HASTINGS
Technology Metals Limited

APPENDIX 6

Preliminary Mine Closure Plan

HASTINGS
Technology Metals Limited

30 January, 2017

Yangibana
Preliminary Mine Closure Plan

Emma Ryan Reid

Document	Prelim. MCP		**Division**	HSEC	**Status**	Approved	**Issued**	30/01/17
Number	HTML-ENV-EMP-00002		**Author**	ERR, MS	**Review Date**	29/01/17	**Version**	0

ACRONYMS AND ABBREVIATIONS

AER	Annual Environmental Report
ALARP	As Low As Reasonably Practicable
AMD	Acid and Metalliferous Drainage
ANZMEC	Australia and New Zealand Minerals and Energy Council
AN	Ammonium Nitrate
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
Bq/g	Becquerel per gram (measure of radioactivity)
BoM	Bureau of Meteorology
CCL	Compacted Clay Liner
CHMP	Cultural Heritage Management Plan
COS	Coarse Ore Stockpile
CTD	Central Thickened Discharge
DER	Department of Environment and Regulation
DFS	Definitive Feasibility Study
DMP	Department of Mines and Petroleum
DEE	Commonwealth Department of the Environment and Energy (formerly Department of the Environment)
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DRET	Department of Resources, Energy and Tourism (Cwlth)
EFA	Ecosystem Function Analysis
EGS	Environmental Group Site
EMP	Environmental Management Plan
EMS	Environmental Management System
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
GL	Gigalitre
GWL	Groundwater Licence
Ha	Hectare
HDPE	High Density Polyethylene
IAEA	International Atomic Energy Agency
IBRA	Interim Biogeographic Regionalisation for Australia
Km	Kilometre
m	Metres
mAHD	Metres Above Height Datum
mBGL	Metres Below Ground Level
MCA	Minerals Council of Australia
MCP	Mine Closure Plan
mg/L	Milligram per litre
MDL	Minimum Detection Limit
Mtpa	Million tonnes per annum
MW	Megawatt
NAF	Non-Acid Forming
NORM	Naturally Occurring Radioactive Material
OEPA	Office of the Environmental Protection Authority
PAF	Potentially Acid Forming
PEC	Priority Ecological Community
PMF	Probable Maximum Flood
REE	Rare Earth Elements
RIWI Act	Western Australian *Rights in Water and Irrigation Act 1914*
RO	Reverse Osmosis

ROM	Run of Mine
RWMP	Radiation Waste Management Plan
SRE	Short Range Endemics
SWMP	Surface Water Management Plan
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
TLD	Thermoluminescent Dosimeters
TO	Traditional Owner
TSF	Tailings Storage Facility
WC Act	Western Australian *Wildlife Conservation Act 1950*
WRC	Water and Rivers Commission
WRL	Waste Rock Landform
YMAC	Yamatji Marlpa Aboriginal Corporation

CHECKLIST

Q No	MCP Checklist	Y/N/NA	Page No.	Comments	Changes from Previous Version (Y/N)	Page No.	Summary
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company?	Y	VIII	Signed corporate endorsement following checklist			
PUBLIC AVAILABILITY							
2	Are you aware that from 2015 all MCPs will be made publicly available?	Y	-				
3	Is there any information in this MCP that should not be publicly available?	N	-				
4	If “Yes”, has confidential information been submitted in a separate document/ section?	-					
COVER PAGE, TABLE OF CONTENTS							
5	Does the MCP cover page include: Project Title Company Name Contact Details (include telephone numbers and email addresses) Document ID and version number Date of submission (needs to match date of this checklist)	Y	Front page				
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements)	Y	14	Submitted with the EPA Referral			
PROJECT OVERVIEW							
7	Does the project summary include: Land ownership details (include any land management agency responsible for the land / reserve and the purpose for which the land/ reserve [including surrounding land] is being managed) Location of the project; Comprehensive site plan(s); Background information on the history and status of the project.	Y	15-20				

Q No	MCP Checklist	Y/N/NA	Page No.	Comments	Changes from Previous Version (Y/N)	Page No.	Summary
LEGAL OBLIGATIONS AND COMMITMENTS							
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y	App A				
STAKEHOLDER ENGAGEMENT							
9	Have all stakeholders involved in closure been identified?	Y	27				
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y	App B				
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	26				
POST-MINING LAND USE(S) AND CLOSURE OBJECTIVES							
12	Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?	Y N	28	Preliminary closure objectives are to be finalised as part of ongoing stakeholder engagement. Conceptual landform designs have not been included as operational designs are still pending.			
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	Y	-	Nil identified			
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the *Contaminated Sites Act 2003*?	NA	-				
DEVELOPMENT OF COMPLETION CRITERIA							
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y	31	Preliminary completion criteria are included, to be further developed once closure objectives have been finalised as part of ongoing stakeholder engagement			

Q No	MCP Checklist	Y/N/NA	Page No.	Comments	Changes from Previous Version (Y/N)	Page No.	Summary
COLLECTION AND ANALYSIS OF CLOSURE DATA							
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y	36	A small number of baseline studies are pending			
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y	69				
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	N	-	Benchmarking will be undertaken during the detailed engineering phase of the Project			
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	81				
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	87	Preliminary, as detailed designs of TSFs, WRLs and pits are pending			
IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES							
21	Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	79				
22	Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?	Y	79				
CLOSURE IMPLEMENTATION							
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	87				
24	Does the MCP include a closure work program for each domain or feature?	Y	88				
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	N	-	Site layout has yet to be finalised, detailed disturbance figures will be included in the next revision			

Q No	MCP Checklist	Y/N/NA	Page No.	Comments	Changes from Previous Version (Y/N)	Page No.	Summary
26	Does the MCP contain a schedule of research and trial activities?	N	-	This schedule will be produced during the detailed engineering phase of the Project			
27	Does the MCP contain a schedule of progressive rehabilitation activities?	N	-	This schedule will be produced during the detailed engineering phase of the Project			
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	103				
29	Does the MCP contain a schedule of decommissioning activities?	N	-	This schedule will be produced during the detailed engineering phase of the Project			
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	N	-	This schedule will be produced during the detailed engineering phase of the Project			
CLOSURE MONITORING AND MAINTENANCE							
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?	Y	105				
FINANCIAL PROVISIONING FOR CLOSURE							
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	N	106	Assumptions are presented, methodology and provision will be included in the next revision			
33	Does the MCP include a process for regular review of the financial provision?	N	-	To be included in the next revision			
MANAGEMENT OF INFORMATION AND DATA							
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y	108				

Corporate endorsement:

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of the Department of Mines and Petroleum.

Name: Charles Tan Signed: _____

Position: Chief Operating Officer Date: _____

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

This preliminary Mine Closure Plan (MCP) has been developed to comply with the Department of Mines and Petroleum (DMP) and Environmental Protection Authority (EPA) (2015) *Guidelines for Preparing Mine Closure Plans.* The preliminary MCP is being submitted as a support document with a referral of the Yangibana Rare Earths Project (the Project) to the EPA. This document has been prepared by Ecoscape Australia on behalf of the Proponent.

Information within the MCP is relevant to the phase of Project, i.e. Definitive Feasibility Study (DFS). Closure planning commences during initial planning phases of a project. This MCP is a dynamic document and will be updated based on further studies and designs, changes in best practice, knowledge-base, mine plan and input from stakeholders. This MCP is designed to address factors which have been identified during the feasibility study phase. Future revisions of this document will address specific Project details (currently not determined) and identified knowledge gaps.

1.2 SCOPE

This MCP covers the activities associated with planned closure at the end of the currently proposed 7-year mine life. This MCP does not cover activities associated with the transport and processing of Rare Earth (RE) concentrate beyond the Project site.

This MCP comprises of the following key components:

- Project overview (section 2.0);
- Identification of closure obligations and commitments (section 3.0);
- Stakeholder engagement (section 4.0);
- Post-mining land use and closure objectives (section 5.0);
- Development of completion criteria (section 6.0);
- Collection and analysis of closure data (section 7.0);
- Identification and management of closure issues (section 8.0);
- Closure implementation (section 9.0);
- Closure monitoring and maintenance (section 10.0);
- Financial provision for closure (section 11.0); and
- Management of information and data (section 12.0).

2.0 PROJECT OVERVIEW

2.1 LAND OWNERSHIP AND TENURE

The Project is located within sixteen tenements (Table 1) obtained under the *Mining Act 1950*, comprising of a total area of approximately 4,936 Ha. The disturbance footprint is approximately 1,000 Ha within a mine activity envelope of 7,067 Ha. Figure 2 presents tenement boundaries, the mine activity envelope and proposed site layout.

Hastings holds tenements which form the Yangibana Rare Earths Project (the Project) under Hastings Technology Metals Limited and through its 100%-owned subsidiaries, Gascoyne Metals Pty Ltd and Yangibana Pty Ltd. Additionally, Hastings has a 70% interest in various tenements in joint venture with Mojito Resources Limited (30% ownership), which is subsidiary of Rare Earth Minerals Plc.

The underlying land tenure is pastoral lease, with the Project overlying Gifford Creek and Wanna Stations (both stations are owned by the same leaseholder, Mr Bill Biggs and previously formed the single lease Wanna Station).

Recently the combined Tiin-Mah Warriyangka, Tharrkari, Jiwarli submitted a native title claim (WC2016/003) (WAD464/2016) over the Project area and beyond. Hastings will negotiate any required mining agreements with the Native Title Claimants.

Table 1: Tenements of the Yangibana Project Environmental Group Site

Lease	Grant Date	Expiry Date	Area (Ha)	Holders
G09/13	Pending		277.20	Gascoyne Metals Pty Ltd (70%), Mojito Resources Limited (30%)
G09/14	Pending		286.08	Gascoyne Metals Pty Ltd
G09/16	Pending		389.83	Yangibana Pty Ltd
G09/XX^	Pending		629.50	Yangibana Pty Ltd
G09/YY^	Pending			Yangibana Pty Ltd
L09/66	6-May-2016	5-May-2037	108.13	Gascoyne Metals Pty Ltd
L09/67	8-Dec-2015	7-Dec-2036	6.79	Gascoyne Metals Pty Ltd
L09/78*	Pending		82.00	Gascoyne Metals Pty Ltd
L09/79*	Pending		34.01	Gascoyne Metals Pty Ltd
L09/80*	Pending		232.87	Gascoyne Metals Pty Ltd
M09/157	1-Jul-2015	30-Jun-2036	289.00	Gascoyne Metals Pty Ltd
M09/158	1-Jul-2015	30-Jun-2036	535.00	Yangibana Pty Ltd
M09/159	1-Jul-2015	30-Jun-2036	1,469.83	Gascoyne Metals Pty Ltd (70%), Mojito Resources Limited (30%)
M09/160	17-Nov-2015	16-Nov-2036	234.17	Gascoyne Metals Pty Ltd
M09/161	25-Feb-2016	24-Feb-2037	313.10	Gascoyne Metals Pty Ltd (70%), Mojito Resources Limited (30%)
M09/162	25-Feb-2016	24-Feb-2037	47.95	Yangibana Pty Ltd
Total Proposed Tenement Area (Ha)			4,936	

Note: * Tenement L09/78, L09/79 and L09/80 will require re-alignment due to stakeholder and hydrological considerations, therefore areas provided in the above table may change.

^ Submission of application for two general purpose tenements is proposed.

Key contact for the Yangibana Project:

Charles Tan
Chief Operating Officer
Hastings Technology Metals Ltd
C/o Wave International
306 Murray Street
Perth Western Australia 6000
Telephone: 0457 853 839
Email: Charles.Tan@hastingstechmetals.com
PO Box 7085
Cloisters Square Western Australia 6850

Postal and phone details for the Yangibana mine site:

Wanna Station
Upper Gascoyne WA 6705
Telephone: +61 8 9943 0576

2.2 PROJECT LOCATION

The Project is located 270 kilometres (km) east-northeast of the town of Carnarvon and approximately 100km northeast of Gascoyne Junction on Wanna Station and Gifford Station in the Gascoyne Region of Western Australia (Figure 1). The Project lies within the Gascoyne Mineral Field.

2.3 OVERVIEW OF OPERATIONS

2.3.1 Mineral Resource

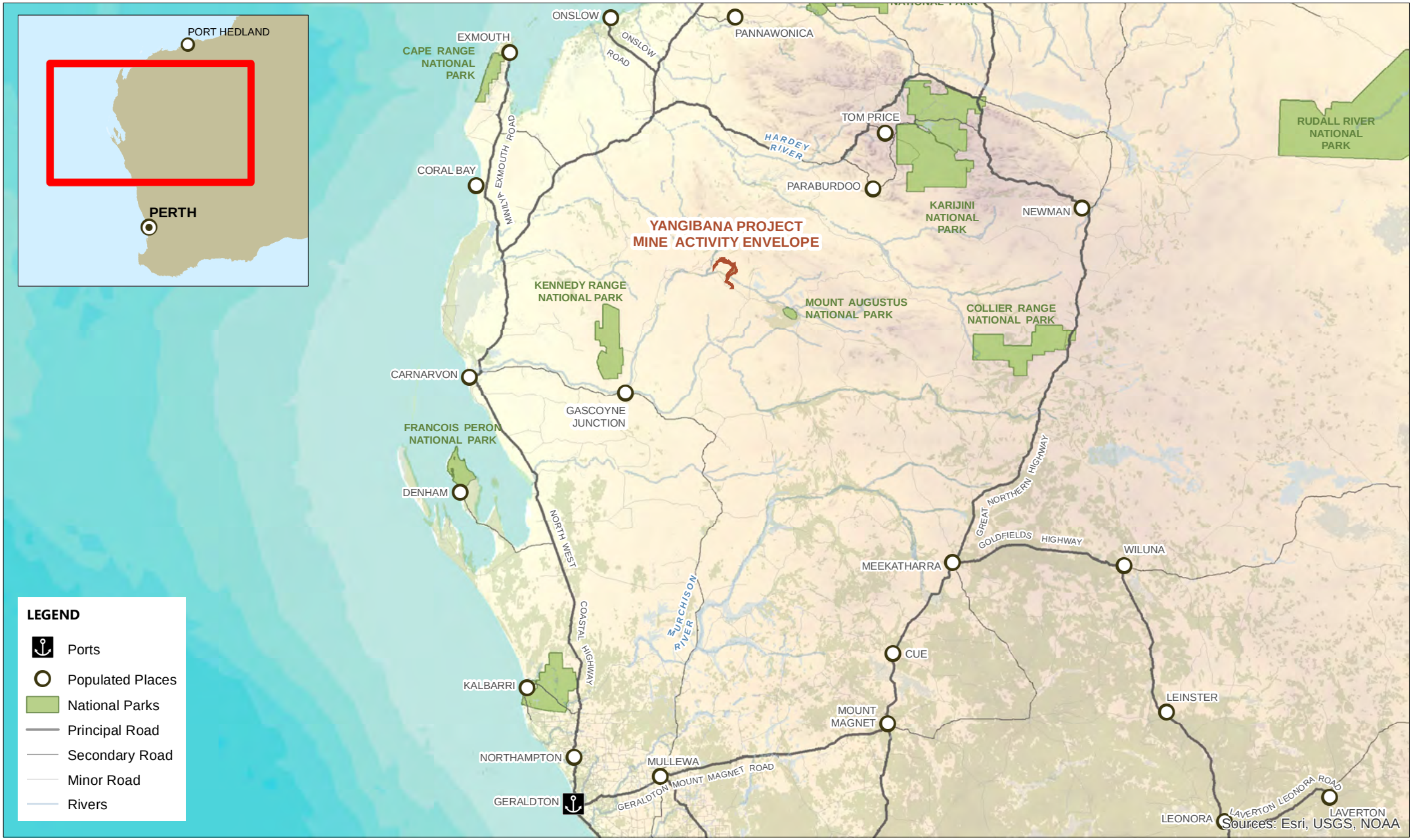
There are four deposits (Yangibana North, Yangibana West, Bald Hill and Fraser's) within the Project area containing economic quantities of rare earth elements (REE) in a monazite ore. The monazite is rich in REE, of which neodymium, praseodymium, dysprosium and europium are most valuable. These elements are primarily used in the industrial metals markets for the production of magnet and advancing technologies in electric vehicles, wind turbines, robotics, and digital devices, to name a few.

2.3.2 Mining

The ore bodies will be mined using conventional open pit methods of drill and blast, load and haul. Proposed depths of open pits range from 70 metres below ground level (mBGL) at Bald Hill, and 95 mBGL at Yangibana and Fraser's. The largest pit will be Yangibana, which comprises of two deposits - Yangibana North and Yangibana West.

Deposits will require dewatering prior to mining. Depth to groundwater within deposits ranges from 6 mBGL to 30 mBGL. Groundwater will likely be abstracted via groundwater production bores, and where possible from in-pit sumps, into transfer dams prior to being distributed to different storage locations around the Project for use in ore processing, dust suppression and potable water uses.

Mine waste rock will be generated throughout the mining phase of operations. The ratio of ore to waste rock will vary depending on the deposit and the depth of mining, with less waste rock produced with depth. The proposed annual mining rate is approximately 8 million tonnes per annum (Mtpa), of which 1 Mtpa will be ore. Four Waste Rock Landforms (WRLs) will be constructed adjacent to the source open pit. WRLs will be reshaped during the rehabilitation phase of the operation to meet final landform design parameters. The proposed maximum height of WRLs is up to 30-40 metres above the natural surface.



