from unauthorised entry to the mine site that could have been reasonably prevented by the lessee.	All unauthorised entries to the mine site are investigated and investigations demonstrate all reasonable and practical measures were in place to prevent entry (and injury, if applicable) (Co, O).	Any security issues will be reported within 24 hours
S_36	Reduced public safety from fire originating from the mine site resulting in injury and/or death.	No unplanned fires onsite, and ensure control measures are in place to manage potential offsite impacts (Co, O).	Any security issues will be reported within 24 hours
S_37	No increase in pest species as a result of the Project	Routine work inspections for hygienic waste management practice (O)	Quarterly waste management records; complaints register.



6.5 Proposed MPL Water Environmental Impact Assessment

To provide processing water to the MPL Sugarloaf, a combination of saline groundwater recovered from Pindari Wellfield and potable water from Jamieson Tank will be piped to the Sugarloaf property. The bore and two pipelines form the infrastructure for the MPL Water.

The Pindari Wellfield will comprise bores drilled in to fracture rock and will be located near the intersection of Ross Ramsey Road and Carapsee Hill Road. A submersible pump will be powered from grid power. There are currently no identified beneficial users of the Pindari Wellfield, however a comprehensive farmer-based survey will be undertaken and results presented in the PEPR to confirm that the proposed extraction does not unduly impact an existing user of the saline water resource.

Process water will be trucked to Sugarloaf during the small-scale start-up operation. For full scale production a pipeline will be installed from Pindari which will follow the alignment on the northern side of Carapsee Hill Road before crossing beneath the road and heading south across private property along an already cleared access track. The pipeline follows the western side of the fence line to Jamieson Tank Road (Figure 6-10).

The potable water pipeline will follow the approximately alignment of Jamieson Tank Road and will be buried within the road verge in accordance with Council standards. The South Australia Water Corporation (SA Water) has existing infrastructure in the area that provides mains water. SA Water's Jamieson Tank has sufficient water for the Project. SA Water and Pirie Resources signed a potable water supply agreement enabling 40 ML per annum rising to 80 ML per annum at Pirie Resources' election to be supplied from the existing Jamieson Tank water system.

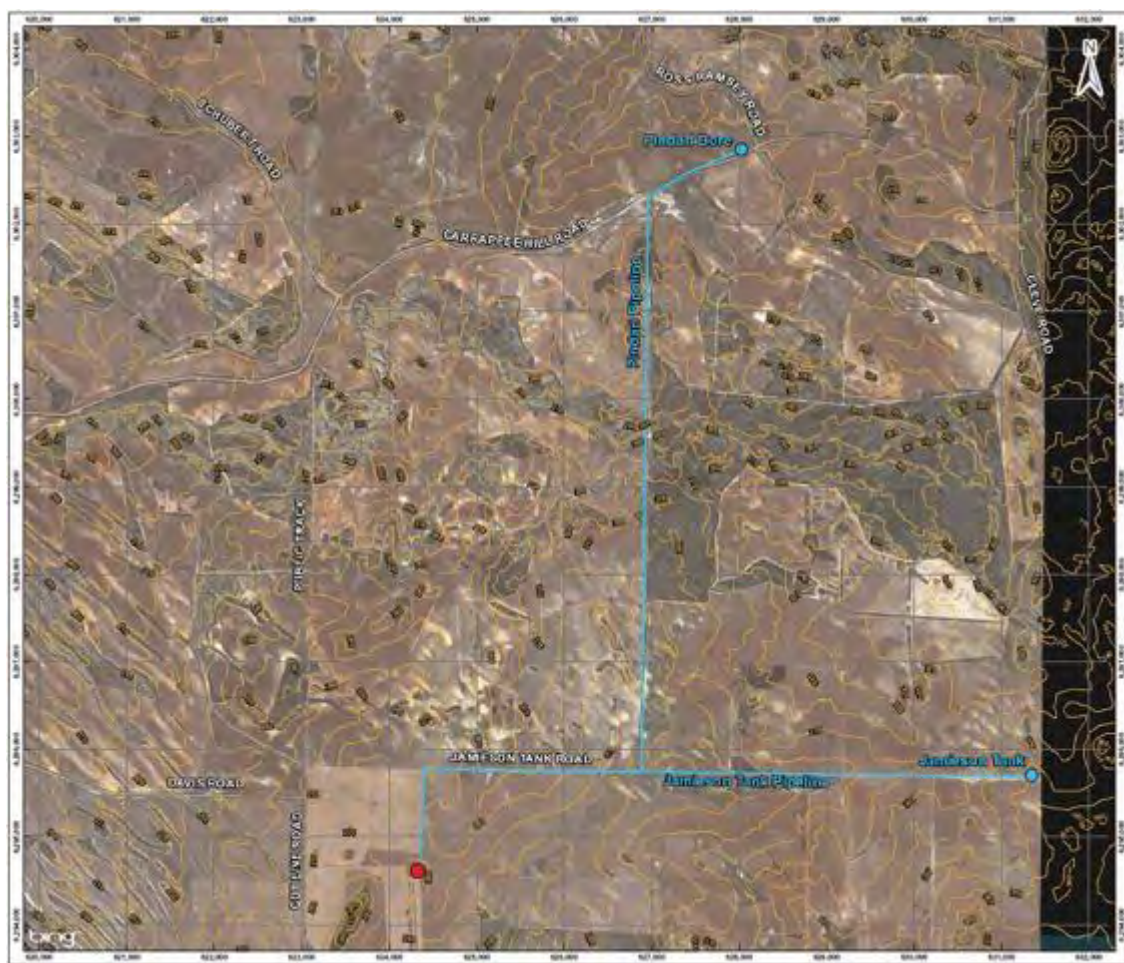


Figure 6-10 Pipeline alignments associated with the MPL Water



There are limited construction and operational works required for the MPL (Water) and the risks and interaction considerations include:

■ Visual amenity	■ Weeds
■ Noise through construction	■ Fauna
■ Dust and air quality	■ Pest species
■ Surface water	■ Topsoil and subsoil
■ Groundwater	■ Waste
■ Vegetation	■ Traffic and transport

Managing the risks of closure is also considered.

6.5.1 Visual amenity

The pipeline from Pindari Wellfield to the processing facility at MPL Sugarloaf runs through undulating country ranging from 280 m AHD elevation at Sugarloaf to around 210 m AHD towards the north and then rising to the east to the Pindari Wellfield which lies at approximately 245 m AHD.

The pipeline from Jamieson Tank follows the existing northern road verge of Jamieson Tank Road and then joins pipeline alignment from Pindari. Both pipelines will be placed underground as required by Council guidelines.

6.5.1.1 Context and views of affected parties

The Pindari Wellfield is located approximately 2.5 km west of a residence. The predominant land use within the potential impact area of the wellfield and pipelines is mapped as 'cropping'. The Pindari pipeline traverses small areas mapped as 'grazing' on modified pastures and 'other minimal uses' which includes residual native vegetation cover.

The Jamieson Tank pipeline also traverses small areas mapped as grazing on modified pastures.

As the infrastructure is low in scale, the impact of the MPL Water to visual amenity of the region is not considered further. At closure, it is possible that alternative uses may have emerged for the use of some or all of the infrastructure. In the absence of any such proposals at this stage, the base case for closure is that all infrastructure will be removed.

6.5.2 Noise

Modelling was undertaken based on the likely noise levels of equipment to predict noise levels associated with construction and operation at the wellfield (MPL Water). Noise predictions of the construction and operation have been made using the Conservation of Clean Air and Water in Europe (CONCAWE) noise propagation model in SoundPLAN.

The model used conservative assumptions, such as the unlikely scenario of all equipment operating simultaneously.

The model outputs identify that the project complies with EPA-derived noise limits at all sensitive receivers. Irrespective of this, Pirie Resources has committed to noise management measures to further reduce noise generated by the project.

6.5.2.1 Context and views of affected parties

Key stakeholders in relation to noise and vibration include EPA, DSD and SafeWork SA (ground vibration), DPTI (transport noise), as well as the adjacent community.

Noise differences (measured in dB) can be noticed with a 5 dB change. A 3 dB change is barely perceptible, with a 1 dB different imperceptible. An increase of 10 dB is considered to be twice as loud, while a 20 dB



increase is four times as loud. The noise level generated by a conversation within a metre of each person is in the range of 60 dB to 65 dB.

The two main noise measures used are dB(A) L_{eq} , which is the equivalent continuous noise level for describing the general noise level for noise that may fluctuate over time, and dB(A) L_{max} , which is the maximum sound level expected.

Based on the council zoning, the EPA has indicated the following noise limits will be applied:

- 52 dB(A) between the hours of 7 am and 10 pm, and
- 45 dB(A) between the hours of 10 pm and 7 am.

when measured and adjusted at noise sensitive receivers (such as nearby residences) in accordance with the Environment Protection (Noise) Policy. The noise criteria were established with reference to the relevant legislation and guidelines, consistent with leading practice in South Australia to ensure that the construction and operations do not unreasonably interfere with the acoustic amenity at the noise sensitive receivers.