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COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	SB	JN	13/12/2016

N

0 50 100 150 km

REGIONAL LOCATION OF THE YANGIBANA PROJECT

YANGIBANA RARE EARTHS PROJECT
CLIENT: HASTINGS

FIGURE 01

410100 420100 430100

7359970 7349970 7339970

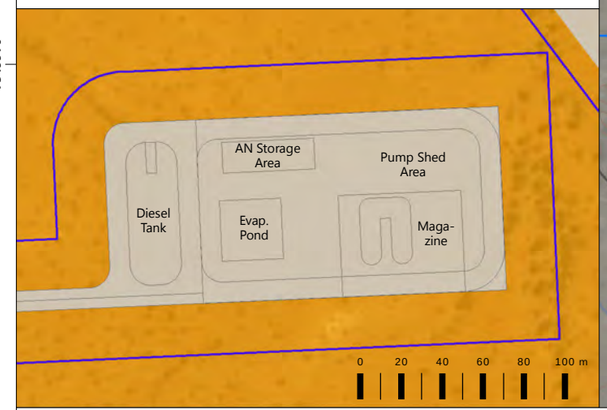
NOTE:
L 09/78, L 09/79 and L 09/80 will be realigned to meet stakeholder

ROCK HOLE CREEK
DINGO CREEK
ULLAWARRA ROAD
EDMUND RIVER
YANGIBANA CREEK
LYONS RIVER
FRASER CREEK
GIFFORD CREEK
PIMBYANA CREEK
ELLIOT CREEK
BOLTON CREEK
COBRA GIFFORD CREEK ROAD
WANNA ROAD

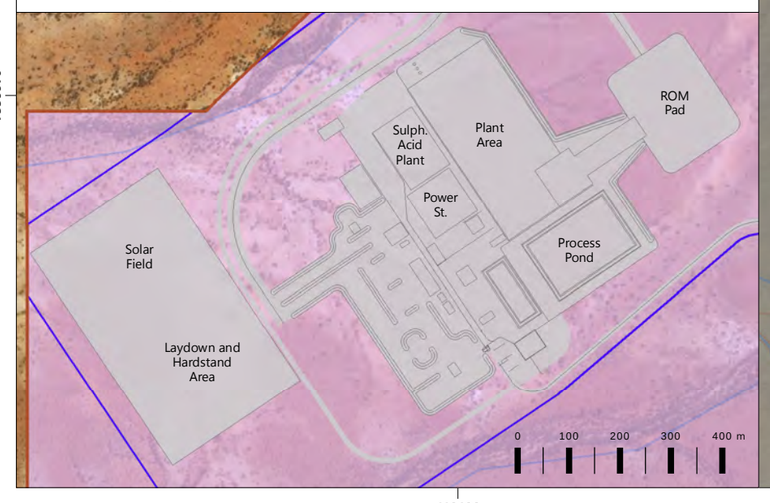
Waste Rock Landform
G 09/13
M 09/160
Pit
Waste Rock Landform
L 09/66
Pit
Waste Rock Landform
YANGI-BANA
M 09/159
Haul Road
Access Road
M 09/162
M 09/161
Pit
BALD HILL
L 09/67
Waste Rock Landform
Waste Rock Landform
M 09/157
Processing Plant
See Plant Enlargement
G 09/14
See Magazine Enlargement
G 09/16
Landfill
TSFs
Pit
Waste Rock Landform
L 09/79
M 09/158
FRASERS
Camp
L 09/80
Airstrip
GIFFORD CREEK HOMESTEAD
Access Road
L 09/78

350 400 450

MAGAZINE ENLARGEMENT



PLANT ENLARGEMENT



LEGEND

- Homestead
- Roads
- Rivers
- Creeks
- Contours 10 m
- Mine Activity Envelope
- Disturbance Envelope
- Infrastructure Footprint

Project Tenements

- Mining Lease
- General Purpose Lease
- Miscellaneous Lease

DATA SOURCES:
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

ecoscape

SITE PLAN OF THE YANGIBANA PROJECT

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:130,000 @ A3

0 1 2 3 4 5 km

PROJECT NO: 3420-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	27/01/2017

FIGURE 02

2.3.3 Processing

2.3.3.1 Beneficiation

The initial phase of processing occurs within the beneficiation plant. This consists of conventional processes to remove economic materials and increase the REE concentrations. This process includes:

- Crushing circuit;
- Grinding in SAG mill and/or ball mill;
- Flotation circuit to produce a mineral concentrate; and
- A regrind mill.

The beneficiation mineral concentrate will represent approximately 3% of the incoming ore mass. The remaining 97% comprising barren material, which will be disposed of in Tailings Storage Facilities (TSFs). The beneficiation concentrate will undergo further processing in the hydrometallurgical plant.

Key reagents used in the beneficiation process include:

- Sodium hydroxide;
- Sodium silicate; and
- Fatty acid collector.

2.3.3.2 Hydrometallurgy

The hydrometallurgical plant will continue processing the concentrate to remove residual materials such as iron, phosphate, aluminium, uranium and thorium (and their decay products) and produce a mixed RE carbonate. The process includes:

- Acidification and roasting of the mineral concentrate to crack the mineral structure;
- Water leaching to bring metals into solution;
- Purification and ion exchange to remove impurities;
- Precipitation of rare earths carbonate product; and
- Neutralisation of waste streams prior to disposal in a TSF.

Approximately 12 - 13,000 tpa of mixed rare earth concentrate will be produced.

The key reagents required for the hydrometallurgical plant include:

- Sulphuric acid;
- Ammonium or sodium bicarbonate;
- Quick lime slaked to hydrated lime;
- Limestone;
- Magnesium oxide; and
- Sodium hydroxide (caustic soda).

The process water generated from the hydrometallurgical plant cannot be reused in the plant due to reagent solutes, and as such this water (~480,000 m^3/annum) will be disposed in an evaporation pond.

2.3.4 Tailings Disposal and Storage

Three separate processing tailings streams will be deposited in distinct TSFs. Table 2 summarises preliminary chemical and physical characteristics, source and disposal location of each tailings stream. Table 3 summarises the TSF operational design features.

Table 2: Source, Disposal and General Characteristics of Tailings Streams

Processing source	Tailings mass (%)	Annual rate (tpa)	Physical processing	Chemical properties	Radionuclide properties	Disposal
Beneficiation	95.0%					
1. Rougher circuit	91.0%	932,100	Crushed and milled ore, flotation	Trace flotation reagents; pH 10-11.5	<1 Bq/g (head of chain)	TSF 1
2. Cleaner circuit	4.0%	37,200	Crushed and milled ore, flotation	Trace flotation reagents; pH 10-11.5	~7 Bq/g (head of chain)	TSF 2
Hydrometallurgical	5.0%	56,000	Acid Heating Water leach Neutralisation and waste removal Thickening	Trace sulphuric acid; U and Th; Iron phosphates; Aluminium; Gypsum; Metal hydroxides; pH 7-8	~24 Bq/g (head of chain)	TSF 3
TOTAL	100%	1,025,300				

Table 3: Summary of Proposed TSF Operational Design Features

Design Feature	TSF 1	TSF 2	TSF 3
Proportion of tailings	91%	4%	5%
Maximum height (m)	6 metre perimeter embankments; Tailings stack 15 metres	6 metre perimeter embankments; Tailings stack 15 metres	6 metre perimeter embankments; Tailings stack 15 metres
Area (Ha)	100 Ha	8 Ha	9 Ha
Number of cells	1	1	1
Construction	Downstream perimeter embankment raising	Downstream perimeter embankment raising	Downstream perimeter embankment raising
Discharge method	Single Point Central Thickened Discharge (CTD)	Perimeter spigots	Perimeter spigots
Lining	Proof compacted basal clayey sand layer	High Density Polyethylene (HDPE) / other and compacted clayey sand	HDPE / other and compacted clayey sand
Encapsulation	Nominal dust control cover/ erosion protection; growth medium (soil and rock armour)	HDPE / compacted clayey sand base; HDPE / compacted clay liner (CCL) engineered capping with growth medium. Design in accordance with IAEA safety standards to provide safe containment of NORM for periods beyond the extent of institutional control	HDPE / compacted clayey sand base; HDPE / CCL engineered capping with growth medium. Design in accordance with IAEA safety standards to provide safe containment of NORM for periods beyond the extent of institutional control
Leak detection	Downstream groundwater monitoring bores	Downstream groundwater monitoring bores	Downstream groundwater monitoring bores; Underdrain detection between compacted clay and HDPE liners with sump

Note: IAEA – International Atomic Energy Agency
NORM – Naturally Occurring Radioactive Material

2.3.5 Support Infrastructure

2.3.5.1 Power Supply

The anticipated total annual power requirements for the Project will be 12 Megawatt (MW). Power requirements to the processing plant and associated infrastructure are anticipated to be in the order of 10 MW per annum, predominantly supplied through solar energy, with five diesel generator sets providing approximately 20% of power supply. Power supply for the accommodation facilities will be supplied by diesel generator sets located adjacent to the accommodation facilities.

2.3.5.2 Water Supply

The estimated annual water demand for the Project is up to 2.5 gigalitres (GL) per year, the majority of which will be supplied by groundwater. Mine dewatering will supply all water requirements initially, however, a borefield will also be developed to meet water demands. Water reuse will occur within the processing plant (TSF1 and TSF2 decant water) and for dust suppression from the washdown pad. The majority of the water demand will occur from ore processing, with minor volumes required for dust suppression, fire protection, equipment washdown and potable uses across the Project. Raw water will undergo necessary treatment through a Reverse Osmosis (RO) plant to meet potable water quality parameters.

2.3.5.3 Other Infrastructure

Access to the Project will be via the Cobra-Gifford Creek Road. Works to upgrade some sections of Shire of Upper Gascoyne roads (i.e. Cobra-Dairy Creek Road) will be required to establish a safe and reliable route for transport of reagents, fuel and other consumables to site, and transport of concentrate to port for export. Existing facilities at the port will be utilised and transport from port will occur on container ships via existing ship loading facilities and shipping lanes.

An aerodrome and accommodation facilities will be located approximately 10 km south-southwest of the processing plant. The accommodation facilities will allow for an estimated peak workforce of up to 200 people during construction, and 180 people during operations. Single storey accommodation blocks are proposed, with laundry, mess and recreational facilities.

Additional infrastructure includes a landfill for putrescible and industrial waste, contaminated waste facility, sewage treatment plants, water transfer infrastructure, communications tower, power infrastructure, bulk diesel tank farm and an explosives magazine.

2.4 LAYOUT AND FEATURES

The preliminary proposed layout and land disturbance of the Project is presented in Figure 2. As the Project is at DFS stage the detail required to meet Schedule 1 of the *Mining Rehabilitation Fund Regulations 2013* will be provided in the next revision of the MCP, following finalisation of the site layout. Figure 2 (insets) presents detailed layout of the processing plant and explosives magazine.

To facilitate effective mine closure planning, the Project has been divided into a number of physically distinct domains and features. Domains contain features that have similar rehabilitation and closure requirements. The estimated area of each feature is summarised in Table 4. The total land disturbance footprint associated with the Project is estimated to be 1,000 hectares (Ha).

Table 4: Proposed Land Disturbance associated with Project Domains and Features

Domain	Feature	Area (Ha)
Landforms	TSF 1 – rougher tails (and decant pond)	105.01
	TSF 2 – cleaner tails	8.21
	TSF 3 – hydrometallurgical tails	9.36
	Bald Hill WRL	140.79
	Fraser's WRL	94.50
	Yangibana WRL	221.39
	Run of Mine pad (ROM) (including Coarse Ore Stockpile (COS) and Low-grade Stockpile)	3.94
Final Voids	Bald Hill Open Pit	33.03
	Fraser's Open Pit	11.70
	Yangibana Open Pit	50.09
Processing Plant	Plant Site including: - Crushers - Sulphuric Acid Plant and Sulphuric Acid Stockpile - Lime Storage Silos - Diesel Power Station - Tailings / Decant Return Pipelines - Plant Workshop - Metallurgical Assay Laboratory - Truck Tyre Wash - Core Shed and Yard	TBC
Industrial Infrastructure	Fuel Storage (including Fuel Farm)	TBC
	HV Workshop and Warehouse, including Lube Storage and Warehouse	TBC
	Freight Laydown, including Laydown and Hardstand	TBC
	HV Washdown and Drying Bed	TBC
	Go-Line and car parks	TBC
	Explosives Magazine and Ammonium Nitrate (AN) Yard	TBC
	Solar Field	TBC
	Landfill and Waste Transfer Station	TBC
	Sewage Treatment Plants (irrigation)	TBC
Water Infrastructure	Borefield and water pipelines	TBC
	Raw Water Storage Pond	TBC
	Yangibana Creek Diversion bund	TBC
	Evaporation Pond (process liquor)	41.64
	Evaporation Pond (magazine)	TBC
	Process Water Pond	TBC
	Sedimentation Pond	TBC
Support Infrastructure	Camp Site	TBC
	Administration, Security and Crib Buildings	TBC
	Communications Tower	TBC
	Airstrip	TBC
	Haul Roads	TBC
	Access Roads	TBC
Other Disturbance	Surface Water / Sediment Management Structures	TBC
	Topsoil Stockpiles	TBC

Domain	Feature	Area (Ha)
	Borrow Pits	TBC
	General clearing	TBC
	Exploration Tracks (existing)	TBC
	Historic Exploration Pads (existing)	TBC
	Total Proposed Disturbance (preliminary)	925.11

3.0 IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

The legal obligations and commitments relevant to closure for the Project have been identified and summarised in the Yangibana Closure Legal Obligations Register (the Register) in Appendix A. The Register of conditions and obligations derived from the "licence to operate" include:

- *Environmental Protection Act 1986* (WA) Licence;
- *Environment Protection and Biodiversity Act 2000* (Cwth) Licence*;*
- Mining Proposal;
- Tenement conditions;
- Works Approval; and
- Licence to Take Water (Groundwater Licence (GWL)).

Specific legislation which governs aspects of rehabilitation and closure for the Project includes:

- *Mining Act 1978* (WA);
- *Mining Rehabilitation Fund Act 2012* (WA);
- *Mines Safety and Inspections Act 1994* (WA);
- *Environmental Protection Act 1986* (EP Act) (WA); and
- *Contaminated Sites Act 2003* (WA).

There are a number of mine closure guidelines that have been considered during the preparation of this MCP. These include:

- *Guidelines for Preparing Mine Closure Plans* (DMP & EPA 2015);
- *Environmental Notes on Mining: Care and Maintenance* (DMP 2009a);
- *Environmental Notes on Mining: Waste Rock Dumps* (DMP 2009b);
- *Mine Void Water Resource issues in Western Australia* (Water and Rivers Commission (WRC) 2003);
- *Western Australian Water In Mining Guideline* (DoW 2013);
- *Tailings Storage Facilities in Western Australia: Code of Practice* (DMP 2013);
- *Guide to Departmental requirements for the management and closure of tailings storage facilities* (DMP 2015b)*;*
- *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) 2000); and
- *Guidelines on Tailings Dams - Planning, Design, Construction, Operation and Closure* (ANCOLD 2012).

4.0 STAKEHOLDER ENGAGEMENT

Stakeholder engagement is required to ensure the stakeholders are able to contribute to the closure planning process and obtain agreement on the post mining land use. Additionally, planned or unplanned mine closure has the potential to affect both internal and external stakeholders whom may have an interest in how and when the Project is completed and decommissioned.

4.1 STAKEHOLDER ENGAGEMENT STRATEGY

Hastings has implemented an external and community relations strategy over the past year, and developed the methodology for ongoing social assessment, engagement, community investment and community consultation.

A Stakeholder Engagement Management Plan has been developed to provide a framework for Hastings to engage in structured, meaningful and effective stakeholder engagement and management. The framework comprises a series of work plans, which together form the company's comprehensive external relations plan for the period 2016 to 2021, including key milestones such as DFS completion, Project Go Ahead, construction, commissioning, and first shipment.

Hastings is committed to ongoing stakeholder communication, engagement and consultation through the planning and approval phase, and through the construction and operational phases of the Project. The Stakeholder Engagement Management Plan strives to provide access to government, to facilitate community partnering, to enable access to land, and a myriad of other objectives to develop and protect the company's reputation.

Hastings can demonstrate, through research and community consultation, that the company has developed and maintains strong relations with the shires and local communities and, utilising an external relations program, that these relationships will continue to be enhanced for the mutual benefit of the Project and relevant stakeholders.

Hastings has adopted principles from the Ministerial Council on Mineral and Petroleum Resources (MCMPR) *Principles for engagement with communities and stakeholders* (2005):

- Communication: Open and effective engagement involves both listening and talking:
    - Two-way communication
    - Clear, accurate and relevant information
    - Timeliness
- Transparency: Clear and agreed information and feedback processes:
    - Transparency
    - Reporting
- Collaboration: Working cooperatively to seek mutually beneficial outcomes.
- Inclusiveness: Recognise, understand and involve communities and stakeholders early and throughout the process.
- Integrity: Conduct engagement in a manner that fosters mutual respect and trust.

4.2 KEY STAKEHOLDERS

Engagement with the Projects' key stakeholders with respect to closure has been undertaken during development of this MCP. Stakeholders identified for the Project are summarised in Table 5. Consultation and engagement will continue throughout all future phases of the project, as detailed in Section 4.1.