6.5.2.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to noise include the following:

- *Environment Protection Act 1993*
- *Environment Protection (Noise) Policy 2007*
- *Guidelines for Separation Distances* (EPA 2007)
- The SA Department of Planning, Transport and Infrastructure's (DPTI) *Road Traffic Noise Guidelines* (RTNG) has been adopted to establish the project specific noise criteria for the road traffic noise from the proposed access road.
- Australian and New Zealand Minerals and Energy Council (ANZMEC) *Guidelines for blast overpressure and ground vibration for residential receivers* (ANZMEC 1995)

6.5.2.3 *Potential construction operation and closure impact/events*

Noise predictions were conducted to determine noise levels from the project at noise sensitive receivers in the vicinity and compared against the established noise criteria. Importantly, the assessment considered an unlikely worst case scenario for site operations in that:

- the plant was closest to receptors,
- weather conditions were conducive noise propagation and
- all equipment was operated simultaneously.

It is not expected that the predicted effects would be realised in real operational terms.

6.5.2.4 *Construction noise*

Construction works are not proposed to occur after 10pm or before 7am on any day.

The following equipment is likely to be used during construction works at the wellfield and associated pipeline. Sound power levels for equipment can be found in Appendix C:

■ Bulldozers	■ Compaction rollers
■ Excavators	■ Generator
■ Trucks	■ Generator for welding
■ Graders	■ Large side booms
■ Front end loaders	



General power tools and hand tools may also be used, although these are not expected to be significant sources of noise compared to the large plant and equipment listed above.

Table 6-71 summarise the noise modelling predictions, at various distances from the source. With the closest receptor being 2.5 km away, the noise generated during construction comply with the Noise Policy.

Table 6-71: Predicted construction activity noise levels - Pindari bore and pipeline

Construction Stage	Predicted Noise Level (dB(A)) at Various Setback Distances		
	at Pindari Bore and along pipeline		
Criterion (dB(A))	800 m	900 m	1800 m
Site preparation and earthworks	51	49	45
Borehole and completion works	49	48	43
Pipeline foundation works	50	47	44
Pipeline and equipment installation	49	48	43

Based on the expected equipment and their predicted noise generation, the model shows that construction noise at MPL Water does not unduly affect noise amenity at any sensitive receivers.

6.5.2.5 Control and management strategies

General measures

- Continual training of staff on site to good work practices and behaviours to control noise emissions from site.

Mobile plant

- To remove the annoying tonal characteristic of reversing beepers on mobile equipment, all mobile equipment will be fitted with broadband reversing beepers.
- Use low noise equipment and plant or noise reducing kits where possible.
- The use of berms or acoustic barriers to block line of site from the main haul routes to the residences.
- Avoid unnecessary revving of engines and switch off equipment when not required.
- Minimise drop height of materials (lowered and placed rather than dropped).
- Keep equipment enclosure panels closed.
- Regular maintenance of equipment and plant.

Stationary equipment

- Use barriers and acoustic enclosures where appropriate to block line of sight from the noisy equipment to the residences
- Consider low noise options or acoustic enclosures for compressors to limit the sound power to 100 dB(A).
- Regular maintenance of the equipment and plant.



6.5.2.6 Evaluation of residual risks

The results of risk levels determined in accordance with the risk assessment process are outlined in Table 6-72.

Table 6-72: Risk assessment of impacts from noise generated during construction and operation of the MPL (Water)

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_13	Disturbance to sensitive receptors due to construction noise from vehicles, equipment and plant operation.	Possible	Minor	Moderate	Compliance with EP (Noise) Policy. Compliance with Traffic Management Procedure. Locate noisy equipment at the greatest practical distance from sensitive receptors. Monitoring of noise and vibration impacts by complaints register. Maintain vehicle fleet in accordance with manufacturer's requirements. Ensure noise reduction devices such as mufflers are fitted and operating effectively.	Unlikely	Insignificant	Low



6.5.2.7 Justification for acceptance of residual risk

It is the opinion of Sonus that the MPL (Water) is able to operate at the site within the requirements of the Noise EPP and not cause nuisance noise to any existing sensitive receivers. The residual risk after implementation of management and control measures is considered unlikely, and the risk low to insignificant.

Monitoring total noise levels in dB measured as 24 hr continuous monitoring will be undertaken at sensitive receptors to show that construction activities do not exceed the EPA Noise Policy of <52 dBA during the day and <45 dBA during night time operations.

6.5.2.8 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-73):

Table 6-73: Environmental outcomes and measurement criteria – noise

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_13	No adverse public nuisance impact to sensitive receptors from construction noise emanating from the MPL.	Noise generated from the lease during construction, operation and closure activities, measured at sensitive receivers in accordance with the Environment Protection (Noise) Policy 2007, does not exceed the following noise limit (averaged over 15 minutes), at those sensitive receivers: - 52 dB(A) between the hours of 7am and 10pm and 45 dB(A) between the hours of 10pm and 7am within a Primary Production Zone (as delineated in the Cleve District Council Development Plan at the time of Lease grant). The above noise levels may only be exceeded if the Director of Mines: - is satisfied, on the basis of information provided to him by an acoustic engineer, that the noise will not cause an adverse impact at the sensitive receiver due to the existing influence of ambient noise, or the limited duration and/or frequency of occurrence of the activity; and - provides prior approval for the exceedance (C).	No increasing trend in noise and vibration complaints by either employees or receptors as a result of the project.

6.5.3 Dust and air quality

6.5.3.1 Context and views of affected parties

The proposed MPL (Water) is located in an area dominated by agricultural land uses and subsequently air quality issues are predominantly related to particulate matter (dust).

There are no known significant anthropogenic industrial sources of air pollution within the vicinity of the proposed site. There are unsealed roads surrounding the MPL site which are used by local residents accessing the surrounding towns and residences. These roads are suitable for light vehicle and semi-trailer traffic but not designed for road train truck haulage. With limited operational traffic associated with the MPL (Water), impacts are restricted to construction.



The local agricultural activities in the area may result in dust material being disturbed by activities such as ploughing, seeding, grain cropping and stock grazing in the greater project area. These activities have the potential to generate localised dust emissions.

6.5.3.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to air quality include the following:

- *Environment Protection Act 1993*
- *Environment Protection (Air Quality) Policy 1994*
- National Environment Protection Measure (Ambient Air Quality) (NEPM (AAQ)) goals to assess the impact of site operations and other existing sources on ambient air quality at sensitive receptors.
- *Guidelines for Separation Distances* (EPA 2007)
- EPA Guideline: Air quality impact assessment using design ground level pollutant concentrations (DGLCs) (EPA 2006).

The adopted standards/goals for this air quality assessment are presented in Table 6-74.

Table 6-74: Air quality goals

Pollutant	Average period	Goal	Exceedences allowed per year	Source
TSP	Annual	90 µg/m ³	n/a	NHMRC
PM ₁₀	24 hour	50 µg/m ³	5	NEPM
PM _{2.5}	24 hour	25 µg/m ³	n/a	NEPM
	Annual	8 µg/m ³		NEPM
Dust deposition	24 hour	4 g/m ² /month	n/a	NERDDC

6.5.3.3 Potential construction operation and closure impact/events

There is the potential for the MPL Water to increase dust generation and impact on air quality as a result of:

- heavy earthwork operations such as excavation and earth moving activities
- vehicle movements on unpaved roads
- wind-blown dust from freshly exposed areas
- handling, transfer and storage of materials

The impact of dust on nearby receptors that may be susceptible to changes in air quality have been identified as:

- residential properties and communities

The potential impacts could therefore be:

- Decrease in air quality resulting in human health impacts at neighbouring sensitive receptors from construction dust

6.5.3.4 Construction phase emissions

The maximum ground level concentrations (GLCs) at a sensitive receiver during construction are described in Table 6-75:



Table 6-75: Construction phase maximum predicted GLCs at a sensitive receptor

Pollutant	Average period	Maximum Predicted GLC ($\mu\text{g}/\text{m}^3$)	Location (UTM Coordinates)	Background GLC ($\mu\text{g}/\text{m}^3$)	Accumulative GLC ($\mu\text{g}/\text{m}^3$)	Goals
TSP	24 hours	28	638510,6289525	42	70	90
PM ₁₀	24 hours	16	638510,6289525	14	30	50
PM _{2.5}	24 hours	2.2	638510,6289525	7.0	9.2	25
	1 year	0.10		7.0	7.1	8

6.5.3.5 Control and management strategies

The following management measures will be adopted during construction and operations of the MPL Water:

Construction

- Limiting vehicle movements to designated entries and exits, haulage routes and parking areas.
- Use of water cart during construction to maintain damp conditions in high activity areas.
- Visually monitor dust and where necessary implement the following measures:
 - apply water to exposed surfaces that are causing dust generation when necessary;
 - pre-moisten material before excavating or clearing to reduce dust generation;
 - appropriately cover loads of fill on trucks transporting material to and from the construction site or water the surface to produce a natural crust. Securely fix tailgates of road transport trucks prior to loading and immediately after unloading;
 - prevent where possible, or remove, mud and dirt being tracked onto sealed road surfaces.
- Where practicable avoid or minimise dust generating activities (particularly clearing and excavating) during dry and extremely windy conditions.
- Limit the area and duration of exposed or unconsolidated areas. For example, stage vegetation stripping or grading where possible and, where practicable, apply vegetation mulch to soil stockpiles or surfaces left standing for extended periods.
- Revegetation activities should proceed as soon as practicable after construction activities are completed within a disturbed area.
- Construction plant and equipment should be well maintained and regularly serviced.

Operation

- Imposing speed restrictions to the MPL Water of 40 km/hr on haul roads.

Dust generated during operation will be from trucks carting water during the start-up phase and then occasional maintenance vehicles. It is unlikely that dust generated as a result of operations will be an impact event.

Procedures/plans will be developed and implemented to address dust and general air quality issues on site during construction and operation. They will include management requirements such as reporting and cessation of works in the event of extreme wind conditions.



6.5.3.6 Evaluation of residual risks

The risk levels determined in accordance with the risk assessment process are presented in Table 6-76.

Table 6-76: Risk assessment of impacts on dust and air quality

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_12	Dust affecting air quality at nearby sensitive receptors and general ambient air quality.	Possible	Minor	Moderate	Manage staged vegetation clearance and ground disturbance. Design the trafficable and working areas to be as small as possible. Implement vehicle speed restrictions and restrict traffic to dedicated formed roads. Implement dust suppression measures. Use a water cart to spray when required to minimise dust. Stabilisation and progressive rehabilitation of exposed areas. Cessation of works in the event of extreme weather and wind conditions.	Unlikely	Minor	Low



6.5.3.7 Justification for acceptance of residual risk

As a result of the proposed dust control measures, the residual risk to the community and sensitive receptors has been significantly reduced with the occurrence of any health impacts being considered unlikely and the residual risk low.

6.5.3.8 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-77):

Table 6-77: Environmental outcomes and measurement criteria – air quality

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_12	No adverse public health and/or nuisance impacts to local residents from air emissions and dust generated by construction operations.	No increasing trend in community complaints regarding dust (Co). Records demonstrate that all operational vehicles and equipment used on lease areas have appropriate emission control devices (according to vehicle specifications) prior to commencement of use and at scheduled maintenance times (Co).	All community complaints from the public regarding dust arising from the lease area addressed within 48 hours and assessed against the NEPM criteria.

6.5.4 Topography and landform

Topography of the area of the MPL (Water) is gently undulating, with elevation between 240 m Australian Height Datum (AHD) to 340 m AHD at the highest point. There will be no change to topography as a result of the works. This is not discussed further.

6.5.5 Surface water

Although there are no mapped water courses within the area of the wellfield and associated pipeline, there is a pathway to salt creek along Jamieson Tank Road and a wetland crossing south of Carapsee Hill Road.

An impact pathway therefore includes unintentional failure of the pipeline. This may cause sedimentation and erosion impacts.

6.5.5.1 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to surface water include the following:

- *Mining Act 1971*
- *Natural Resources Management Act 2004*
- *Environment Protection Act 1993*
- *Environment Protection (Water Quality) Policy 2003*
- Australian National Committee On Large Dams (ANCOLD), “Guideline on Tailings Dams – Planning, Design, Construction, Operation and Closure”, May 2012.



6.5.5.2 *Potential construction operation and closure impact/events*

Surface water flows across the site have the potential to collect, transport and release sediment laden water from the site originating from road and site works areas during construction. Potential impacts to the environment include:

- Sedimentation and erosion impacts from construction within the road shoulder.
- Pipeline failure during operation may increase in the sediment load in local watercourses and have subsequent impacts to flora and fauna.

6.5.5.3 *Control and management strategies*

Soil erosion and drainage management measures will be in place around all infrastructure to ensure offsite water quality is protected.

The likelihood and consequence may be reduced by implementing the following control and management strategies:

- diversion of up-slope surface water run-off during construction.
- design to include drainage control measures in key sensitive areas.
- regular visual inspections and maintenance of surface water control systems will be undertaken during construction immediately after rainfall events and remediated.
- monitor pipeline integrity.



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6.5.5.4 Evaluation of residual risks

Table 6-78: Risk assessment of impacts on surface water

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_08	Contamination of surface water and loss of environmental values due to erosion from construction activities.	Possible	Minor	Moderate	Design of roads to incorporate appropriate drainage (where practicable). Undertake visual inspections of surface water control systems immediately after rainfall events and remediate incidents by diverting flows appropriately and/or treating surface water (if required). A surface water quality monitoring program consistent with the risks will be developed and implemented during operations. Soil erosion and drainage management measures in place around all infrastructure.	Unlikely	Minor	Low
P_09	Pipeline failure causing release of sediment laden water from site operations.	Possible	Minor	Moderate	Pipeline integrity inspections A surface water quality monitoring program consistent with the risks will be developed and implemented during operations. Soil erosion and drainage management measures in place around all infrastructure.	Unlikely	Minor	Low



6.5.5.5 Justification for acceptance of residual risk

With the implementation of the above control and management measures it is unlikely that erosion and sediment discharge and impact on off-site areas would occur.

Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the water supply infrastructure (Table 6-79).

Table 6-79: Environmental outcomes and measurement criteria – surface water

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_08 P_09	No long term impact on local environmental values as a result of deterioration of surface water quality due to contamination	Audits and inspection records demonstrate that waste is stored and correctly disposed and no evidence of waste disposed of on-site (Co)	Inspection of drainage containment system after rain events that generate run-off confirms no loss of containment (Co)

6.5.6 Groundwater hydrogeology

6.5.6.1 Context and views of affected parties

Pirie Resources has established two wells at Pindari and demonstrated consistency between the pumping and recovery data.

Two wells were installed at Pindari in May 2014 and a third in March 2015 to assess whether the area could supply sufficient water to meet the expected full scale operational needs (i.e. ~100 ML/year of water to treat 140,000 tonnes of ore per annum). This Pindari location was selected as data available show that wells there have higher yields than recorded elsewhere near Campoona and that might usually be expected from groundwater in the region in general.

It is judged that the supply is expected to provide at least part of the project demand, but given the heterogeneous nature of the fractured rock aquifer system at Pindari, barrier boundaries are likely to be shown by longer term pumping than the 48-hour tests. Barrier boundaries would be formed by the limits of the fracture zone or zones that have been encountered in the test work at Pindari and they have the effect of increasing the rate of drawdown in the production wells. Drawdowns of a few metres at distances of 1 km, approximately, would be expected over time.

Using similar logic, the presence of such barrier boundaries reduces the risk of the wellfield affecting the degraded saline wetland in the area. A supplementary water supply is available from SA Water mains at Jamieson Tank (allocation of 40 ML/yr rising to 80 ML/yr if required).

A survey of landowners during community consultation revealed that groundwater in the area is highly saline and has low yield. For this reason, most landholders use mains for domestic water and dam water for stock watering. The salinity of basement rocks is variable and ranges from 1,500 mg/L to >50,000 mg/L TDS. Groundwater salinity data were also obtained from the government database. Based on the data available the local groundwater is saline, and the salinity is slightly lower immediately to the east and north of Sugarloaf. The data show that groundwater salinity in the area is generally higher than 10,000 mg/L TDS and up to 41,800 mg/L TDS.

Landholder discussions and interviews were carried out by Pirie Resources, with two questionnaires formally returned indicating that no groundwater was being used by those particular landholders. Based on the discussions and feedback, it is assumed that few landholders use groundwater. This is likely to be due to the lack of availability of good quality groundwater. In the Project area, the majority of the water for agricultural use is sourced from either local dams or SA Water mains supply.



There are 38 groundwater wells on the DEWNR WaterConnect database within 10 km of the Pindari pumping well installed in May 2014. Total drilled depths of the wells in the database search ranged from 1.2 m to 84 m. The uses of those wells that are still operational and are within 10 km of the Pindari pumping well are mostly for observation, but may also include some used for include stock watering and irrigation. Twelve of the wells listed in the Pindari search were identified as abandoned.

There are numerous areas of native vegetation (e.g. in drainage lines) with a low potential for groundwater interaction. These are not considered relevant in the context of potential groundwater-related environmental impacts and are not discussed further. The BOM GDE Atlas indicates there are two GDEs within a 10 km radius of the pumping well installed at Pindari in May 2014. The nearest GDE is already degraded and the other GDE is unlikely to be affected.