Table 5: Stakeholders of the Yangibana Project

Category	Group	Key Stakeholder
Internal Stakeholders		
JV employees and contractors	All JV employees and contractors involved with the Yangibana Project	No
External Stakeholders		
State Government departments	DMP, OEPA, Department of Environmental Regulation (DER), Department of Parks and Wildlife (DPaW), Department of Water (DoW), Radiological Council	Yes
JV tenement holders	Mojito Resources Limited (Rare Earth Minerals Plc)	Yes
Pastoral Leasee – Project within lease	Wanna Station (Bagden Pty Limited), Gifford Station	Yes
Pastoral Leasee – Project outside lease	Edmund Station, Cobra Station, Yinnetharra Station	No
Non-Government Organisations	Community Groups and Environmental Groups	No
Industry and Business	Local and Regional	No
General Public	Local, Regional, State	No
Relevant Communities	Shire of Upper Gascoyne, Traditional Owners (Yamatji Marlpa Aboriginal Corporation (YMAC)	No

4.3 SUMMARY OF CONSULTATION TO DATE

Substantial consultation with state regulatory agencies and the community has been undertaken in the preparation and finalisation of approval documents. A community forum was held at Gascoyne Junction to discuss environmental aspects of the Project to interested members of the community. Hastings will continue to engage relevant stakeholders and involve them during Proposal development, construction and operations for the life of the mine. Decommissioning and closure aspects are also actively discussed with relevant stakeholders during the planning phase.

Regular meetings with Bagden Pty Ltd (Wanna and Gifford Creek station owners) has informed the location of infrastructure to preserve high value grazing country, reduce potential impacts of surface water drainage associated with linear infrastructure, and ensure TSFs are located away from Lyons River and Fraser Creek.

Hastings has built a good relationship with the Traditional Owners (TOs), and will continue to consult with TOs on all relevant aspects of the Project. Recently the combined Tiin-Mah Warriyangka, Tharrkari, Jiwarli submitted a native title claim (WC2016/003) (WAD464/2016) over the Project area and beyond. Prior to the native title claim, Hastings worked closely with the TOs to survey the majority of areas planned for disturbance to identify significant heritage sites. As a result of the surveys, Hastings has designed its infrastructure to avoid impacts to sites of cultural significance. Therefore, rehabilitation of significant heritage sites will not be warranted. However, Hastings will continue to consult with the TOs on closure aspects of the Project.

The stakeholder engagement register relevant to closure is presented in Appendix B. All consultation to-date has been informative and no specific issues have been raised by key stakeholders with regard to closure.

5.0 POST-MINING LAND USE AND CLOSURE OBJECTIVES

5.1 PRE MINING LAND USE

The underlying land tenure is pastoral lease. The predominant land use in the Upper Gascoyne region, and in the proposed Project area, is cattle grazing. Current impacts to the terrestrial environment exist from historic grazing, most evident along stream banks where cattle access water. The majority (~71%) of the Project area is in Excellent condition with native vegetation largely intact (Ecoscape 2015a).

5.2 POST MINING LAND USE

The final post mining land use, following rehabilitation, will consist of self-sustaining native vegetation and fauna habitats suitable for grazing to reflect the pre-mining state as closely as possible.

In consultation with Bagden Pty Ltd (Wanna and Gifford Creek Station), some roads and tracks will remain to enable increased access of lands for pastoral activities. In addition, some groundwater production bores will remain functional to provide an additional water source for cattle, where water quality is suitable. Selected production bores may be maintained for rehabilitation water supply requirements to facilitate germination and establishment, but this is yet to be determined.

The open pit voids, WRLs and TSFs will remain permanent features in the landscape. The following bunds will remain post closure:

- Surface water diversion / flood protection bunds;
- Pit abandonment bunds - to preclude entry, and ensure safety of humans and fauna; and
- Surface water bunds - to protect the WRLs and TSFs final landforms from erosion.

Given the benign nature of the surrounding waste rock and water quality outcomes, there is a possibility that the post mining land use for the permanent pit lakes may include consideration of:

- Providing habitat for native fauna including migratory birds; and
- Providing water sources for pastoral activities i.e. cattle.

A program to verify the final void hydrology and solute model conducted in the planning phase, geotechnical stability of pit walls, access and entry scenarios and investigate the establishment of riparian vegetation may be instigated to determine the post mining land use of the pit lakes. If investigations find that the pit lakes are not suitable for the purpose of providing fauna habitat or a water source, works will be undertaken to make them safe, stable and non-polluting.

Immediately following closure activities, and until rehabilitation monitoring indicates the site can be relinquished, the land use will be considered as “mine site rehabilitation”. Hastings proposes to install fencing around TSF 2 and TSF 3 to exclude stock access in order to assist establishment of resilient vegetation on these landforms during the post closure period. Other areas, yet to be determined, may also require fencing to protect from cattle and other fauna grazing, during the vegetation establishment phase.

5.3 SITE-SPECIFIC CLOSURE OBJECTIVES

The Proponent intends to leave the Project area upon cessation of operations in a safe and stable condition such that the tenements can be relinquished without any future financial, environmental or safety liability for the company or the community.

The specific closure objectives detailed in Table 6 aim to meet this over-arching closure objective.

Table 6: Specific Closure Objectives for Yangibana Project

No.	Objective
1. Compliance	
1.1	Comply with all legally binding conditions and commitments relevant to rehabilitation and closure
1.2	Remove all redundant infrastructure not required by relevant stakeholders prior to rehabilitation
1.3	Ensure all general wastes are disposed of such that they are contained and isolated
1.4	Apply soils that will promote and benefit rehabilitation
2. Landforms	
2.1	Construct safe, stable, non-polluting post mining landforms which support vegetation growth and are erosion resistant.
2.2	TSF1 will have a fit for purpose cover, which will encourage evapotranspiration.
2.3	TSF2 and TSF3 will have a fit for purpose liner and cover systems, which will limit infiltration and seepage.
3. Hydrology	
3.1	Surface drainage structures will be constructed to an appropriate hydrology design standard to minimise erosion of permanent mining landforms and maintain ecosystem function
3.2	Impacts on the availability and quality of regional groundwater are minimised and do not limit the proposed post-mining land use
4. Ecosystem	
4.1	Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites
5. Stakeholders	
5.1	Ensure the interests of all relevant stakeholders are considered during all stages of closure planning
6. Heritage	
6.1	Cultural heritage sites within the Project will be preserved
7. Safety	
7.1	Leave the post mining landscape in a condition that is safe for humans and fauna
7.2	Land contamination will be assessed and remediated as part of the decommissioning process
7.3	Control radiation levels at the surface of rehabilitated landforms and across the Project area equivalent to pre-mining levels

5.4 CONCEPTUAL LANDFORM DESIGNS

A final landform design and closure strategy for all TSFs and WRLs will be developed as a component of the DFS, with further refinements in the detailed engineering phase of the Project.

As detailed in the Hastings (2016a) *Technical Note Closure Considerations - TSF2 and TSF3* (Appendix C) specific closure parameters to be determined, include:

- Sources of suitable materials for final encapsulation of TSF2 and TSF3;
- Source and storage of suitable rock cover materials;
- Specifications of encapsulation layer(s) to limit infiltration into tailings and potential seepage;

- Prescribed thickness of rock cover / batters to protect tailings against long-term erosion;
- Methods for minimisation of long-term radiation emissions;
- Final height and footprint;
- Outer slope geometry;
- Growth medium cover: soil-rock mulch blend – ratio of blending, thickness of cover and selection or competent benign waste rock; and
- Location and design of surface water drainage measures.

6.0 COMPLETION CRITERIA

Completion criteria have been developed to ensure the overall and specific objectives for closure are achievable, and have been designed to allow effective monitoring, reporting and auditing for a definitive endpoint on rehabilitation activities.

At this stage in the Project, qualitative completion criteria have been developed, and will be refined during further studies and during operations. Quantitative measures and values, where applicable, will be developed and detailed in subsequent revisions of this MCP.

A summary of preliminary completion criteria, along with associated measurement tools and performance indicators, are presented in Table 7.

Table 7: Preliminary Closure Criteria and Performance Indicators for Yangibana Project

Closure Objective		Completion Criteria	Measurement Tools	Performance Indicators
1. Compliance				
1.1	Comply with all legally binding conditions and commitments relevant to rehabilitation and closure	All conditions and commitments are met	Audit of conditions and commitments in the *Yangibana Closure Legal Obligations Register*	Compliance with all conditions and commitments Relinquishment of tenements
1.2	Remove all redundant infrastructure not required by relevant stakeholders prior to rehabilitation	Infrastructure contaminated with radionuclides will be buried on-site or decontaminated prior to handover	Survey of all infrastructure prior to decommissioning	No contaminated infrastructure will remain on-site
		Retained infrastructure shall be left in a safe condition and transferred to a legally responsible entity	Inspection of retained infrastructure prior to handover Written agreement of transfer of infrastructure with legally responsible entity	Transfer of infrastructure liabilities completed
		Redundant infrastructure will be removed from site	Audit against *Yangibana Decommissioning Plan*	No redundant infrastructure remaining on-site
1.3	Ensure all general wastes are disposed of such that they are contained and isolated	Wastes shall be disposed of to the on-site landfill, contaminated waste area or transferred off-site to licenced waste disposal sites for salvage, recycling and/or disposal	Audit against *Yangibana Decommissioning Plan*	No waste left uncontained on-site
1.4	Apply soils that will promote and benefit rehabilitation	Delineation of vegetation, topsoil and subsoil stockpiles	Monitoring of land disturbance, vegetation and soil harvesting, delineation, and stockpiling activities *Yangibana Soil Register* with identification number, source location, soil type, quantity, storage requirements and storage location.	Compliance with the *Land Clearing Work Instruction*, the *Vegetation, Topsoil and Subsoil Collection and Storage Work Instruction,* and this MCP
		Application of soils in locations where soil type and harvested volumes of useable soils dictate	*Rehabilitation Record Form* including soil ID number from the *Yangibana Soil Register*, area of application and map showing area rehabilitated.	Compliance with the *Yangibana Rehabilitation Work Instruction* and this MCP
2. Landforms				
2.1	Construct safe, stable, non-polluting post mining landforms	Landforms are placed outside the pit void zone of instability	Geotechnical assessment of pit wall stability	All landforms are constructed outside the zone of pit wall instability

Closure Objective		Completion Criteria	Measurement Tools	Performance Indicators
	which support vegetation growth and are erosion resistant	Surface water management and drainage is incorporated into the landform design	Audit of constructed landform against design	Compliance with landform design
		Final surfaces do not significantly erode following heavy rainfall events	Erosion monitoring	Erosion not greater than levels within analogue sites
		Characterisation of waste and rehabilitation materials to determine appropriate placement / segregation in the final landform	Materials characterisation during operations Audit of constructed landform against design	Compliance with the *Waste Rock Management Plan* and *Radiation Waste Management Plan* (RWMP)
2.2	TSF1 will have a fit for purpose cover, which will encourage evapotranspiration	Cover measures meet design criteria	Audit of TSF construction and closure	Compliance with landform design parameters
		Drain-down of TSF 1 does not result in impacts to Groundwater Dependent Ecosystems (GDEs)	Groundwater level and quality monitoring	Changes in water chemistry and levels do not limit post-mining land use
2.3	TSF2 and TSF3 will have a fit for purpose liner and cover systems, which will limit infiltration and seepage	Cover measures meet design criteria	Audit of TSF construction and closure	Compliance with landform design parameters
		No alteration of groundwater system beyond the immediate vicinity of TSF2 and TSF3	Groundwater level and quality monitoring GDE vegetation monitoring downstream of TSF1 Permanent photographic sites of downstream GDE	Fluctuations in water levels are consistent with regional monitoring bores Changes in water chemistry does not limit post-mining land use
3. Hydrology				
3.1	Surface drainage structures will be constructed to an appropriate hydrology design standard to minimise erosion of permanent mining landforms and maintain ecosystem function	Surface drainage to downstream environments is maintained	Audit of drainage structures against design standards	Compliance with design parameters No substantial erosion evident following heavy rainfall events
3.2	Impacts on the availability and quality of regional groundwater are minimised and do not limit the proposed post-mining land use	Pit water quality does not impact on areas beyond the immediate mining area	Groundwater monitoring downstream of TSFs	Change in water chemistry does not limit post-mining land use
		Any groundwater contamination will be confined to the immediate mining area and will not impact on surrounding groundwater resources	Modelling of groundwater recovery rates Groundwater monitoring of the borefield	Change in water chemistry does not limit post-mining land use

Closure Objective		Completion Criteria	Measurement Tools	Performance Indicators
		Groundwater levels in the vicinity of production bores will recover to pre-abstraction levels after mine closure	Modelling of groundwater recovery rates Groundwater monitoring of the borefield	Change in water level is consistent with regional monitoring bores
4. Revegetation				
4.1	Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites	Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem	Quadrat based Ecosystem Function Analysis (EFA) monitoring compared to analogue sites	Species richness and diversity trending towards that of analogue sites No establishment of weed populations Resilient to cattle grazing at levels representative of analogue areas
		Rehabilitated areas (excluding final pit voids and remaining infrastructure corridors i.e. roads, bores) support revegetation with local provenance vegetation in the short-medium term	Quadrat based vegetation monitoring	Presence of local provenance species No establishment of weed populations
5. Stakeholders				
5.1	Ensure the interests of relevant stakeholders are considered during all stages of closure planning	Key stakeholders have been engaged to determine the post mining land use	Post mining land use has been documented and endorsed, to the extent practicable, by key stakeholders	Compliance with post mining land uses established
		Key stakeholders shall be informed of any change to the Project and MCP	Stakeholder register	Stakeholder considerations are included in development of the MCP
		Formal agreement with post closure land users for the retention of any infrastructure or service	Formal agreements in writing for any infrastructure that will be retained post closure	Transfer of liabilities completed
6. Heritage				
6.1	Cultural heritage sites within the Project will be preserved	Access to cultural heritage sites within operational areas are re-established	Audit against *Cultural Heritage Management Plan* (CHMP)	Compliance with CHMP
7. Safety				
7.1	Leave the post mining landscape in a condition safe for humans and fauna	Construct abandonment bunds around the perimeter of open pit void, outside the pit wall zone of instability	Audit against the DoIR *Safety Bund Walls Around Abandoned Open Pit Mines Guideline* (1997)	Compliance with this MCP and regulatory guidelines No reported incidents of human or animal injury or harm
		Block open pit ramps to restrict vehicle access	Visual inspection of closure of pit ramps	

Closure Objective	Completion Criteria	Measurement Tools	Performance Indicators
	All drill holes and bores shall be capped, filled or made safe	Audit of drill holes *Ground Disturbance Completion and Decommissioning Form*	Compliance with the *Exploration Environmental Management Plan*
7.2 Land contamination will be remediated as part of the decommissioning process	Contaminated site assessment in areas where hydrocarbons and chemicals have been stored, used, or where historic spills have occurred	Audit of *Yangibana Contaminated Sites Assessment Register* (detailing date of assessment, report reference, site name and location) against known and potential sites	Compliance with the *Decommissioning Plan* and this MCP
	Soil remediation, to agreed levels, shall occur where contamination is reported	Correspondence of suspected contaminated sites with DER Remediation reports: Agreed contaminant levels in soil are reduced to acceptable levels	Compliance with regulatory requirements
7.3 Control radiation levels at the surface of rehabilitated landforms equivalent to pre-mining levels	Landforms do not emit radiation at surface exceeding thresholds determined through baseline monitoring	Post closure radiation monitoring	Compliance with RWMP

7.0 COLLECTION AND ANALYSIS OF CLOSURE DATA

This section summarises key environmental data collected during baseline studies. This data forms part of the basis of knowledge for closure strategies and completion criteria, and will grow and evolve with time as more data is collected and analysed.

7.1 CLIMATE

The Bureau of Meteorology (BoM) climate mapping provides an overall indication of the historical climatic conditions across Australia. This mapping has been utilized to provide an overview of the expected climatic description for the Project area and summarised in Table 8.

Table 8: Climatic Description of the Yangibana Project

Mapping	Description
Major seasonal rainfall zone – climate class	Arid, low rainfall
Climate zone based on temperature and humidity	Hot dry summer, mild winter
Average annual rainfall	200-300 mm
Average annual pan evaporation	2800-3000 mm

Source: BoM (2016a)

The nearest BoM station with long-term rainfall data is Mount Phillip (Site No. 007058), 70 km south of the Project. This station has been active since 1902 (BoM 2016b). The site is subject to northern monsoon influences over the summer and early autumn period, and southern frontal influences in late autumn and winter (BoM 2016c). There are two periods of higher rainfall from January to March and May to July, and a drier period from August to December (Figure 3). Information regarding the frequency, intensity and duration of rainfall for this site was not available.