6.5.6.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to groundwater include the following:

- *Mining Act 1971*
- *Natural Resources Management Act 2004*
- *Environment Protection Act 1993.*

6.5.6.3 *Potential construction operation and closure impact/events*

The high level risk assessment identified the potential for pumping from the current wells to impact nearby existing wells and GDEs. The existence and use/significance of these potential receptors should be monitored.

The database search indicates that the closest operational wells are a private well located approximately 1.5 km west and observation wells (potentially associated with monitoring of the nearby GDE) located approximately 1.4 km southwest. Further investigation of these wells is needed to determine their current use, abstraction rates and allow assessment of whether the predicted groundwater level decline would pose a significant risk to the wells' operations.

The results of the initial risk assessment suggest that groundwater extraction at this rate may impact the nearby wells and the nearby GDE, though the GDE is already classified as degraded.

6.5.6.4 *Control and management strategies*

Potential impacts to local groundwater users would be mitigated by implementing the following control and management strategies:

- A groundwater monitoring program will be developed and implemented during operations to monitor potential impacts. Specifically, monitoring would include the discussions with the surrounding users.

Implementation of remedial action if there is a reduction in water supply attributable to the mine operations, which could include deepening of existing wells or provision of alternative water supply.



6.5.6.5 Evaluation of residual risks

Table 6-80: Risk assessment of impacts on groundwater

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_06	Reduction of groundwater for existing users of the Wellfield.	Rare	Insignificant	Low	A groundwater monitoring program will be developed and implemented during operations to monitor potential impacts. Specifically, monitoring would include the discussions with the surrounding users. Implementation of remedial action if there is a reduction in water supply attributable to the mine operations, which could include deepening of existing wells or provision of alternative water supply	Rare	Insignificant	Low
P_07	Reduction of groundwater available to maintain environmental values.	Possible	Minor	Moderate	A groundwater monitoring program will be developed and implemented during operations to monitor potential impacts.	Unlikely	Minor	Low



6.5.6.6 Justification for acceptance of residual risk

The residual risk is considered to be low. Management includes deepening operational wells that have been affected and result in a loss of agricultural production. Groundwater levels and availability in existing wells would return close to normal after mine closure.

6.5.6.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-81).

Table 6-81: Environmental outcomes and measurement criteria – groundwater

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_06 P_07	No reduction in water supply to existing users and environmental values as a result of water extraction for processing.	Annual records indicate no significant decrease in supply at third party extraction wells, or If decrease in supply occurs at a third party well, alternative water supply arrangements are provided to the third party to the satisfaction of the Director of Mines	Monitoring of drawdown levels at monitoring wells at the MPL boundary consistent with modelling predictions

6.5.7 Vegetation

Pirie Resources has undertaken three seasonal surveys in the broader project region and specifically at the project sites. Specific work was undertaken along the pipeline routes for MPL Water.

No species or communities listed under the EBPC Act or the NPW Act were recorded, nor were potential breeding sites for listed migratory species.

6.5.7.1 Context and views of affected parties

The proposed MPL Water is on a highly modified landscape that has been extensively used for agriculture. Survey work was undertaken on a regional level, and surveys undertaken specifically on the MPL (Water) site. There was reasonable quality native vegetation at the boundary of a property, and the pipeline route was realigned to protect the vegetation on the advice from ecologists.

No EPBC- listed species were found on site, nor any state threatened species. As such, there is no loss of listed vegetation at the Pindari site anticipated.

6.5.7.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to vegetation include the following:

- *National Parks and Wildlife Act 1972*
- *Native Vegetation Act 1991*
- *Natural Resources Management Act 2004*
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the Clearance of Native Vegetation Associated with the Minerals and Petroleum Industry (DWLBC 2005)*



6.5.7.3 *Potential construction operation and closure impact/events*

Although the infrastructure has been designed to be in cleared tracks and alignments, minor clearance is required. It is expected that less than 1 ha of degraded vegetation will be lost to facilitate pipelines associated with MPL (Water). A contribution to the Native Vegetation Fund is envisaged. Whilst the vegetation is degraded, Pirie Resources is willing to negotiate the SEB value between \$500 and \$3500 for the hectare loss.

6.5.7.4 *Control and management strategies*

The clearing of native vegetation and occasional loss of individuals cannot be practically avoided however the impact and consequences may be reduced by implementing the following control and management strategies:

- induction of site personnel to indicate areas of approved clearance/protection.
- design and layout of project components to areas that will require limited land clearance.
- implementation of a program for stage clearance ensuring clearance only occurs prior to and within designated clearance area.
- progressive rehabilitation of disturbed areas where practicable.
- a native vegetation management plan and mine rehabilitation and closure plan will be prepared and implemented.
- significant environmental benefit will be established for the project.



6.5.7.5 Evaluation of residual risks

Table 6-82: Risk assessment of impacts on vegetation

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_01	Isolated removal and/or pruning of vegetation along existing road reserves and track alignments to construct the pipelines and wells	Likely	Minor	Low	Demarcate areas with natural vegetation with bunding to prevent accidental losses	Unlikely	Insignificant	Low
P_02	Loss of individuals from threatened flora populations for construction of pipelines and wells.	Possible	Minor	Moderate	Implement mitigation measures that consider the following: Minimise the development footprint and vegetation removal. Demarcate areas with natural vegetation with bunding to prevent accidental losses.	Unlikely	Insignificant	Low



6.5.7.6 Justification for acceptance of residual risk

The proposed control and management measures should reduce the potential for long term consequence on abundance of vegetation communities at the regional level and local level.

Pirie Resources has minimised the development footprint and designed the mining infrastructure to avoid these areas. As such, the construction and operation works are designed to occur in the cleared and formerly farmed areas of each site.

Site clearance will require approval from DSD (delegate of the Native Vegetation Council). An offset project or payment into the NVC fund will be established as an SEB. Additionally, it is expected that vegetation in the affected areas will recover following completion of operations.

6.5.7.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-83).

Table 6-83: Environmental outcomes and measurement criteria – vegetation

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_01 P_02	No loss of abundance or diversity of native vegetation on the Land through; • clearance, • dust/contaminant deposition, • fire, • reduction in water supply, or • other damage, unless prior approval under the relevant legislation is obtained	Review of vegetation clearance permits indicates clearance has been authorised under the Native Vegetation Act, 1991 as per the Native Vegetation Management and Monitoring Plan..	No indicator required

6.5.8 Weeds

Pirie Resources has undertaken three seasonal surveys in the broader project region and specifically at the project sites and pipeline routes and identified that weed management will be required, with specific measures for Bridal Creeper. The residual risk of the Campoona Graphite Project proliferating weeds is deemed low as Pirie Resources has extensive weed controlling procedures on and off-site.

6.5.8.1 Context and views of affected parties

The landscape is dominated by weeds.

During the Campoona field studies completed in Spring 2012, 2013 and 2014, a total of six introduced species were recorded within the MPL (Sugarloaf) area.

Of these introduced species, one is classified as a declared weed species under either the State or Commonwealth legislation:

■ Bridal creeper (*Asparagus asparagoides*) (Weed of National Significance WoNS)

- Is considered to be a major threat to native plant communities, agricultural and forestry industries and communities.
- The berries are spread by birds, rabbits and foxes that feed on and later excrete the seeds. Movement of soil or dumping of garden rubbish containing Bridal Creeper seeds or roots can also spread the weed (CRC 2003 in Department of the Environment n.d.).
- Landholders are required by law to control WoNS growing on their properties.



6.5.8.2 *Applicable legislation and standards*

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to weeds and pathogens include the following:

- *Natural Resources Management Act 2004*
- *Natural Resources Management Plan for the Eyre Peninsula Natural Resources Management Region, Volume 2: Caring for our Resources* (EPNRMB 2009)
- *State Biosecurity Policy 2013-16* (PIRSA undated)
- *The Australian Weed Strategy: A national strategy for weed management in Australia* (NRMMC 2007a)

6.5.8.3 *Potential construction operation and closure impact/events*

Weeds are prevalent in native vegetation in both survey areas and dominate in many areas.

The establishment and operation of the Wellfield infrastructure and water pipeline infrastructure will result in minimal clearance of vegetation and disturbance of soil including the topsoil and subsoil. These conditions provide a competitive advantage to weed species and result in the spread of weed species to cleared areas. The movement of vehicles on the site could also result in spreading of weed species from one area of the site to another.

6.5.8.4 *Control and management strategies*

Establishment of weeds may be reduced by implementing the following control and management strategies:

- site induction to include identification of weed species
- implementation of a program for staged clearance; ensuring clearance occurs immediately prior to development and within designated areas, protect topsoil stockpiles from weed infestation
- active management and control of weeds in newly cleared areas
- earth moving machinery and equipment is cleaned prior to entering and leaving the site
- inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak

consultation with farmers to identify any further weed species and initiate shared programs of weed eradication in the region, particularly for *Asparagus asparagoides*.



6.5.8.5 Evaluation of residual risks

Table 6-84: Risk assessment of impacts from weeds

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_03	Soil disturbance during construction and operation of mine site results in an increase in the abundance of weeds and impacts on agricultural production.	Possible	Insignificant	Moderate	Site induction to include identification of weed species. Implementation of a program for staged clearance; ensuring clearance occurs immediately prior to development and within designated areas. Develop and implement weed mitigation measures that consider: ■ Working with NRM for monitoring, mapping and controlling Bridal Creeper (<i>Asparagus asparagoides</i>) populations in the project areas; ■ Controlling new weeds that are introduced in the project areas; ■ Rehabilitating disturbed areas as soon as practical. ■ Inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak. ■ Protect topsoil stockpiles from weed infestation. ■ Consultation with farmers to identify any further weed species.	Unlikely	Insignificant	Low
P_04	Movement of vehicles, machinery and equipment onto the site results in introduction of new weeds and impacts on agricultural production.	Possible	Minor	Moderate	Earth moving machinery and equipment is cleaned prior to entering and leaving the site. Inspect construction and operation areas for weed outbreaks after rainfall and regularly monitor areas with high potential for weed outbreak. Protect topsoil stockpiles from weed infestation. Consultation with farmers to identify any further weed species. Conduct regular flora and fauna site walkovers to confirm no increase in invasive species and abundance. Restrict traffic to established site roads. Monitor vegetation impacts.	Unlikely	Minor	Low



6.5.8.6 Justification for acceptance of residual risk

The proposed control and management measures that include limiting the extent of clearance and vegetation disturbance and the regular monitoring program and eradication of emergent weeds will reduce the likelihood for significant increases in the density and distribution of weeds.

6.5.8.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-85).

Table 6-85: Environmental outcomes and measurement criteria – weeds

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_03 P_04	No introduction of new species of weeds, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the MPL compared to adjoining land.	Inspection of cleared areas for weed establishment 12 months after rehabilitation has been completed indicates no increase in weed density or distribution compared to control sites (Co).	Complaints-based records.

6.5.9 Fauna

The historically cleared landscape associated with the Campoona Graphite Project limits the opportunity for fauna impact pathways. No EPBC-listed species were recorded onsite at MPL (Sugarloaf) and there is no suitable habitat for breeding that will be affected.

6.5.9.1 Context and views of affected parties

Fauna species diversity recorded in the project areas was 10 reptiles, 67 birds and nine mammals. No amphibian species was recorded in either project area.

- No fauna species listed as threatened under the EPBC Act was recorded in either survey.
- No reptile species protected by the NPW Act or EPBC Act was recorded during either survey.
- One species, Rainbow Bee-eater, listed as migratory under the EPBC Act, was recorded in November 2012. The project areas were found to potentially contain suitable breeding sites for this species but they were not deemed to represent significant breeding sites.

The project areas were found to support populations of the following state-listed (NPW Act) species:

- Purple-gaped Honeyeater (*Lichenostomus cratitius*), listed as rare and recorded in both the Campoona and Sugarloaf sites. Breeding activity outside both of the project sites is considered very likely for Purple-gaped Honeyeater given the presence of suitable mallee habitat.

6.5.9.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to fauna include the following:

- *National Parks and Wildlife Act 1972*
- *Natural Resources Management Act 2004*
- *Environment Protection and Biodiversity Conservation Act 1999*



6.5.9.3 Potential construction operation and closure impact/events

Within a regional context, project related clearing represents a minor and almost undetectable habitat loss and will occur in an area that is already highly degraded and fragmented. The small area of degraded habitat that will be cleared does not represent significant habitat for any species of conservation significance and impacts are expected to be inconsequential. The habitat values of this vegetation have been assessed and there is a very low risk that its values could be greater than expected. Consequently, it is not considered that any significant fauna values will be impacted by the proposed mining operations and, as a result, no further assessment or outcome is required.

6.5.10 Pest species

Four feral species were recorded during the comprehensive survey work. These species all require management under the *Natural Resources Management Act 2004* and Pirie Resources will implement pest species management procedures.

6.5.10.1 Context and views of affected parties

Foxes, cats, rabbits and house mice were recorded during the field surveys. These species are already established in the area and have negatively impacted native flora and fauna.

The key stakeholders are NRM EP and farmers in terms of potential impacts on pest species. No concerns have been raised by either stakeholder.

The community has not raised any concerns relating to pest species.

6.5.10.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to pest species include the following:

- *Natural Resources Management Act 2004*
- *Natural Resources Management Plan for the Eyre Peninsula Natural Resources Management Region, Volume 2: Caring for our Resources* (EPNRMB 2009)
- *State Biosecurity Policy 2013-16* (PIRSA undated)
- *The Australian Pest Animal Strategy: A national strategy for the management of vertebrate pest animals in Australia* (NRMMC 2007b)

6.5.10.3 Potential construction operation and closure impact/events

Disturbance and mining activities within the site, including rehabilitation works could attract and provide suitable conditions for the further spread of feral animals including herbivorous pests such as rabbits. The destruction of native flora by these feral animals could result in decreased vegetation cover and limit the success of revegetation and rehabilitation of the site. This is a short term construction activity. There are no means by which operations could encourage feral animals to an extent greater than any other properties in the area.

6.5.10.4 Control and management strategies

The impacts of introduced feral (pest) species can be reduced by implementing the following control and management strategies:

- designing and locating roads and drainage to reduce the potential for water pooling and providing a source of drinking water.
- undertake inspection of mine site areas likely to harbor pest species.
- implementation of a waste management plan to ensure no sources of food.
- liaise with NRM Board in relation to control and eradication measure.
- implement eradication programs.



6.5.10.5 Evaluation of residual risks

Table 6-86: Risk assessment of impacts from pests

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_05	Increases in feral animal populations through increased food and habitat associated with the MPL construction activities and storage practices.	Unlikely	Insignificant	Low	Develop and implement feral animal mitigation measures that consider: managing waste disposal and eliminating available waste food stuffs, as a result of human activities, to exclude cats and other feral animals; and destroying foxes, cats, rabbits and house mice in a manner consistent with adjoining landholders (as required by local NRM under legislation).	Unlikely	Insignificant	Low



6.5.10.6 Justification for acceptance of residual risk

Introduced species are currently present in the MPL and adjoining areas. The proposed control and management measures will provide for the control of feral (pest) species and the density and distribution is unlikely to increase significantly or to an extent that cannot be managed.

6.5.10.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-87).

Table 6-87: Environmental outcomes and measurement criteria – pests

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_05	No sustained increase or introduction of new pest species on the mining lease compared to adjoining farms.	Annual review of records indicates that there has been no significant in the abundance of pest species from baseline (O)	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.5.11 Topsoil and subsoil

Topsoil will be mounded and stabilised so that the potential for soil erosion and mobilisation of sediments in any run-off is limited.

6.5.11.1 Context and views of affected parties

The soil cover within the proposed MPL consists of sands to sandy clay loams that have been degraded by land clearing, grazing and cultivation for over a hundred years.

6.5.11.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to topsoil and subsoils include the following:

- *Natural Resources Management Act 2004*
- *Liquid Storage Guidelines: Bunding and spill management* (EPA 2012)
- *Site contamination: determination of background concentrations* (EPA 2008)
- *Guidelines for the site contamination audit system* (EPA 2010)
- *Composite soil sampling in site contamination assessment and management* (EPA 2005)
- *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM 1999).

6.5.11.3 Potential construction operation and closure impact/events

During the construction phase of the project there is potential for soil erosion from pipeline establishment activities.

Erosion is the process of soil removal with particles transported by wind or water. Erosion is particularly susceptible on slopes and soil stockpiles, especially during high rainfall events. The loss of topsoil from the stockpiles through erosion can result in reduced quantity available for rehabilitation. There is also potential for onsite erosion to generate an increase in the sediment load of surface run-off. This has been further addressed in Surface Water. If soil erosion is not properly managed, it could result in damage to soil structure; increased sedimentation in waterways; reduced efficiency of site drainage system and loss of top soil.



6.5.11.4 *Control and management strategies*

The MPL Water infrastructure footprint will be confined the mine footprint to as small an area as practicable to enable the abstraction of process water

The likelihood and consequence of soil erosion due to exposure of soils may be reduced by implementing the following control and management strategies:

- staged clearing to remove topsoils and subsoil from only the required footprint of the project components and undertake progressive rehabilitation and stabilisation.
- design will incorporate surface water drainage control measures to reduce erosion and sediment loss.
- regular inspections and maintenance of sediment and erosion control devices.
- operational activities will keep to established and designated track and work zones.