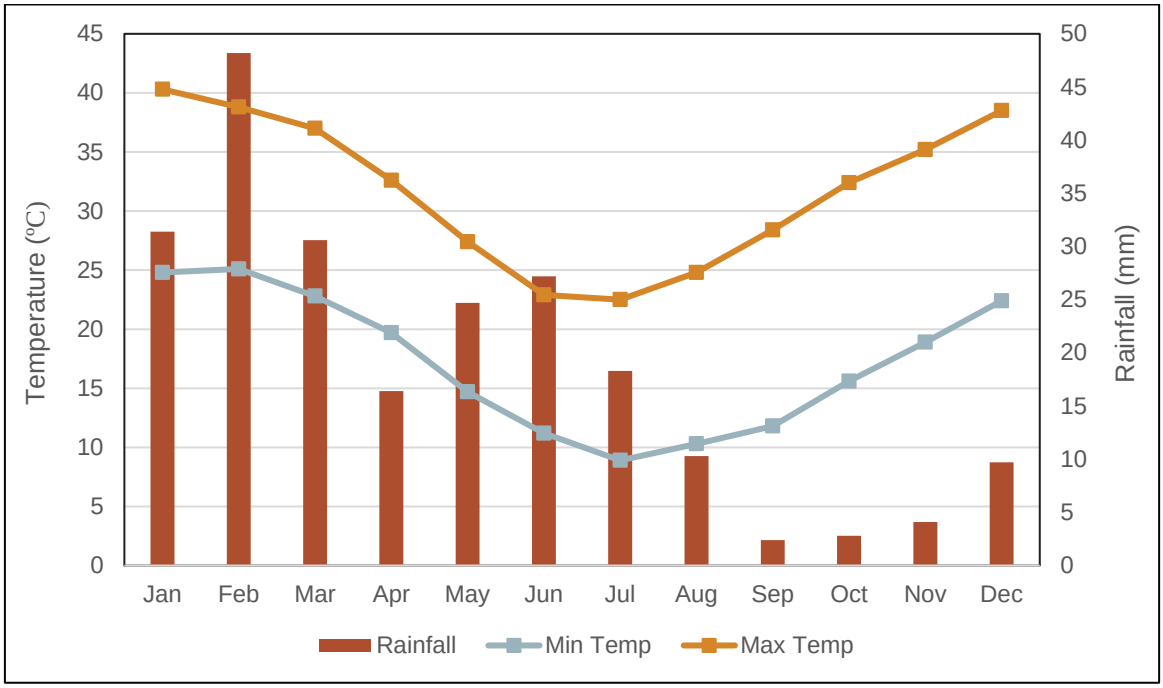


Figure 3: Monthly Rainfall and Daily Maxima and Minima for Mount Phillip Station 7058

The Mount Phillip station receives a mean annual rainfall of 226 mm. January has the highest temperatures with a mean maximum of 40.3°C and mean minimum of 24.8°C. July temperatures are the lowest ranging from a mean maximum of 22.5°C to a mean minimum of 8.9°C (Figure 3).

Monthly mean wind roses recorded at 9am and 3pm from the Mount Phillip station show that the predominant wind direction varies throughout the day and year (BoM 2016b). At 9am the predominant wind direction is generally easterly (including north-easterly and south-easterly), with the exception of October where the predominant direction is south-westerly. The 3pm readings show two patterns: January to August the wind direction is relatively evenly distributed from all directions, however from September to December the predominant direction is westerly (including north-westerly and south-westerly). Throughout the year wind speeds are predominantly between 0 to less than 20 km/hour.

A search of the DoW Water Information Reporting tool (DoW 2016, accessed 1 June 2016) indicated the absence of river gauging stations in the upper reaches of the Lyons River and Edmund River, in the vicinity of the Project area. Information regarding historic flooding of these rivers, and their tributaries was not available.

7.1.1 Projected Climatic Conditions

According to the *Climate Change in Australia Projections for Australia's Natural Resource Management Regions* (Watterson *et. al.* 2015), the Project is located within the Rangeland South sub-cluster. The key projections, with high to very high confidence, regarding future climate conditions for this region are:

- Average temperatures will continue to increase in all seasons;
- More hot days and warm spells are projected along with fewer frosts;
- Changes to summer rainfall are possible but unclear; winter rainfall is projected to decrease;
- Increased intensity of extreme rainfall events is projected;
- Mean sea level will continue to rise and height of extreme sea-level events will also increase; and
- A harsher fire-weather climate in the future.

7.2 LANDSCAPE

7.2.1 Biogeographic Region

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into regions (bioregions) of similar geology, landform, vegetation, fauna and climate characteristics (Department of the Environment (DoE) 2014). According to IBRA the Project lies within the Gascoyne region, with the majority of the Project within the Augustus subregion.

7.2.1.1 Augustus Subregion

The Augustus subregion comprises (Desmond *et. al.* 2001):

> *Rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys. Also includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margin of the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. Although the Gascoyne River System provides the main drainage of this subregion, it is also the headwaters of the Ashburton and Fortescue Rivers. There are extensive areas of alluvial valley-fill deposits. Mulga woodland with* Triodia *occur on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland. A desert climate with bimodal rainfall. The subregional area for GAS3 is 10,687,739 Ha.*

7.2.2 Land Systems

A total of ten land systems within the Project area, grouped according to land type on the basis of a combination of landform, soil, vegetation and drainage characteristics (Wilcox & McKinnon 1972). The land systems are described in Table 9, along with proportions within the proposed disturbance footprint. Land system within the proposed mine activity envelope are presented in Figure 4.

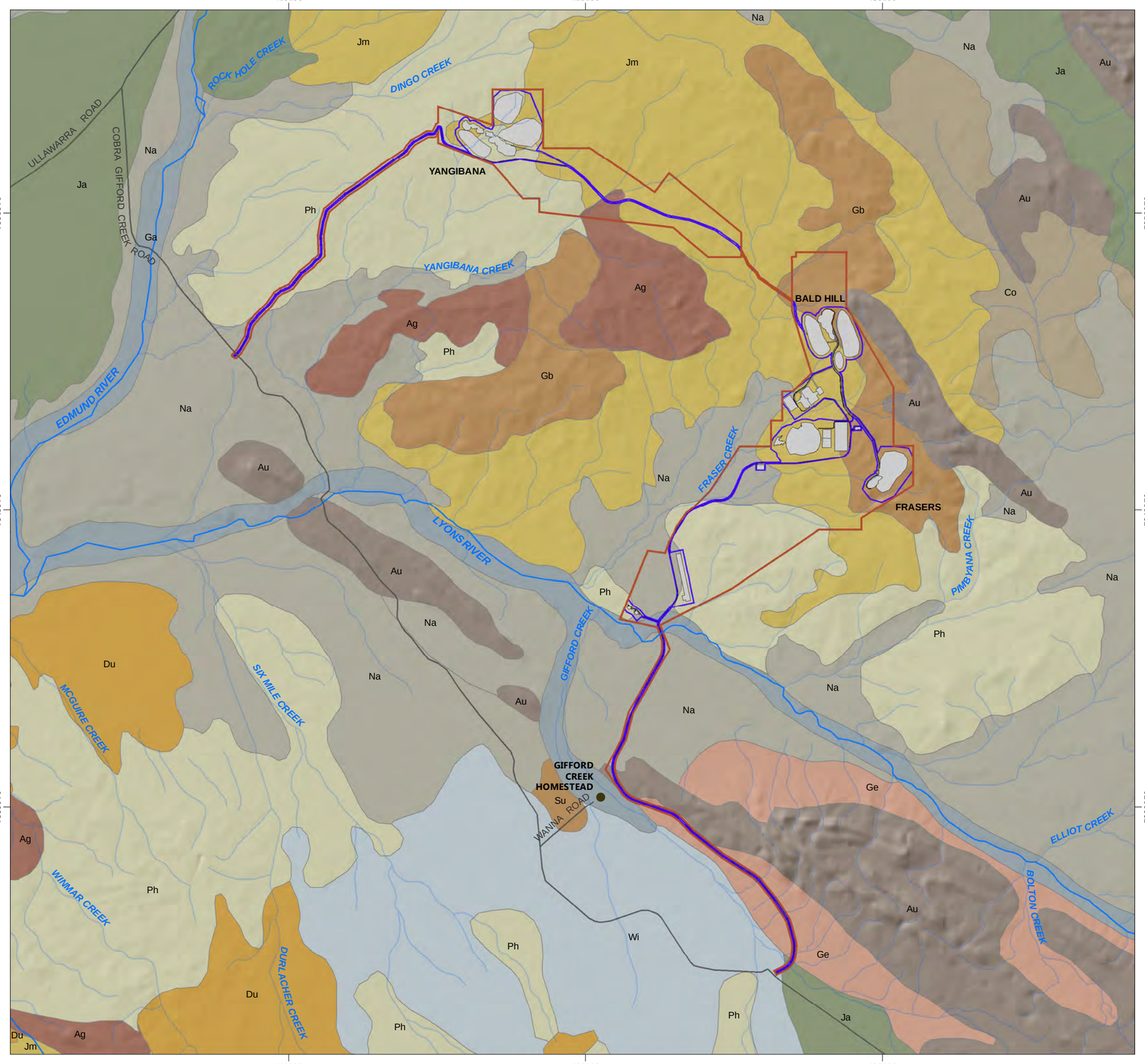
Table 9: Land System Descriptions within Project Footprint

Land System	Description
Agamemnon	Rocky hills, with peaks and ridges above extensive stony slopes, supporting scattered tall shrublands of mulga and other acacias
Augustus	Rugged ranges, hills, ridges and plateaux with skeletal soils supporting mulga and other acacia shrublands in southern parts or hard spinifex grasslands in northern parts
Gascoyne	River channels and associated narrow alluvial plains and inclusions, supporting river redgum fringing woodlands, also mulga and other acacias, *Senna* spp. and buffel grass
George	Very stony lower slopes and interfluves below hill systems, supporting stunted acacia, eremophila and cassia shrublands
Glenburgh	Rugged granite hills, stony uplands and lower plains supporting scattered tall shrublands of mulga and other acacias
James	Low hills, ridges and tors of granite and quartz, with stony lower plains, rises and drainage floors, supporting scattered tall shrublands of mulga and other acacias
Jamindie	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey
Nadarra	Plains and calcrete rises with chenopod shrublands and hard spinifex grasslands
Phillips	Low hills and undulating uplands on gneiss and quartz supporting mulga and other acacia tall shrublands
Winmar	Stony plains with sandy banks supporting mulga and other acacia shrublands with eremophila and cassia low shrubs and wanderrie grasses on banks

7.2.3 Topography

The elevations across the Project area vary from 367 metres Above Height Datum (mAHD) to 309 mAHD. Regional ground elevations generally grade across the Project area towards the Lyons River.

The majority of mine infrastructure is located within the top to mid elevations of the Project area, as presented in Figure 2.



LEGEND

- Homestead
- Roads
- Rivers
- Creeks
- Mine Activity Envelope
- Disturbance Footprint
- Infrastructure Footprint

Land Systems (DAFWA, 2012)

- Agamemnon System (Ag): Rocky hills, with peaks and ridges above extensive stony slopes, supporting scattered tall shrublands of mulga and other acacias.
- Augustus System (Au): Rugged ranges, hills, ridges and plateaux with skeletal soils supporting mulga and other acacia shrublands in southern parts or hard spinifex grasslands in northern parts.
- Collier System (Co): Undulating stony uplands, low hills, ridges, stony plains and drainage floors supporting mulga shrublands and some spinifex.
- Durlacher System (Du): Stony plains, lower tributary drainage plains and low stony rises, supporting scattered tall shrublands of mulga, other acacias and chenopod low shrubs.
- Gascoyne System (Ga): River channels and associated narrow alluvial plains and inclusions, supporting river redgum fringing woodlands, also mulga and other acacias, Senna spp. and buffel grass.
- George System: Very stony lower slopes and interfluves below hill systems, supporting stunted acacia, eremophila and cassia shrublands.
- Glenburgh System (Gb): Rugged granite hills, stony uplands and lower plains supporting scattered tall shrublands of mulga and other acacias.
- James System (Jm): Low hills, ridges and tors of granite and quartz, with stony lower plains, rises and drainage floors, supporting scattered tall shrublands of mulga and other acacias.
- Jamindie System (Ja): Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.
- Nadarra System (Na): Plains and calcrete rises with chenopod shrublands and hard spinifex grasslands.
- Phillips System (Ph): Low hills and undulating uplands on gneiss and quartz supporting mulga and other acacia tall shrublands.
- Sugarloaf System: Gently undulating stony plains, tributary slopes and drainage floors supporting mulga and other acacia shrublands with halophytic and non-halophytic low shrubs.
- Winmar System: Stony plains with sandy banks supporting mulga and other acacia shrublands with eremophila and cassia low shrubs and wanderrie grasses on banks.
- Yinnietharra System (Yi): Scattered granite tors and domes above stony slopes, broad sandy plains with groved vegetation and wide drainage tracts; supporting tall shrublands of mulga and other acacias.

DATA SOURCES :
SERVICE LAYERS:

ecoscape

LAND SYSTEMS UNDERLYING THE YANGIBANA PROJECT

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:130,159 @ A3

0 1 2 3 4 5 km

PROJECT NO: 3420-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	27/01/2017

FIGURE 04

7.2.4 Local Geology

The dominant lithologies in the tenement area are the Pimbyana Granite to the north and the Yangibana Granite to the south, both members of the Proterozoic Durlacher Supersuite (Johnson *et. al.* 2011a; Johnson *et. al.* 2011b). Rafts of meta-sedimentary rocks including sandstones, calc-silicates and schists occasionally occur within the Project area. The granites are very well exposed and form extensive low rugged hills covered in boulders, tors and whaleback. The orebody is hosted in the Gifford Creek Ferrocarbonatite Complex (Figure 5), formed by intrusion of ferrocarbonatite dykes, veins and sills into the granites, which are generally southeast to east-southeast trending (Hastings 2016b; Pirajno and González-Álvarez 2013). The country rock consists of dolomite, ankerite and siderite with accessory minerals that include magnetite, and the REE-bearing mineral phosphate monazite. Sinuous ironstone veins and pods are spatially associated with, but likely post-date, the ferrocarbonatite intrusions. They are north-northeast to east-southeast trending, surrounded by narrow haloes of fenitic alteration and are locally anomalously radioactive (Hastings 2016b).

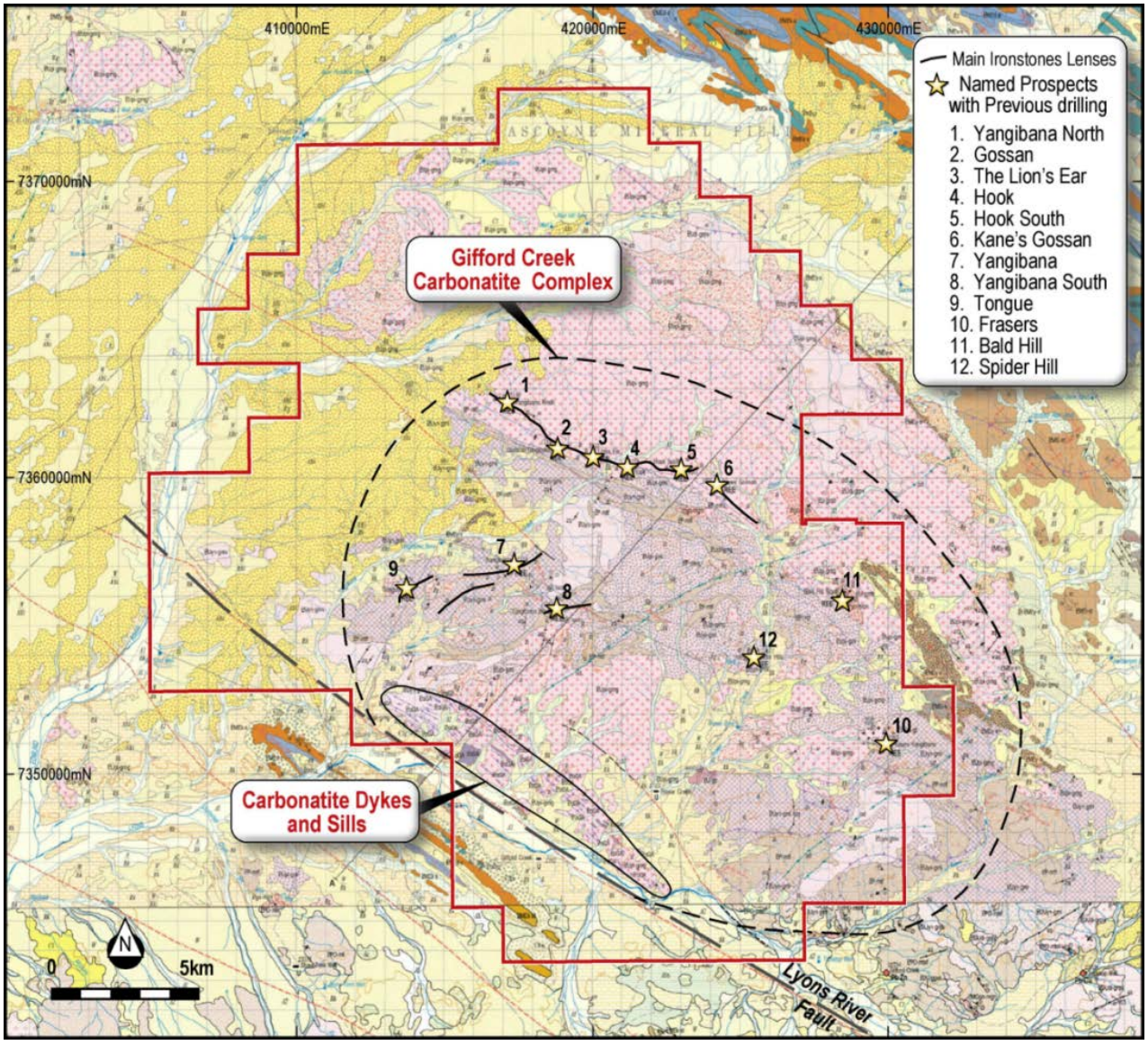


Figure 5: Local Geology of the Yangibana Project

(Source: ATC Williams 2016)

Martin *et. al*. (2005) subdivided the superficial strata into a set units linked to the physiographic division in which they occurred, and their provenance. Localised deposits of unconsolidated silt, sand and gravel are

present in the creeks dissecting the Project area, however, the most significant superficial strata in the Project area is the calcrete deposits, locally present along the alluvial channels of major drainage lines. The calcrete units are characterised by a hard surface layer of brecciated and partly silicified calcrete underlain by softer more friable material. These units consist mostly of vuggy calcrete with irregular, lenticular, bedding parallel cavities. Veins and cavities can be filled by quartz cement, especially in upper parts of the calcrete profile. The calcrete can be 30 m thick and possibly up to 50 m thick (Thorpe 1990), and is commonly partly eroded and degraded.