The likelihood and consequence of soil compaction may be reduced by implementing the following design and operational management measures:

- ensure all vehicles only use designated roads.
- removal of hardstand areas post-mining.
- scarifying compacted areas.
- spreading of topsoil.



6.5.11.5 Evaluation of residual risks

Table 6-88: Risk assessment of impacts on topsoil and subsoil

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_11	Soil erosion due to exposure of soils.	Likely	Minor	High	Minimise potential through staged clearing from only the required footprint and progressive rehabilitation. Strip topsoil and excavate subsoil only from those areas that will be disturbed by mining operations. Use erosion control techniques to protect stockpiles and minimise erosion and sediment loss. Select soil stockpile locations avoiding working areas, areas of natural drainage and on-site traffic routes. Regular inspections and maintenance of sediment and erosion control devices.	Possible	Minor	Moderate



6.5.11.6 Justification for acceptance of residual risk

Minimising land clearance, the separate stockpiling of topsoil and subsoil, progressive rehabilitation, revegetation and the proposed control and management measures will reduce the potential for loss of soil quality. On this basis that impact is considered to be insignificant and the residual impact low.

The removal of hardstand and other trafficked and compacted areas through implementation of the proposed management and control measures will minimise the impacts.

6.5.11.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-89).

Table 6-89: Environmental outcomes and measurement criteria – topsoils

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_11	Existing top soil quality and quantity is maintained.	Vegetation is self-sustaining and comparable to undisturbed surrounding area (Co)	Records indicate that compacted areas have been removed, or scarified and topsoil spread

6.5.12 Heritage

The proposed MPL (Water) area lies within the traditional territory of the Barngarla people. Barngarla Nation is the registered claimant for a Native Title claim over the proposed area. When Pirie Resources purchased the Wildhorse Plain EL 4693, it became a party to the existing Native Title Mining Agreement (NTMA).

6.5.12.1 Context and views of affected parties

There are a number of locations of State and Local Heritage significance to non-Indigenous cultural heritage located in the region although none are within the vicinity of the various project components. There are no previously recorded sites of significance to Indigenous archaeology, anthropology, history or tradition in the study area.

Ground disturbance activities have the potential to directly impact archaeological and/or anthropological sites of significance. However, the desktop review identified that the majority of the project footprint has minimal predictive archaeological sensitivity.

All Aboriginal archaeological sites, objects and remains in South Australia are protected by provisions of the *Aboriginal Heritage Act 1988*, regardless of whether they are located on freehold or crown land, which makes it an offence to collect, damage or destroy Aboriginal sites, objects or remains without the written authorisation of the Minister for Aboriginal Affairs based on consultation with the relevant Aboriginal community. Pirie Resources is committed to eliminating their risk of damaging or destroying any Aboriginal sites, objects or remains.

6.5.12.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to Indigenous and non-Indigenous cultural heritage values include the following:

- *Heritage Places Act 1993*
- *Aboriginal Heritage Act 1988*
- *Development Plan: Cleve Council* (DCC 2013)
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *Environment Protection and Biodiversity Conservation Act 1999.*



6.5.12.3 *Potential construction operation and closure impact/events*

Heritage desktop surveys over the proposed MPL (see Appendix H) did not identify any previously recorded sites of significance to Indigenous archaeology, anthropology, history or tradition in the study area. No intact sites have been identified due to the severely degraded nature of the area as a consequence of agricultural enterprises and environmental processes.

Ground disturbance activities have the potential to directly impact archaeological sites of significance. However, based on the heritage review, the majority of the project footprint has minimal predictive archaeological sensitivity. The likelihood of disturbing Aboriginal sites (without prior approval) is therefore considered unlikely in the proposed MPL Water area.

No European heritage sites have been identified within or around the proposed MPL Water area.

6.5.12.4 *Control and management strategies*

While there is no legal obligation under the Aboriginal Heritage Act to undertake a survey, Pirie Resources will proactively educate all staff to raise awareness and manage ground disturbing activities to ensure any archaeological sites, objects and remains, are not damaged, collected or destroyed.

The following control and management strategies will be implemented:

- undertake induction of personnel on responsibilities under the Act, procedures relating to ground disturbance and identified sites, and reporting requirements
- develop Aboriginal heritage management procedures in consultation with Barnjarla representatives with procedures to be implemented in the event a discovery is made. Protocol to also address statutory reporting requirements as per legislation
- restrict vehicle access to site access tracks and project roads to prevent damage to identified or unknown sites. Any Aboriginal Heritage sites will be clearly identified sites and, if required by the heritage management plan, designated as "no go" zones with prohibited access to these sites
- monitor the status of the heritage sites and implementation of the heritage management procedures
- establish and implement procedures should new sites be discovered during site works



6.5.12.5 Evaluation of residual risks

Table 6-90: Risk assessment of impacts on heritage

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_12	Disturbance to Aboriginal heritage sites.	Unlikely	Moderate	Moderate	Develop Aboriginal heritage management procedures in conjunction with Barngarla representatives with procedures to be implemented in the event a discovery is made. Protocol to also address statutory reporting requirements as per legislation. Restrict vehicle access to site access tracks and project roads to prevent damage to identified or un-known sites. Clearly mark identified sites and, if required, designate as "no go" zones and prohibit access to these sites. Monitor the status of heritage sites and implementation of the Aboriginal Heritage Management procedures. Establish and implement procedures should new sites be discovered during site works. Undertake induction of personnel on responsibilities under the Act, procedures relating to ground disturbance and identified sites, and reporting requirements.	Unlikely	Minor	Low



6.5.12.6 Justification for acceptance of residual risk

Ongoing awareness and management of the risks will be required during construction and operation to ensure unknown sites are not impacted. The proposed management measure should mitigate significant impacts.

Disturbance of aboriginal heritage sites will be unlikely as site clearance will have been undertaken of project components and no-go zones will have been identified.

6.5.12.7 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-91).

Table 6-91: Environmental outcomes and measurement criteria – heritage

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_12	No disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation has been obtained.	Records show that if an Aboriginal site or artefact is discovered that work ceases and appropriate procedures are followed approval sought under the <i>Aboriginal Heritage Act 1988</i> (Co). No incident reports relating to disturbance of heritage sites (Co).	Records indicate heritage management procedures in place.

6.5.13 Conservation areas

The Heritage Agreement Scheme is a program administered by the Native Vegetation Council that encourages landowners to conserve native vegetation on their properties and help to reverse the effects of over-clearance.

The Scheme was introduced because of concern over excessive native vegetation clearance in the agricultural region of the state. A Heritage Agreement is a private conservation area, established by agreement between the landholder and the Minister for Sustainability, Environment and Conservation.

A small section of the pipeline from Pindari to Sugarloaf runs adjacent to Heritage Agreement area (HA 569). No works are planned within the Heritage Agreement.

Another heritage agreement areas lies to the east of the eastern end of Jamieson Tank Road pipeline route (south of the road at Jamieson Tank, HA 877). The pipeline construction route avoids these areas.

6.5.13.1 Context and views of affected parties

There have been no concerns raised relating to the interaction between MPL (Water) and the existing Heritage Agreement.

6.5.13.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to Heritage Agreements include the following:

- *Native Vegetation Act 1991*



6.5.13.3 Potential construction operation and closure impact/events

There is no intent or requirement to enter the area under Heritage Agreement. Accordingly, there is no proposed vegetation removal, introduction of vegetation, grazing or introduction of fauna. Pirie Resources does not propose to undertake any of the prohibited activities associated with standard Heritage Agreements.

There is a risk that the areas under Heritage Agreement will be indirectly affected by abstraction of saline groundwater at the Pindari Wellfield. With wellfield water at salinities of 22,500 mg/L TDS and between 15 and 30 m below ground level, it is considered unlikely that the vegetation is dependent on the deep and salty water.

Pipeline failure is also considered as a risk event.

6.5.13.4 Control and management strategies

Potential impacts to the vegetation protected by the Heritage Agreement would be mitigated by implementing the following control and management strategies:

- A groundwater monitoring program will be developed and implemented during operations to monitor potential impacts. Specifically, monitoring would include the discussions with the surrounding users.

Implementation of remedial action if there is a reduction in water attributable to the mine operations, which could include deepening of existing wells or provision of alternative water supply.



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Table 6-92: Risk assessment of impacts on conservation

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_15	Reduced health of vegetation under Heritage Agreements through a reduction in groundwater resources.	Unlikely	Minor	Low	A groundwater monitoring program will be developed and implemented during operations to monitor potential impacts.	Unlikely	Minor	Low
P_16	Pipeline failure releases saline water into Heritage Agreement areas	Rare	Minor	Low	Fortnightly pipeline inspections will be undertaken. Surface water controls implemented and inspected after significant rainfall events. Pipelines will be immediately inspected should any reduction in water delivery be experienced	Rare	Minor	Low



6.5.13.5 Justification for acceptance of residual risk

With the implementation of the above control and management measures it is unlikely that off-site vegetation in the Heritage Areas will be impacted. The primary and residual risks are both low.