7.2.5 Hydrogeology

The Project is located within the Gascoyne Groundwater Proclamation Area under the *Rights in Water and Irrigation Act 1914* (RIWI Act) (DoW 2009a). All groundwater abstraction must be licenced by the DoW.

Environmental values of groundwater in the vicinity of the Project include maintenance of Groundwater Dependent Ecosystems (GDEs) and stygofauna habitat. The Atlas of Groundwater Dependent Ecosystems (BoM 2016d) reports that both the Lyons River and Edmund River represent known GDEs.

Known and potential GDE vegetation types recorded during the flora and vegetation biological assessment are discussed in Section 7.3.1 and presented in Figure 13.

7.2.5.1 Regional Hydrogeology

A conceptual appraisal of the hydrogeology of the Project area was undertaken by Global Groundwater (2016).

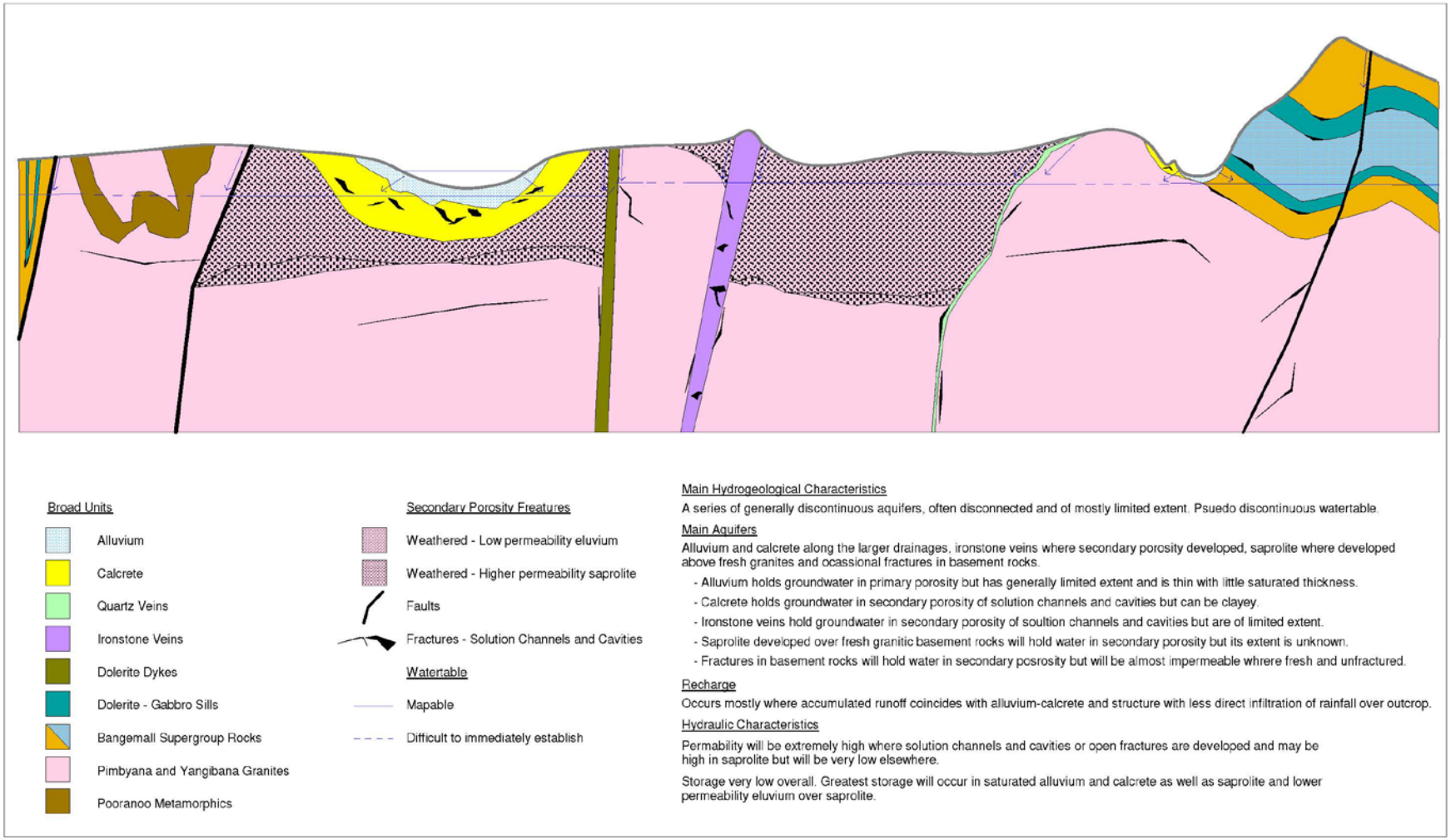
The Project area is characterised by local superficial aquifers and underlying fractured and weathered basement rock aquifers. Across the Project area, it is considered that aquifers will be mostly unconfined with confined conditions occurring locally. These two aquifer types are described as follows:

- Superficial units: calcrete and alluvium, of low permeability and/or unsaturated. Only alluvium units in proximity to recharge along the main drainage lines will form aquifers with potential to supply usable, sustainable quantities of groundwater. Both units will have a high variable permeability, predominantly where solution channels and cavities are present within the calcrete and lowest where the strata is clayey. Groundwater is likely to be generally unconfined but confined groundwater will be present locally where the aquifer is overlain by low permeability units (clay sections of calcrete or alluvium).
- Basement rocks: fractured and weathered basement rocks, forming isolated and effectively disconnected aquifers. Some degree of hydraulic connection will occur locally depending on geological structure, weathering, landscape position and aquifer geometry. Permeability will be low, and could be regarded as effectively impermeable throughout much of the Project area. Zones of very high permeability will occur in the vicinity of bedding plane partings, fractures and where solution cavities and channels have developed in the ironstone veins.

Figure 6 presents a schematic cross-section of the relationship between geological and hydrogeological units within the Project area.

Appendix D presents the conceptual hydrogeological appraisal.

Figure 6: Conceptual Hydrogeological Cross-section of the Yangibana Project



(Source: Global Groundwater 2016)

7.2.5.2 Local Hydrogeology

At the time of preparing this MCP, the hydrogeological investigation report was not available for inclusion. The next revision of the MCP will summarise key baseline and closure related information.

7.2.5.3 Recharge and Flow

The intermittent nature of rainfall in the region produces periods of high runoff to drainage lines which produces sporadic recharge to permeable units. Groundwater recharge by direct infiltration of rainfall over the superficial units or fractured outcropping rocks will likely be minor. Approximate recharge values have been estimated as 1 GL/annum and 6 GL/annum for outcropping fractured rock outcropping and superficial units, respectively (Global Groundwater 2016).

Regional flow systems are not likely to exist due to the presence of small and disconnected aquifer units. It is likely that the irregular geological structure and distribution of permeability would result in both preferential groundwater flow paths and flow barriers such that the watertable configuration would be difficult to accurately represent (Global Groundwater 2016).

Baseline groundwater levels recorded in the fractured ironstone in December 2016 (pers comms Kathy McDougall Groundwater Resources Management 2017) are presented in Figure 7. Although data points are limited, the standing water levels (in mAHD) clearly show a general groundwater flow direction towards the southeast, which corresponds with the strike of ironstone veins associated with the ore deposits.

Global Groundwater (2016) reviewed publically available water levels from the study area in the superficial aquifers. Although data were non-synoptic, having been obtained over a number of years, a trend was evident indicating shallowest water levels (generally 10 m depth or less) closest to the drainage lines with water level depths increasing with distance from drainage lines and up catchment where levels were often 15 to 23 m depth.

Expected flow rates and corresponding recharge mechanisms in the fractured ironstone aquifer is pending completion of the Groundwater Resource Management hydrogeological investigation. The next revision of the MCP will include a summary of results.

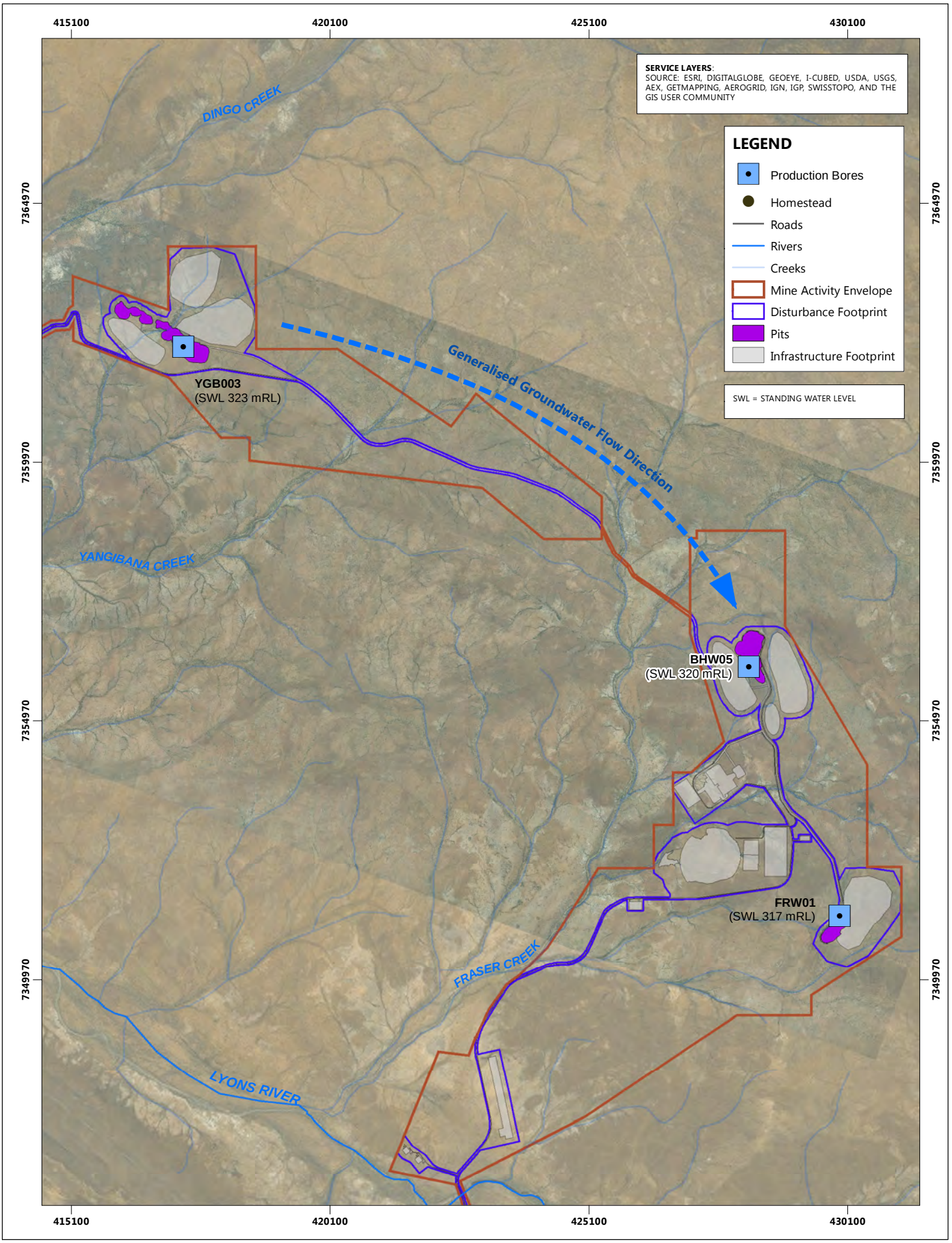
7.2.5.4 Groundwater Quality

Groundwater samples have been collected by ATC Williams (2015) and Hastings (2016) from existing pastoral bores, and a limited number of bores and drill holes associated with the Project, the results of which are summarised in RadPro (2016a) *Baseline Radiation Report* (presented in Appendix E). Additional groundwater analysis conducted in 2016 will be provided in the Groundwater Resource Management hydrogeological investigation report, to be included in the next revision of the MCP.

Groundwater salinity in the Project region is variable ranging from 600 to 2,800 mg/L Total Dissolved Solids (TDS). The presence of fluoride, uranium and salinity indicate that water treatment will be required for potable water uses within the Project. The presence of fluoride is likely to represent the presence of trace fluorite minerals, namely CaF_2, as discussed in Section 7.7.1. Results pertaining to radiation are discussed in Section 7.5.

Figure 8 presents groundwater sample locations, and Table 10 summarises groundwater analytical results.

Appendix E presents the baseline radiation report, providing details of groundwater laboratory analysis.



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PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES:
GROUNDWATER INFORMATION: GROUNDWATER RESOURCE MANAGEMENT, JANUARY 2017
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

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N 0 1 2 3 km

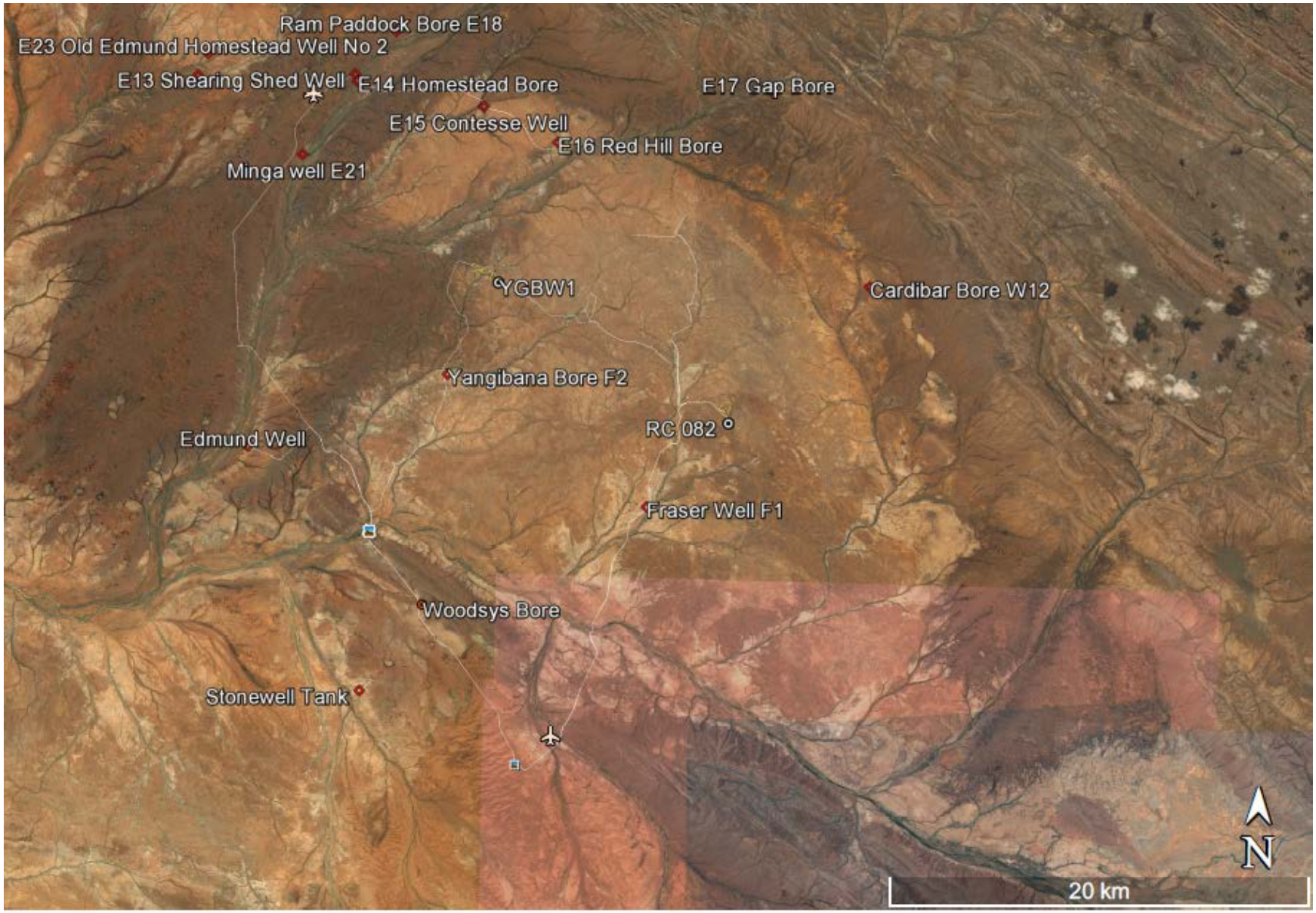
BASELINE GROUNDWATER LEVELS WITHIN THE FRACTURED IRONSTONE AQUIFER

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 07

Figure 8: Groundwater Sample Locations



(Source: ATC Williams 2016)

Table 10: Groundwater Quality Regional and Project Bores – June 2015 and October 2016