6.5.13.6 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-93).

Table 6-93: Environmental outcomes and measurement criteria – conservation

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_06 P_07	No reduction in water supply to existing users and environmental values.	Annual records indicate no significant decrease in supply at third party extraction wells (in adjacent landholder wells outside those immediately within the modelled cone of depression) (O). Monitoring of drawdown levels at monitoring wells at the MPL boundary consistent with modelling predictions (O).	No leading indicator criteria required because of the limited reliance on control strategies to reduce risk.

6.5.14 Waste disposal

The development of MPL (Water) may generate construction-based wastes such as waste oil, oil filters, oily rags, tyres, petrochemicals, chemical containers.

6.5.14.1 Context and views of affected parties

No concerns have been raised relating to waste management of the MPL (Water).

Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to waste management include the following:

- *Environment Protection Act 1993*
- *Liquid Storage Guidelines: Bunding and spill management* (EPA 2012).

6.5.14.2 Potential construction operation and closure impact/events

Hazardous materials such as waste oils, waste grease will be stored prior to pick up. If these wastes are incorrectly stored, the risk of a leak or spill occurring will increase, resulting in potential soil contamination. Minimal waste will be produced during operation as the only activities will be maintenance and monitoring.

6.5.14.3 Control and management strategies

Consumption of resources and materials is minimised as far as reasonably practicable. Waste management will be considered as a life cycle response from purchasing of the product up until when the product is no longer required to ensure all waste products are handled in a way that minimizes impact on the environment. In order to limit the amount of waste that requires to be sent to landfill it is important that when purchasing products, preference is given to:

- Products which are reusable
- Products which are recyclable
- Suppliers which recycle their products and packaging
- Suppliers who offer return of unused product



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- Suppliers who offer to collect used products or empty containers
- Suppliers of products with packaging minimisation programs.

All remaining wastes and recyclables will be disposed at off-site facilities, and landfill will be disposed of at EPA approved facilities.

During operations at the MPL, waste will be managed in accordance with a waste management plan. Further, Pirie Resources will:

- Ensure appropriate litter and rubbish bins/skips are available on site.
- Ensure rubbish bins and recyclable waste is removed by contractors as regularly as possible to minimise the risk of soil contamination and pest attraction.
- On-site hazardous wastes such as waste oils and used car batteries will be stored as per EPA bunding guidelines prior to disposal.
- Waste tracking forms will be required for all waste removed from site.



6.5.14.4 Evaluation of residual risks

Table 6-94: Risk assessment of impacts from waste

ID	Source, Pathway, Receptor	Primary Risk Level			Control and management measures	Residual Risk Level		
		L	C	PR		L	C	RR
P_14	Soil or water contamination due to incorrect waste disposal during construction.	Possible	Minor	Moderate	Controls in place such as bunding, skips and all facilities designed, constructed and maintained in accordance with the relevant legislation.	Unlikely	Minor	Low



6.5.14.5 Justification for acceptance of residual risk

With the described control measures in place, the residual risks for all of the other potential impacts associated with waste disposal on the proposed MPL are classified as low.

6.5.14.6 Proposed outcome(s)

Pirie Resources is committed to the following outcomes during construction and operation of the mine (Table 6-95).

Table 6-95: Environmental outcomes and measurement criteria – waste

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_14	No contamination and pollution is caused by waste products and their disposal during construction.	An annual audit of the waste disposal records of the volumes of putrescible and hazardous waste taken off-site demonstrate that the disposal of all potentially polluting waste has been taken to an approved EPA site and in accordance with the Waste Management Plan (Co).	NA

6.5.15 Traffic and transport

A proposed Wellfield at Pindari will be located near the intersection of Ross Ramsey Road and Carappee Hill Road approximately 9 km north of the MPL Sugarloaf processing site.

The pipeline will be buried as required and/or agreed during negotiations with the road authorities and property owners. The exact construction is not yet known.

6.5.15.1 Context and views of affected parties

No views relating to traffic associated with MPL Water have been raised. All works will be in accordance with DPTI and Council expectations.

6.5.15.2 Applicable legislation and standards

Primary national and South Australian legislation, standards, regulations, guidelines and policies applicable to traffic include the following:

- *Road Traffic Act 1961*
- *Dangerous Substances Act 1978*
- *Local Government Act 1999*
- *Roads (Opening and Closing) Act 1991*
- *Occupational Health Safety and Welfare Act 1989.*

6.5.15.3 Potential construction operation and closure impact/events

Construction of the pipelines will impact approximately 1.5 km of Carappee Hill Road to the west of Ross Ramsey Road.

Actual construction impacts need to be determined during planning of construction to identify the:

- Length and duration of road works zones as the pipeline is constructed along the roads.
- Parking areas for construction crew vehicles and plant and materials storage areas.
- Locations of road closures for road crossings.
- Access routes for construction vehicles and equipment.



Construction impacts of the pipelines will be daily during the duration of roadworks. Operational impacts will be periodical based on maintenance and inspection requirements.

6.5.15.4 Control and management strategies

Impacts will need to be identified during detailed design and construction planning. However, Pirie Resources will ensure that:

- site induction procedures, and training regarding local conditions if necessary, for all external driver to ensure safety standards and company expectations are met.
- all vehicle operators have appropriate licences.
- work with local farmers to ensure stock movements can be safely facilitated during mine construction and operations.
- negotiate with the District Council of Cleve for maintenance and upgrades of roads as required.

6.5.16 Closure

Closure criteria presented have been discussed with stakeholders but are preliminary. Closure criteria will be reviewed throughout the life of the mine. They will also be reviewed and revised to incorporate the results of trials and investigations, regulatory requirements, stakeholder consultation and any changes in mine operations or approaches to rehabilitation.



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Table 6-96: Closure outcomes and measurement criteria – Pindari

Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
WP1	Weed infestation and plant disease across the site post-closure.	- Any imported material will be certified before use as clean fill. - Ensure correct plant hygiene procedures are utilised during rehabilitation or import of clean fill/topsoil material is certified. - Implement vehicle and equipment wash down procedures to minimise risk of pathogen importation.	N/A	N/A	- Weed presence on site is commensurate with those in surrounding landscapes and Council area. - The site meets general landholder obligations and duty of care with regard to weeds.	An audit confirms the revegetated areas are free of declared weeds.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
V1	Increased dust emissions impacting vegetation health	■ Maintain vegetation cover on the landforms. ■ Revegetation undertaken during seasons conducive to successful vegetation establishment. ■ Any temporary stockpiled materials will be protected or wetted to prevent dust. ■ Vehicle movement around the site during rehabilitation will comply with existing speed limit and controls. ■ Rehabilitation species may be selected for drought tolerance. ■ Use established seeding techniques and soil conservation techniques. Seedling protection to be undertaken.	Revegetation occurs in favourable growing seasons and develops to be self-sustaining.	Seasonal variation and results of progressive rehabilitation	■ Vegetation is resilient, self-sustaining and reflective of the regional landscape and native vegetation values in closure domains identified for native vegetation as final land use.	■ Progressive rehabilitation occurs on areas no longer required for mining. ■ Ecosystem function analysis (EFA) monitoring for native vegetation.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
V2	Revegetation on rehabilitated areas is unsuccessful resulting in loss of ecological values and/or increase in soil erosion	- Species selection for rehabilitation will be chosen based on ability to achieve post-closure objective of self-sustaining vegetation. - Revegetation undertaken during seasons conducive to successful vegetation establishment. - Rehabilitation species may be selected for drought tolerance. - Use established seeding techniques and soil conservation techniques. - Seedling protection to be undertaken.	Revegetation species are similar to species within the surrounding area.	Results of progressive rehabilitation trials will confirm which species will be used in revegetation.	Vegetation is resilient, self-sustaining and reflective of the regional landscape and native vegetation values in closure domains identified for native vegetation as final land use.	An audit confirms all disturbed areas have been successfully revegetated as specified in the PEPR	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
GW5	Adverse change in ecological conditions as a result of uncontrolled release of groundwater	■ Decommissioning and capping of bores undertaken in accordance with all relevant Australian and South Australian standards.	N/A	N/A	Vegetation is resilient, self-sustaining and reflective of the regional landscape and native vegetation values in closure domains identified for native vegetation as final land use.	■ Decommissioning and capping of bores undertaken in accordance with all relevant Australian and South Australian standards.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.
GW6	Reduction in groundwater quality or quantity or surface water quality as a result of uncontrolled release of groundwater	■ Decommissioning and capping of bores undertaken in accordance with all relevant Australian and South Australian standards.	N/A	N/A	No reduction in groundwater quality or quantity or surface water quality as a result of uncontrolled release of groundwater	■ An audit confirms decommissioning and capping of bores has been undertaken in accordance with all relevant Australian and South Australian standards.	No leading indicator criteria (LIC) identified as there is not a high level of reliance on control strategies to reduce risk.