	Cl	SO_4	NO_2	Na	K	Ca	Mg	F	Al	Fe	As	Ba	B	Cu	Mn	Mo	Se	Zn	Th	U	TDS	TSS
Quantitation Limit	5	1	0.01	0.1	0.1	0.1	0.1	0.1	0.1	0.01	0.001	0.01	0.01	0.01	0.01	0.01	0.001	0.01	0.001	0.001	5	5
Date Sampled: 1 June 2015																						
Minga Well	110	110	6.5	150	-	39	58	2.3	<0.1	<0.01	0.002	0.04	0.5	<0.01	<0.01	0.01	0.003	<0.01	<0.001	0.004	920	<5
Contessi Bore	95	45	0.05	70	-	30	48	2.5	<0.1	<0.01	<0.001	0.16	0.26	0.02	<0.01	0.01	<0.001	<0.01	<0.001	0.02	600	7
Edmund Well	810	320	17	610	-	79	100	2.9	<0.1	<0.01	<0.001	0.04	1.4	0.04	<0.01	0.01	0.003	<0.01	<0.001	0.038	2200	17
YGBWB1*	240	73	11	150	-	61	38	2.1	<0.1	<0.01	<0.001	0.23	0.36	<0.01	0.07	0.03	0.005	<0.01	<0.001	0.016	870	5
RC081*	410	100	21	340	-	60	43	3	0.8	0.26	<0.001	0.08	0.61	<0.01	0.01	0.02	0.008	<0.01	<0.001	0.014	1300	84
Fraser's Well	570	160	12	550	-	47	40	3	<0.1	<0.01	<0.001	0.04	0.83	<0.01	<0.01	0.02	0.005	<0.01	<0.001	0.025	1600	<5
Yangibana Bore	530	180	18	350	-	120	75	2.2	<0.1	<0.01	<0.001	0.03	0.55	<0.01	<0.01	<0.01	0.005	<0.01	<0.001	0.029	1600	<5
Woodsys Bore	590	250	12.98	380	-	110	110	1.3	<0.1	<0.01	<0.001	0.03	0.8	<0.01	<0.01	<0.01	0.003	<0.01	<0.001	0.009	1800	<5
Red Hill 2	710	830	<0.01	620	-	250	130	4	<0.1	0.19	0.004	0.07	2.1	<0.01	0.87	0.01	<0.001	<0.01	<0.001	0.079	2800	76
Date Sampled: 27 October 2016																						
Windmill Bore	460	360	15	280	15	160	88	-	<0.1	<0.01	0.001	-	-	<0.01	-	-	0.009	<0.01	0.001	0.038	1600	<5
Fraser's Well	510	170	11	420	9.1	53	41	-	0.1	0.84	<0.001	-	-	<0.01	-	-	0.005	<0.01	0.002	0.029	1400	5
Bald Hill Bore	320	110	17	240	11	86	52	-	<0.1	0.19	<0.001	-	-	<0.01	-	-	0.009	0.03	<0.001	0.029	980	<5
Australian Drinking Water Guideline	250	250	50	180	-	-	-	1.5	0.2	0.3	0.01	2	4	2	0.5	0.05	0.01	3	-	0.017	600	-

Notes: Elements reporting concentrations below laboratory detection limit, and not presented in the table include Cd (<0.002); Cr, Pb and Ni (<0.01).

Shading indicates analytes exceeding Australian Drinking Water Guidelines (NHRMC 2011)

* denotes Project related production bore / drill hole

All units are mg/L

7.2.5.5 Final Voids and Pit Lakes

Pit lake modelling to assess final void conditions post closure has been undertaken by Groundwater Resource Management in 2017 as part of the hydrogeological investigation. Preliminary results have been presented here, however the final report was still pending at the time of completed this MCP. All methods and assumptions will be detailed in the next revision of the MCP.

The pit lake modelling indicates all final voids will act as groundwater sinks following mine closure when groundwater levels rebound. It is expected that groundwater inflows and direct rainfall will be the source of pit lake water, however, with evaporative losses exceeding rainfall for the region (Table 8), it is considered that pit lakes will form permanent groundwater sinks, with pit lake levels below the ambient groundwater level over the 500-year simulation period.

The pit lake model will be refined once further hydrological assessment has been completed and details of each post closure pit catchment has been calculated. Results from the updated model will be presented in the next revision of the MCP.

Closure considerations relating to final voids and pit lakes are discussed in Section 7.9.2.

Early indications (pers comms Rob Garnham, Groundwater Resource Management 2017) support the conceptual hydrogeology assessment indicating fractured rock aquifers occur within the resource areas and are not interconnected with the PEC calcrete aquifers.

7.2.6 Hydrology

The Project is located within the lower reaches of the Lyons River catchment which forms part of the Gascoyne Surface Water Proclamation Area under the RIWI Act (DoW 2009a). A major tributary of the Gascoyne River, the Lyons River is located along the southern boundary of the Project, and flows in a generally westerly direction. The Edmund River, which is a tributary of the Lyons River, is associated with the western boundary of the Project and flows in a southerly direction. Both rivers are ephemeral and only flow following rainfall, although permanent or semi-permanent waterholes occur along their length. Local surface water features are presented in Figure 2.

Perennial pools are present along the Lyons River (southwest of the Project area), Rockhole Creek (northwest of the Project area) and Pimbyana Creek (southeast of the Project area), however springs and soaks are not known to occur within the Project area.

The downstream catchment of the Lyons River is the Gascoyne River, which supplies irrigation water to the Carnarvon district from direct river flows (opportunistic) and significant groundwater recharge to the underlying sand aquifer (DoW 2011). Stream flow contributions of the Lyons River to the Lower Gascoyne and coastal plain is considered significant (DoW 2009b).

The beneficial use and environmental values of surface flows from the Lyons and Edmund Rivers in the upper Gascoyne catchment are riparian vegetation, intermittent pools with associated GDEs and groundwater recharge.

7.2.6.1 Surface Water Quality

Due to the intermittent nature of rainfall in the Gascoyne region and ephemeral nature of stream flows, surface water samples have been obtained by Hastings from two temporary pools within the Lyons River and Fraser Creek following a large rain event in October 2016. The physical and chemical parameters reported from these pools is not considered representative of surface water quality due to evaporative concentration of solutes, however, results are presented in Table 11.

As part of on-going hydrological assessment, water samples from running streams will be obtained following rain events of sufficient magnitude to generate adequate stream flows, on an opportunistic basis. Samples will be obtained, where possible, from within the proposed mine activity envelope, as well as up-gradient and down-gradient of proposed disturbance. Updated results, where available, will be presented in the next revision of the MCP.

7.2.6.2 Regional Hydrological Assessment

A preliminary hydrological assessment was undertaken by JDA Consultant Hydrologists (2017) to assess the impacts of the Lyons River, Yangibana Creek and Fraser Creek on the Project design. The Lyons River hydrological model was developed to generate flow hydrographs for a detailed hydrodynamic model of the Fraser Creek and Yangibana Creek catchments. This detailed model assessed flood conditions that are likely to impact on proposed mine infrastructure of the Project during operations and post closure, the findings have been used to determine where surface water management structures are required.

The modelled scenario most applicable to assessing possible impacts to post closure landforms, particularly TSFs, is the Probable Maximum Flood (PMF) inundation depth. Figure 9 presents the PMF inundation depth in relation to the proposed site layout.

7.2.7 Surface Water Management

Based on the assessment of the impact of regional and local flood waters on the proposed mine infrastructure a combination of diversion channels, floodways and culverts would be required to mitigate impacts associated with surface water flows in the Project area (JDA 2017). Those structures relevant to the post closure landscape include Yangibana Creek diversion structure and floodways and culverts for roads retained post mining for pastoralists.

The Yangibana mining area is located in the upper reaches of Yangibana Creek, within a number of minor tributaries, flowing in a generally south-west direction within ephemeral drainage lines which ultimately discharge into the Lyons River. Diversion of these drainage networks would be required to protect the integrity of proposed Yangibana WRLs and to prevent flooding of the open pits. The preliminary surface water assessment completed by JDA (2017) identified that a 2,250 km long diversion channel would be required to divert floodwaters from the Yangibana Creek tributaries around the proposed Yangibana open pits and WRLs, and back into the Yangibana Creek. Figure 10 presents preliminary preferred option for the Yangibana Creek diversion.

The Bald Hill and Fraser's mining areas are located within the tributaries of Fraser Creek. Both open pits are situated almost directly on the upper reaches of these tributaries, with local drainage away from the open pits.

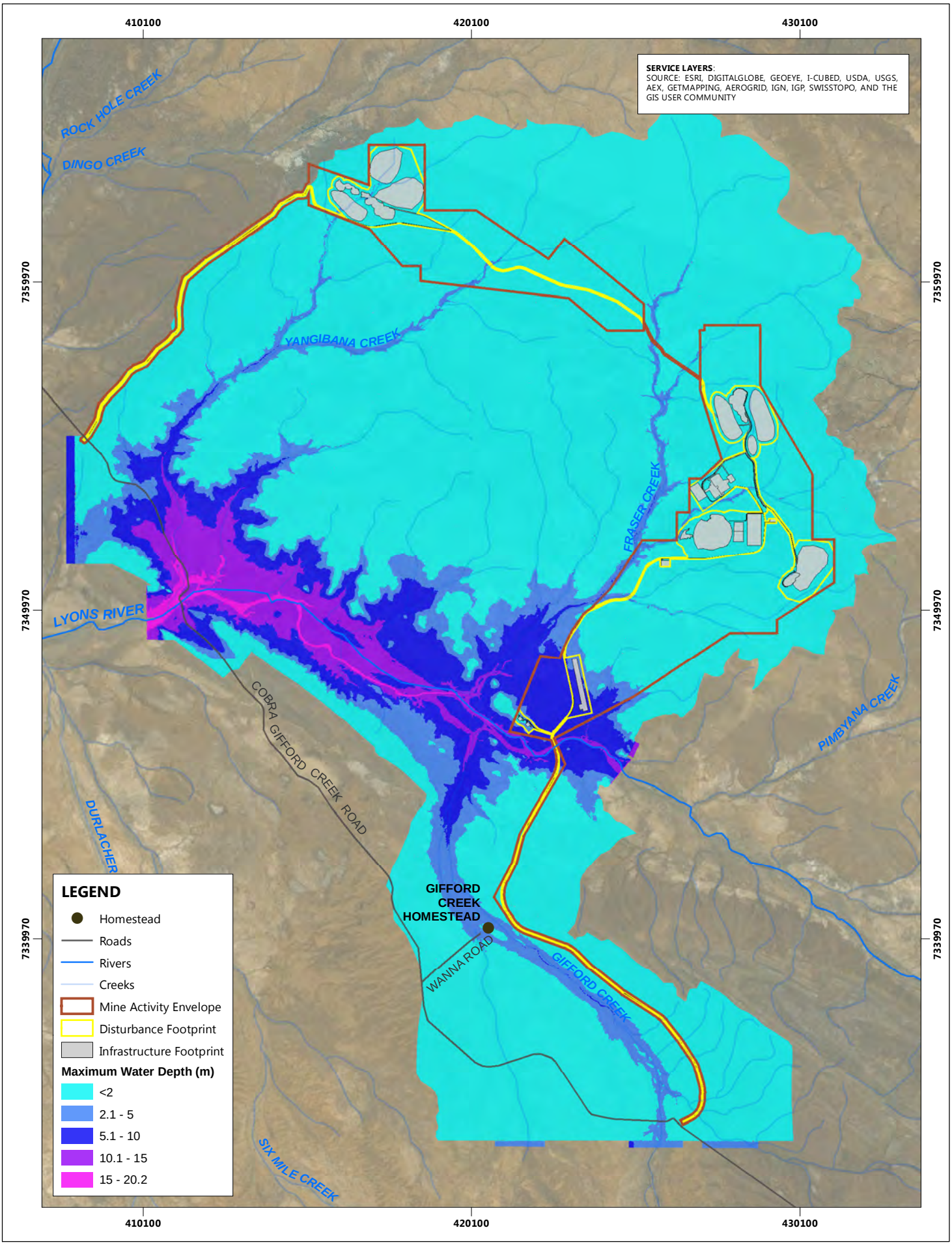
Appendix F presents the preliminary hydrology assessment.

Table 11: Surface Water Quality Intermittent Pools - October 2016

	Chloride (mg/L)	Sulphate (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Iron (mg/L)	Arsenic (mg/L)	Uranium (mg/L)	Total Dissolved Soils (mg/L)	Total Suspended Solids (mg/L)
Quantitation Limit	5	1	0.1	0.1	0.1	0.1	0.01	0.001	0.001	5	5
Lyons River Pool	430	290	290	23	38	88	0.08	0.001	0.004	1200	6
Fraser's Cr Pool	30	<1	23	22	43	17	0.45	0.002	0.001	330	<5
Australian Drinking Water Guideline	250	250	180	-	-	-	0.3	0.01	0.017	600	-

Notes: Elements reporting concentrations below laboratory detection limit, and not presented in the table include Cd (<0.002); Al, Cr, Cu, Pb, Ni, Zn and nitrate (<0.01); Se and Th (<0.001).

Shading indicates analytes exceeding Australian Drinking Water Guidelines (NHRMC 2011)



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DATUM: GDA 1994
UNITS: METER

DATA SOURCES:
FLOOD INFORMATION: JDA CONSULTANT HYDROLOGISTS, JANUARY 2017

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PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	17/01/2017

N

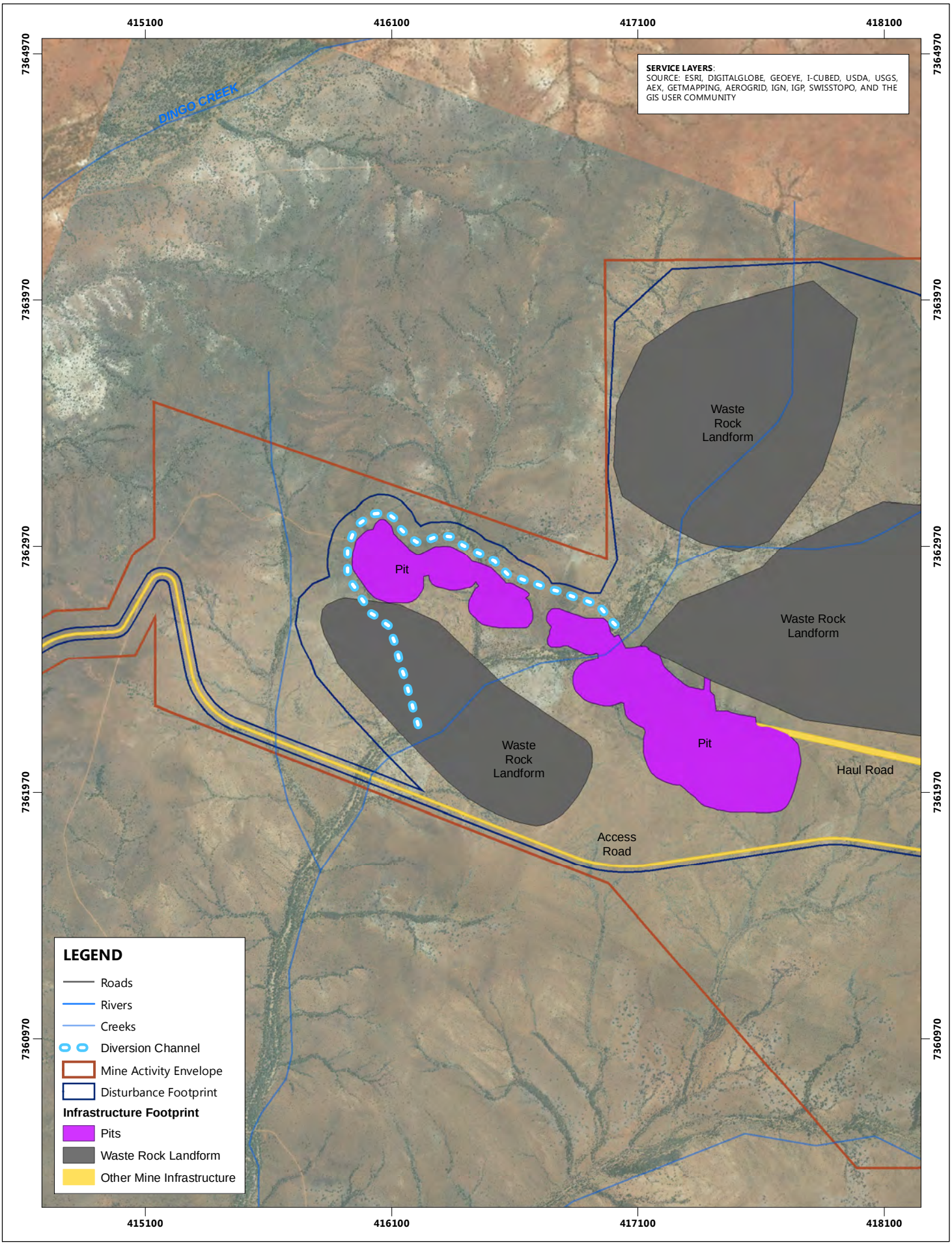
0 1 2 3 4 km

PROBABLE MAXIMUM FLOOD INUNDATION DEPTH

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 09



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DATA SOURCES:
CREEK DIVERSION: JDA CONSULTANT HYDROLOGISTS, JANUARY 2017

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PROJECT NO: 3402-15

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0	JN	ERR	17/01/2017

N

0 100 200 300 400 500 m

PRELIMINARY YANGIBANA CREEK DIVERSION STRUCTURE

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 10

7.2.8 Seismicity

The Geoscience Australia Atlas of Seismic Hazard Maps of Australia (Leonard, *et. al.* 2012), the peak ground acceleration in the area for return period of 500 years has been estimated to be 0.07g.

7.2.9 Geotechnical Data

Geotechnical assessments are being undertaken as part of the DFS for WRLs and TSFs. The next revision of the MCP will include details of these geotechnical assessments.