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Impact ID	Impact event	Control measures	Uncertainties and assumptions	Sensitivity to change of assumptions	Proposed outcome (acceptable level of impact/consequence)	Draft measurement criteria for Closure	Draft leading indicator criteria
PH1	Creation of hazards to the public and fauna if the condition of infrastructure deteriorates post closure	- All infrastructure is removed from the site - If it is agreed by the Director of Mines and the relevant landowner that some infrastructure will remain post mine completion, it will be left in a safe condition.	N/A	N/A	No adverse impact on public health or fauna from on-site infrastructure	Audit confirms all infrastructure has been removed from site or has been made safe.	
V1	Reduction in visual amenity for landowners and road users if waste material or remnants of infrastructure are left on site	- All infrastructure will be removed from the site - If it is agreed by the Director of Mines and the relevant landowner that some infrastructure will remain post mine completion, it will be left in a safe condition. - All waste material will be removed from site	N/A	N/A	No reduction in visual amenity from waste material or remaining infrastructure	Audit confirms all infrastructure has been removed from site or has been made safe. Audit confirms all other waste material has been removed from the site.	



6.5.17 Summary table of outcomes with leading indicators

Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_13	No adverse public nuisance impact to sensitive receptors from construction noise emanating from the MPL.	Noise generated from the lease during construction, operation and closure activities, measured at sensitive receivers in accordance with the Environment Protection (Noise) Policy 2007, does not exceed the following noise limit (averaged over 15 minutes), at those sensitive receivers: - 52 dB(A) between the hours of 7am and 10pm and 45 dB(A) between the hours of 10pm and 7am within a Primary Production Zone (as delineated in the Cleve District Council Development Plan at the time of Lease grant). The above noise levels may only be exceeded if the Director of Mines: - is satisfied, on the basis of information provided to him by an acoustic engineer, that the noise will not cause an adverse impact at the sensitive receiver due to the existing influence of ambient noise, or the limited duration and/or frequency of occurrence of the activity; and - provides prior approval for the exceedance (C).	No increasing trend in noise and vibration complaints by either employees or receptors as a result of the project.
P_12	No adverse public health and/or nuisance impacts to local residents from air emissions and dust generated by construction operations.	No increasing trend in community complaints regarding dust (Co). Records demonstrate that all operational vehicles and equipment used on lease areas have appropriate emission control devices (according to vehicle specifications) prior to commencement of use and at scheduled maintenance times (Co).	All community complaints from the public regarding dust arising from the lease area addressed within 48 hours and assessed against the NEPM criteria.
P_06 P_07	No reduction in water supply to existing users and environmental values as a result of water extraction for processing.	Annual records indicate no significant decrease in supply at third party extraction wells, or If decrease in supply occurs at a third party well, alternative water supply arrangements are provided to the third party to the satisfaction of the Director of Mines	Monitoring of drawdown levels at monitoring wells at the MPL boundary consistent with modelling predictions
P_03 P_04	No introduction of new species of weeds, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species on the MPL compared to adjoining land.	Inspection of cleared areas for weed establishment 12 months after rehabilitation has been completed indicates no increase in weed density or distribution compared to control sites (Co).	Complaints-based records.
P_11	Existing top soil quality and quantity is maintained.	Vegetation is self-sustaining and comparable to undisturbed surrounding area (Co)	Records indicate that compacted areas have been removed, or scarified and topsoil spread



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Impact ID	Outcomes	Measurement criteria	Leading indicator criteria
P_12	No disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation has been obtained.	Records show that if an Aboriginal site or artefact is discovered that work ceases and appropriate procedures are followed approval sought under the <i>Aboriginal Heritage Act 1988</i> (Co). No incident reports relating to disturbance of heritage sites (Co).	Records indicate heritage management procedures in place.



7.0 REFERENCES

This document has largely been informed by the research and studies presented in the appendices. Each appendix contains a reference list that has used literature to inform each topic. In addition to those reference lists, the following information has been cited in the Mining Lease Application and Management Plans main document:

ABS Census Data (2011) accessed from

<http://www.abs.gov.au/websitedbs/censushome.nsf/home/2011information?opendocument&navpos=310>

Australian Bureau of Statistics (2012), Mineral and Petroleum Exploration, Australia, December, (Cat. No. 8412.0). '2011 Census of Population and Housing: Cleve Time Series Profile'.

South Australian Centre for Economic Studies (SACES) (2012), "Economic Briefing Report", June, Vol 30 (2012), "Whyalla and Eyre Peninsula Regional Profile", commissioned by the Local Government Association of South Australia.

Bureau of Meteorology (2014) Weather Station Database. <http://www.bom.gov.au/climate/data/stations/> Accessed 2014.

Geoscience Australia (2012) Australian Atlas of Minerals Resources, Mines and Processing Centres, <http://www.australianminesatlas.gov.au/?site=atlas>.

Berens V., Alcoe D., and Watt E (2011) Non-prescribed Groundwater Resource Assessment – Eyre Peninsula Natural Resources Management Region, Phase 1 – Literature and Data review.

Shepherd, R.G. (1983) Underground water resources of South Australia. Geological Survey of South Australia, Bulletin 48.

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Harding, A., Henschke, C., Ciganovic, P. and Dooley, T. (2002) Eastern Cleve Hills Salinity Management Plan. Rural Solutions SA, Government of South Australia.

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Laut *et al.* (1977) Environments of South Australia. Compiled by Peter Laut. CSIRO Division of Land Use Research.

Twidale C.R., Tyler M.J. and Davies M. (1985) Natural history of Eyre Peninsula. Royal Society of South Aust

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South Australian Chamber of Mines and Energy (SACOME) *Industry Code of Practice for Community Engagement* (2012).



8.0 IMPORTANT INFORMATION

Your attention is drawn to the document – “Important Information”, which is included in Appendix U of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Forward Looking Statements

The information in this document is published to inform you about Archer Exploration Limited and its activities. Some statements in this report regarding estimates or future events are forward looking statements. Although Archer Exploration Limited believes that its expectations reflected in these forward-looking statements are reasonable, such statements involve risks and uncertainties and no assurance can be given that actual results and outcomes will be consistent with these forward-looking statements.

Competent Person Statement

Mineral Resource Statements

The Mineral Resources Statements shown in this document as a whole has been approved by Wade Bollenhagen who consents to its inclusion in the Annual Report in the form and context in which it appears. The exploration results and exploration targets reported herein, insofar as they relate to mineralisation, are based on information compiled by Mr Wade Bollenhagen, Exploration Manager of Archer Exploration Limited.

Mr Bollenhagen is a Member of the Australasian Institute of Mining and Metallurgy who has more than twenty years' experience in the field of activity being reported. Mr Bollenhagen has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity that he is undertaking to qualify as a Competent Person as defined in the 2012 Edition of the “Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves” relating to the reporting of Exploration Results. Mr Bollenhagen consents to the inclusion in the report of matters based on his information in the form and context in which it appears.

Campoona Shaft and Central Campoona

The information pertaining to the Campoona Shaft and Central Campoona Mineral Resource estimates were:

- detailed in an announcement entitled “Archer Exploration announces Australia’s largest JORC 2012 Graphite Resources”, lodged with ASX on 6 August 2014.
- prepared by Mr B Knell who is a Member of the AusIMM and peer reviewed by Dr C Gee who is also a Member of the AusIMM (CP). At the time of the report Mr Knell and Dr Gee were both time employees of Mining Plus Pty Ltd and both qualify as Competent Persons as defined in the 2012 Edition of the ‘Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves’.

Wilclo South

The information pertaining to the Wilclo South Mineral Resource estimate was:

- extracted from an announcement entitled “Maiden Wilclo South Graphite Resource”, lodged by Monax Mining Limited with ASX on 26 August 2013.
- prepared by Ms Sharon Sylvester who at the time of the report Ms Sylvester was a full time employee of AMC Consultants Pty Ltd and qualifies as a Competent Person as defined in the 2012 Edition of the ‘Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves’.



Confirmation by Archer

The Company confirms it is not aware of any new information or data that materially affects the information included in the original market announcements referred to above and, in the case of estimates of Mineral Resources, that all material assumptions and technical parameters underpinning the estimates in the relevant market announcements continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcement.



Report Signature Page

GOLDER ASSOCIATES PTY LTD

A handwritten signature in black ink, appearing to read 'L-C-A'.

Lissa van Camp
Principal Environmental Consultant

BT/LvC/hhh

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