7.2.9.1 Open Pits

Snowden Mining (2017) completed a geotechnical slope assessment of the Bald Hill and Fraser's pits. The inputs into the geotechnical model included a number of uncertainties (pers comms Frank Blanchfield, Snowden, 2017):

- low to moderate geological/structural confidence;
- unreliable structural orientation data;
- uncertain hydrogeological conditions;
- lack of data for sectors around each pit; and
- uncertain material strength parameters for the saprolite unit.

Snowden (2017) recommend that the preliminary slope designs presented in Figure 11 and Figure 12 (Bald Hill and Fraser's pits, respectively) should undergo further geotechnical assessment once the geological model has been improved, following completion of structural and geotechnical drilling and laboratory analysis of relevant samples.

As it is anticipated that most of the slopes in the ultimate pit shells will be below the watertable, groundwater pressures will have significant impact on wall stability, particularly along areas where slopes were designed steeply on a deep portion of the pit. Snowden (2017) recommends that a comprehensive hydrogeological investigation be undertaken to verify the assumptions used in slope stability analysis.

Full details of the geotechnical assessment will be included in the next revision of the MCP, with full report appended.

Figure 11: Preliminary Slope Design - Bald Hill Pit

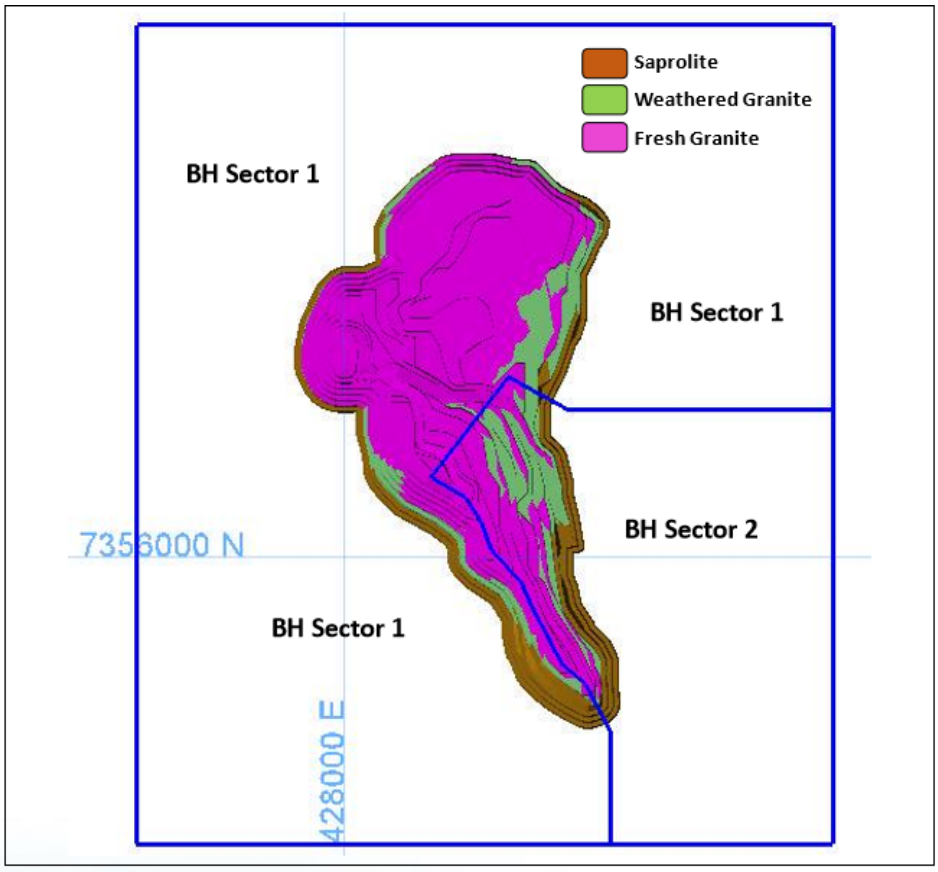
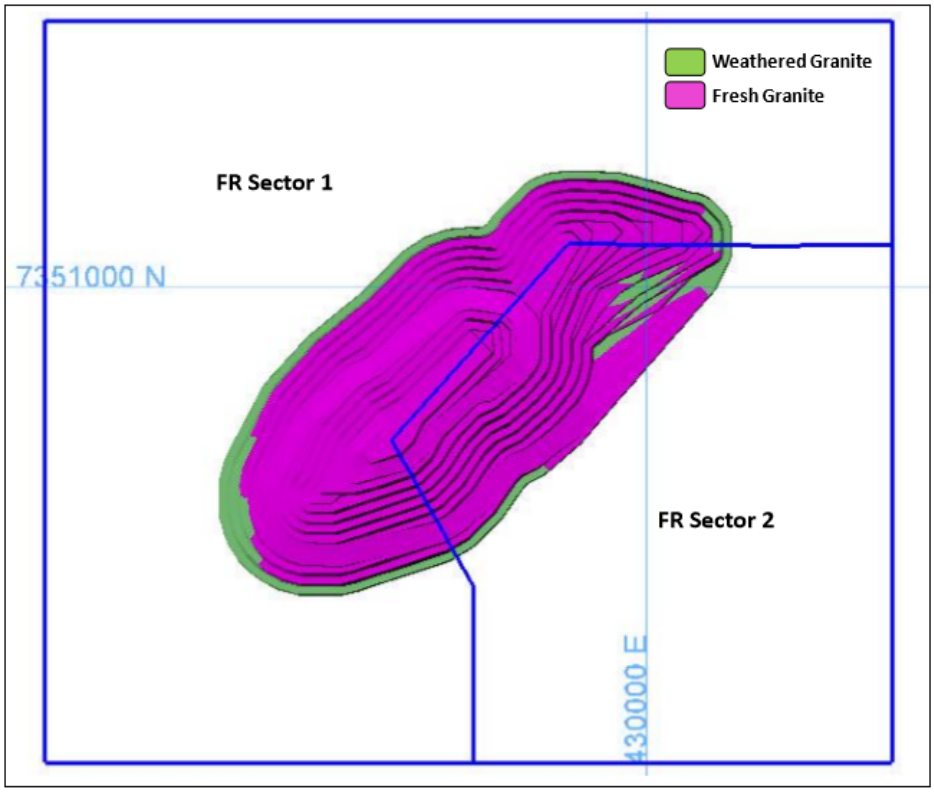


Figure 12: Preliminary Slope Design - Fraser's Pit



7.3 FLORA AND FAUNA

7.3.1 Flora and Vegetation

Biological assessment of flora and vegetation, including targeted conservation significant flora searches, within the Yangibana tenement area was completed by Ecoscape (Australia) Pty Ltd (2015a). Appendix G presents the flora and vegetation report.

Vegetation condition across the 55,000 Ha study area ranged from Poor to Pristine, with 71% of sites in Excellent condition. Generally, riparian vegetation associated with drainage lines were in lesser condition compared with upland sites, due to impacts from weed infestations and grazing by cattle and other hooved mammals.

A total of 472 vascular flora taxa were recorded in the study area. Eight priority flora listed under the *Wildlife Conservation Act 1950* (WC Act) (WA) were recorded in the study area, two of which were recorded within the proposed mine activity envelope (Figure 13):

- *Acacia curryana* (listed as Priority 1 (P1)) – recorded in the mine activity envelop;
- *Rhodanthe frenchii* (P2) – recorded in the mine activity envelop;
- *Solanum octonum* (P2);
- *Wurmbea fluviatilis* (P2);
- *Gymnanthera cunninghamii* (P3);
- *Sporobolus blakei* (P3);
- *Goodenia berringbinensis* (P4); and
- *Goodenia nuda* (P4).

Acacia curryana was particularly poorly known with few populations previously recorded across a restricted range, with only four previous records. *Acacia curryana* was abundant and widespread within the study area, frequently occurring as a dominant species of the vegetation.

No Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC) were identified during the desktop study or field survey. No threatened flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* EPBC Act (Cwth) and WC Act were recorded in the study area.

58 taxa were recorded as having significant range extensions or filling substantial range gaps in species distribution. Additionally, one undescribed species (*Elacholoma sp.* 'Showy Flowers') was recorded in the study area but outside the proposed mine activity envelope.

Twenty-four introduced species (weeds) were recorded within the study area. Of these, **Argemone ochroleuca* (Mexican Poppy) and **Datura leichhardtii* (Thornapple) were both recorded within the proposed mine activity envelope, and are Declared Pests listed under the *Biosecurity and Agriculture Management Act 2007* (WA). Both species require some form of management to alleviate impact, reduce the numbers or distribution, or prevent/contain the spread (refer to Section 7.9.3).

Of the twenty vegetation types recorded within the study area, twelve are present within the proposed mine activity envelope. None of the mapped vegetation types are restricted to the proposed mine activity envelope. Three vegetation types occupy a total of 90% of the proposed disturbance footprint (Figure 13), all three being represented in the broader Yangibana tenement area. All other mapped vegetation types represent less than 6% of the proposed disturbance footprint.

One vegetation type represents a GDE (presence of *Eucalyptus camaldulensis)*, and three other vegetation types represent potential GDEs (presence of *Eucalyptus victrix*). General GDE vegetation types are located outside the proposed mine activity area, except where linear infrastructure crosses the Lyons River and its tributaries (Figure 13). Section 7.9.2 further discusses impact on the Project on GDE vegetation types.

Following completion of the flor and vegetation assessment, the southern access road was realigned to allow for stakeholder and hydrology considerations. A preliminary assessment of likely vegetation types and fauna habitat in this new alignment was undertaken by Ecoscape (Australia) Pty Ltd (2017).

The outcomes of the preliminary assessment indicate that two land systems not found within the larger study area are within the new alignment area, and as such a Level 1 survey is recommended to confirm vegetation types and the presence of any conservation significant species or communities. Appendix H presents the preliminary assessment.

7.3.2 Terrestrial Fauna

Biological assessment of terrestrial fauna and Short Range Endemic (SRE) species within the Yangibana tenement area was completed by Ecoscape (Australia) Pty Ltd (2015b). Appendix I presents the terrestrial fauna report.

A total of 134 vertebrate fauna species were recorded in the 55,000 Ha study area over two phases of survey, which consisted of 20 species of mammal (12 species of non-volant mammals, eight species of bat), 85 species of bird, 25 species of reptile and four species of amphibian.

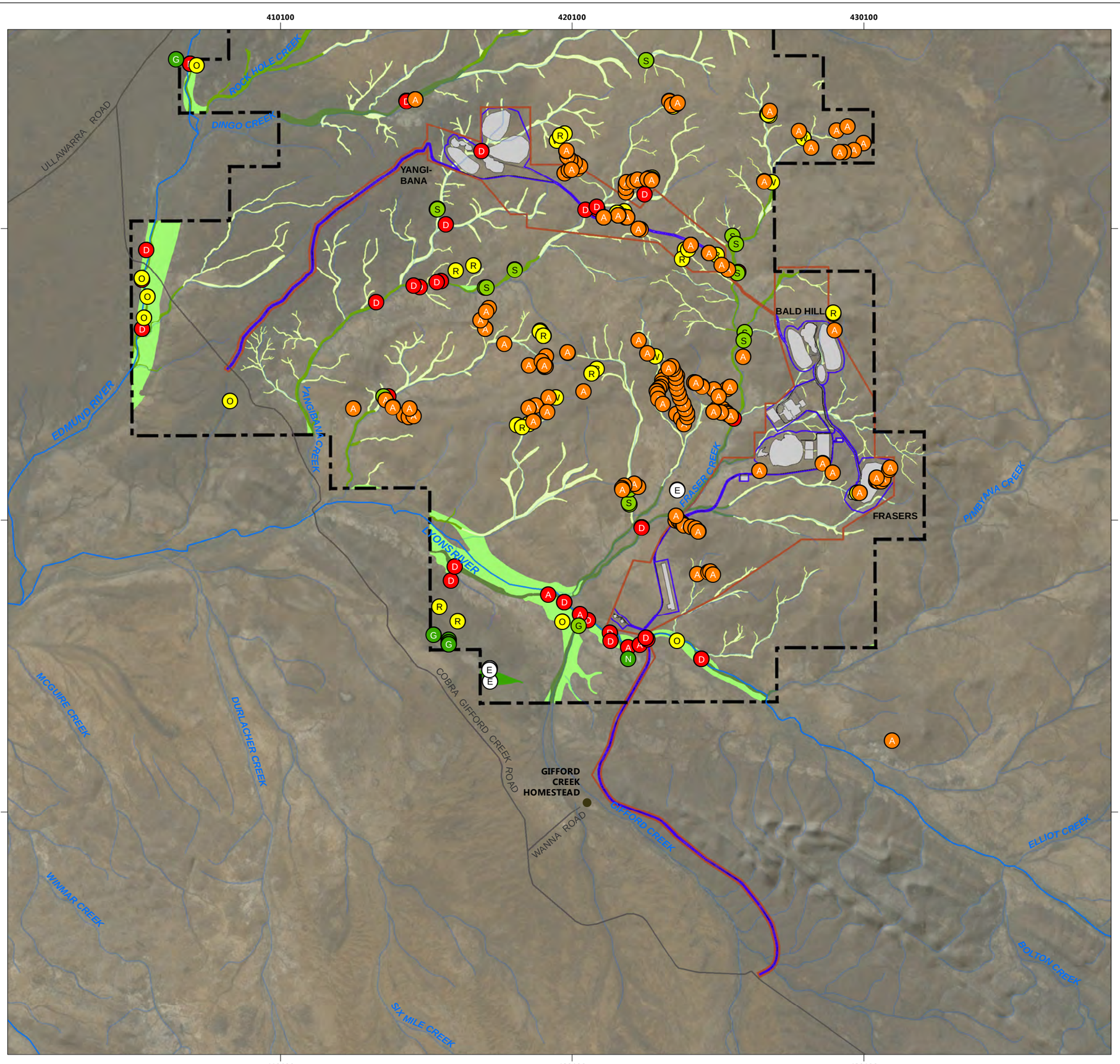
One species of conservation significance was recorded in the study area: *Sminthopsis longicaudata* (Longtailed Dunnart; DPaW P4). In addition, *Falco hypoleuca* (Grey Falcon; listed as a Schedule 1 species under the WC Act) was recorded 3.5 km south of the study area, but within the area of the proposed southern access road (Figure 14).

Historic mounds of *Pseudomys chapmani* (Western Pebble-mound Mouse; DPaW P4) were recorded throughout the study area. Based on the guide for the indication of presence and activity of the Western Pebble-mound Mouse, all mounds were older than 50 years, indicating no recent or current occupation of this species within the study area.

The study area was characterised by five habitat types (Figure 14), namely rocky plain and hills, sandy plains, granite outcrop, major river and minor creek line. Of these, the rocky plain and hills is the most widespread habitat type (75%), followed by sandy plains (12%). The remaining three habitats, granite outcrops, major river and minor creek line were recorded from isolated areas of smaller extent, each less than 10%. All habitat types were also recorded from the wider region and are not thought to be unique to the study area.

Following completion of the flor and vegetation assessment, the southern access road was realigned to allow for stakeholder and hydrology considerations. A preliminary assessment of likely vegetation types and fauna habitat in this new alignment was undertaken by Ecoscape (Australia) Pty Ltd (2017).

The outcomes of the preliminary assessment indicate that two land systems not found within the larger study area are within the new alignment area, and as such a Level 1 survey is recommended to confirm vegetation types and the presence of any conservation significant species or communities. Appendix H presents the preliminary assessment.



LEGEND

- Homestead

Conservation Significant Flora

Priority 1
- *Acacia curryana*

Priority 2
- *Rhodanthe frenchii*
- *Solanum octonum*
- *Wurmbea fluviatilis*

Priority 3
- *Gymnanthera cunninghamii*
- *Sporobolus blakei*

Priority 4
- *Goodenia berringbinensis*
- *Goodenia nuda*

Other Significant Flora
- *Elacholoma* sp. Showy Flower

Declared Plants
- *Argemone ochroleuca*
- *Datura leichhardtii*

- Roads
- Rivers
- Creeks
- Flora and Fauna Survey Area
- Mine Activity Envelope
- Disturbance Envelope
- Infrastructure Footprint

Potential GDEs

Phreatophytic Vegetation Types
- EcMgCc

Vadophytic to Weakly Phreatophytic.
- AcAsCc
- AcEt
- EvCc
- EvReMg

DATA SOURCES :
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

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KEY FLORA AND VEGETATION FEATURES OF THE YANGIBANA PROJECT

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

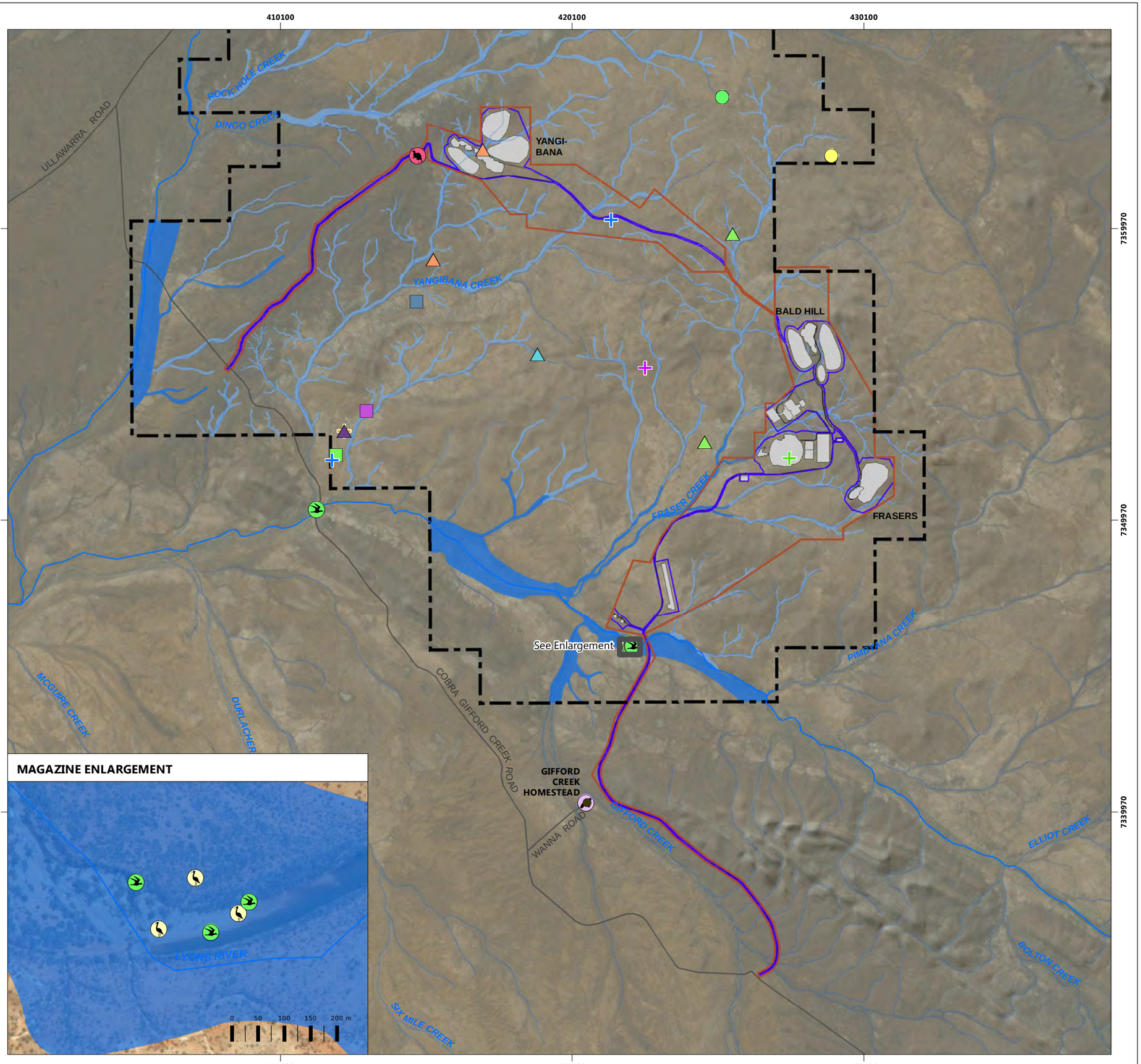
SCALE: 1:130,000 @ A3

0 1 2 3 4 5 km

PROJECT NO: 3420-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	27/01/2017

FIGURE 13



LEGEND

Conservation Significant Fauna

- Grey Falcon (VU, EPBC Act; Schedule 1, WC Act
- Eastern Great Egret (no longer listed under WC Act or EPBC Act)
- Rainbow Bee-eater (no longer listed under WC Act or EPBC Act)
- Long-tailed Dunnart (Priority 4, DPAW)

Potential SRE Species

- Acanthodillo sp. B16
- Aganippe sp. B21
- Aname sp. B19
- Beierolpium 8/2 sp.
- Beierolpium 8/3 sp.
- Buddelundia sp. B59
- Buddelundia sp. B60
- Cryptops sp.
- Cubaris sp. B07
- Linnaeolpium sp. B04
- Lychas `hairy tail group`
- Lychas `multipunctatus group`
- Synothele sp. B14

Fauna Habitat Mapping

Significant Fauna Habitat

- Major River
- Minor Creekline

- Flora and Fauna Survey Area
- Mine Activity Envelope
- Disturbance Envelope
- Infrastructure

DATA SOURCES:
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

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KEY TERRESTRIAL FAUNA AND HABITAT TYPES OF THE YANGIBANA PROJECT

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:130,000 @ A3

0 1 2 3 4 5 km

PROJECT NO: 3420-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	27/01/2017

FIGURE 14

7.3.2.1 Short Range Endemics

Overall, 935 specimens belonging to 24 species in seven SRE groups were collected during the terrestrial fauna biological assessment (Ecoscape 2015b). Pseudoscorpions and terrestrial slaters were most diverse with six and five species, respectively. Spiders, scorpions and centipedes were represented by three species each, and centipedes and snails were present with two species.

None of the SRE species recorded within the study area were of conservation significance.

Three potential SRE species occur within the proposed mine activity envelope (Figure 14):

- Linnaeolpium sp. B04;
- Beierolpium 8/3 sp.; and
- Aname sp. B19.

The habitat of these species is associated with the dendritic pattern of surface hydrology and GDEs, which provide shade, leaf litter and moisture. This is comparison to the surrounding flat, sparsely vegetated plains and slightly elevated hills, which the majority of the disturbance footprint overlies.

Appendix I presents the terrestrial fauna report.

7.3.3 Subterranean Fauna

7.3.3.1 Local Subterranean Fauna Assessment

Biological assessment of subterranean fauna (troglofauna and stygofauna) within the Yangibana tenement area was completed by Ecoscape (Australia) Pty Ltd (2015c).

A DPaW listed PEC occurs within the study area, and the mine activity envelope intersects the northern portion of this PEC. The PEC is listed as:

> *Priority 1 (P1) Gifford Creek, Mangaroon, Wanna calcrete groundwater assemblage type on Lyons palaeodrainage on Gifford Creek, Lyons and Wanna Stations.*

DPaW refer to the PEC as the “Gifford Creek Calcrete PEC”, which comprises unique assemblages of invertebrates (stygofauna) that have been identified in the groundwater calcretes.

Stygofauna and troglofauna have been found within the proposed deposits in the mine activity envelope. However, the proposed deposits cover a total of approximately 101.5 Ha of the mapped PEC, which equates to only 0.034% of the total PEC area. Figure 15 presents the results of the local subterranean assessment, indicating the location of the PEC in relation to the mine activity envelope.

In total, 236 stygofauna specimens from four families representing ten species were recorded from eight drill holes in the study area. Of the stygofauna recorded during the survey, at least three taxa are likely to be of conservation concern. The records were made from three locations within the mine activity envelope which will not be mined (i.e. prospects that are not economically feasible for mining).

In addition, 11 troglofauna specimens from five orders representing at least five separate species were recorded from six drill holes in the mine activity envelope. All of the troglofauna records are likely to be of conservation concern.

Habitat analysis indicated that there is no obvious link between the calcrete habitats of the PEC and the occurrence of subterranean fauna in the Project area. Geological drill logs and datasets have shown that

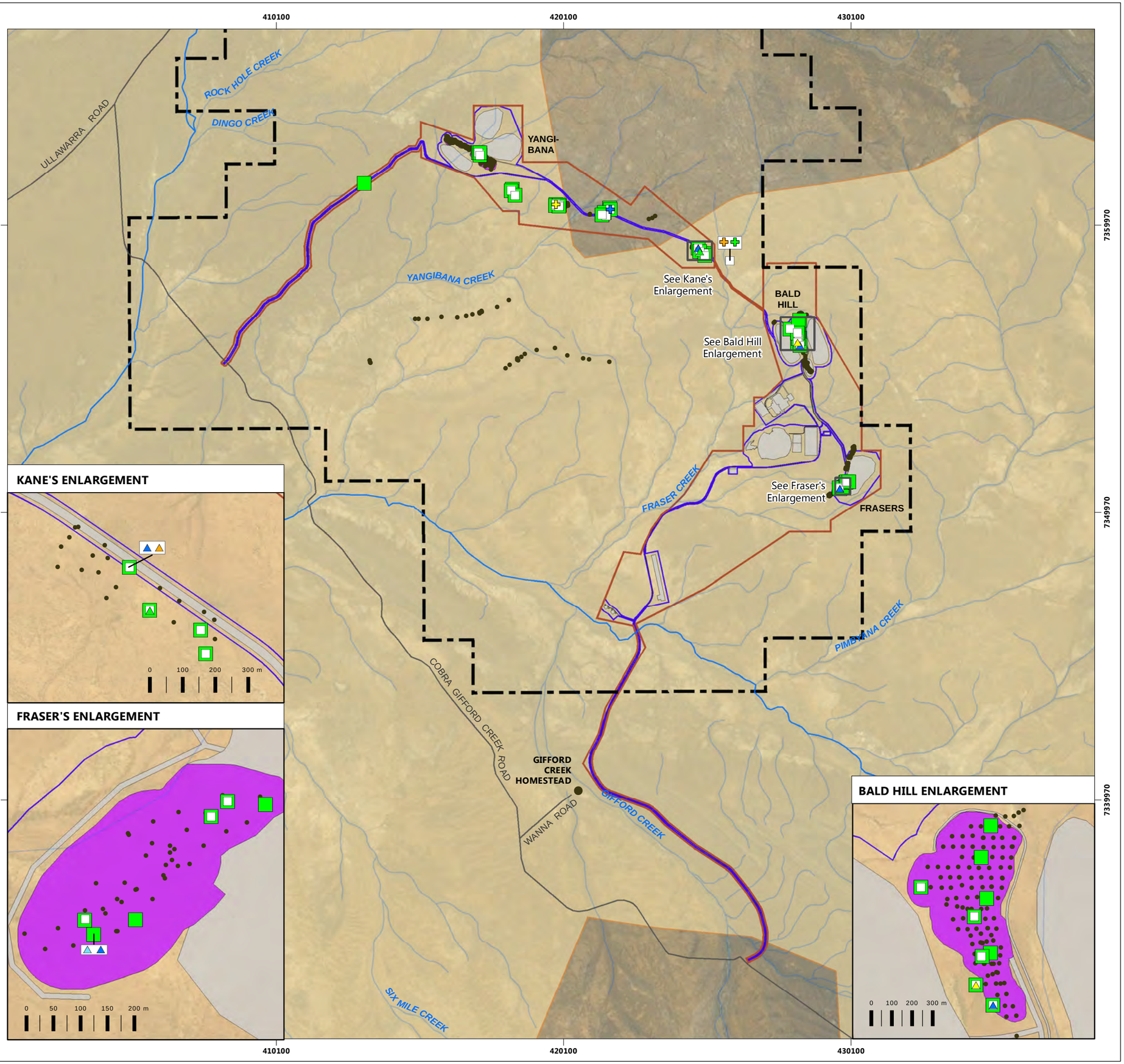
calcrete is not present within the mineral exploration areas of the Proposal, indicating that subterranean fauna habitat is not typical of that recorded from the PEC calcrete areas, although it may overlap and be representative of that on the fringes of the Gifford Creek PEC.

7.3.3.2 Regional Subterranean Fauna Assessment

The findings of the local subterranean fauna assessment completed by Ecoscape (2015c) triggered a broader regional assessment focusing on the Gifford Creek Calcrete PEC. This assessment was undertaken by Bennelongia Environmental Consultants in 2016.

Although the draft report was not available for this MCP, the preliminary results of the regional subterranean fauna assessment (pers comms Stuart Halse, Bennelongia 2016) report a greater diversity and abundance of stygofauna species is represented within the calcretes of the PEC than compared to the deposits of the Project.

The next revision of the MCP will include subterranean fauna assessment results and mapping showing spatial distribution and abundance in the broader region.



LEGEND

- Homestead
- Existing Drillholes

Stygofauna

- Samples

Stygofauna records of conservation concern

- Ameiridae gen. nov. sp. B04
- Areacandona sp. BOS550
- Paramelitidae sp.
- Paramelitidae sp. B49

Troglofauna

- Samples

Troglofauna records of conservation concern

- Geophilidae sp.
- Projapygidae sp. B19
- Scutigerella sp. B09
- Trinemura sp. B29
- Troglarmadillo sp. B60
- Roads
- Rivers
- Creeks
- Flora and Fauna Survey Area
- Mine Activity Envelope
- Disturbance Envelope
- Proposed Pits
- Infrastructure Footprint

Priority 1 Ecological Community

- Gifford Creek calcrete groundwater assemblage type on Lyons palaeodrainage

DATA SOURCES :
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

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SUBTERRANEAN FAUNA WITHIN THE YANGIBANA PROJECT

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
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N

SCALE: 1:130,000 @ A3

0 1 2 3 4 5 km

PROJECT NO: 3420-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	27/01/2017

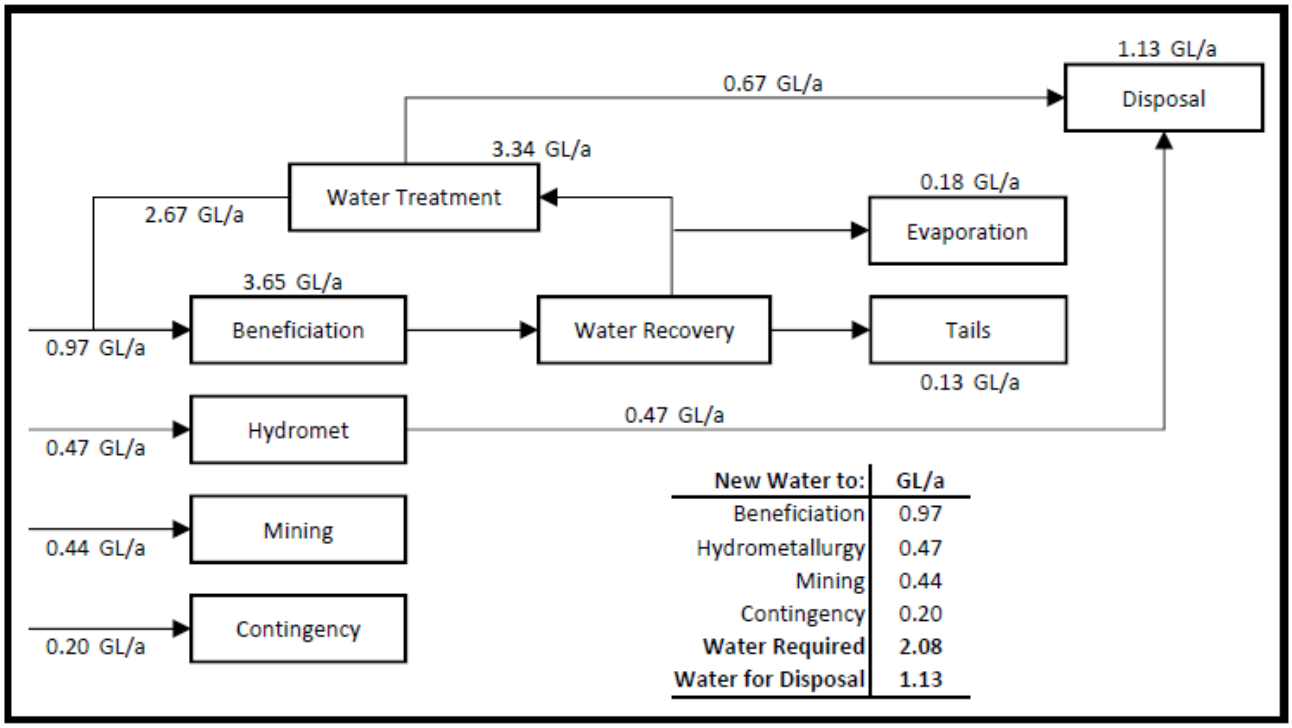
FIGURE 15

7.4 WATER RESOURCES

The Project has an estimated annual water demand of up to 2.5 GL per year, the majority of which will be supplied by groundwater. A linear borefield is proposed along a 12 km ironstone strike and will include pit dewatering bores and sumps.

Water reuse will occur within the processing plant (TSF1 and TSF2 decant water) and for dust suppression from the washdown pad. The majority of the water demand will occur from ore processing (Figure 16), with minor volumes required for dust suppression, fire protection, equipment washdown and potable uses across the Project. Raw water will undergo necessary treatment through a Reverse Osmosis (RO) plant to meet potable water quality parameters.

Figure 16: Preliminary Processing Water Balance



7.4.1 Mine Dewatering and Groundwater Production

Groundwater Resource Management undertook hydrogeological investigation and groundwater modelling in late 2016 – early 2017 to determine predicted dewatering rates for the Project, based on in-pit sumps and two existing production bores adjacent to the Fraser's and Bald Hill deposits (FRW01 and BHW05).

Dewatering rates have been based on expected aquifer conditions, however dewatering rates of individual bores will be within a range of 6 L/sec to 17 L/sec.

7.5 BASELINE RADIONUCLIDE ASSESSMENT

Baseline monitoring commenced in 2015 and were conducted by RadPro (2016a). A number of these are on-going and further data will be reported in the next revision of the MCP. Baseline monitoring included:

- Gamma surveys;
- Dust assessment;
- Radon and thoron concentrations;

- Soil assessment; and
- Water (surface and groundwater).

Appendix E presents the baseline radiation report, presenting all methodologies and complete results.

7.5.1 Gamma Surveys

Gamma survey measurements were taken using three methods: handheld instrument gamma surveys, interpretation of an aerial radiometric survey and integrating monitors.

Results from surveys report that gamma levels are elevated above outcropping ironstone, which is associated with mineralisation in the Project area, as summarised in Table 12. Average gamma dose rates are 0.23 $\mu Gy.h^{-1}$ in areas away from the outcropping mineralisation, and dose rates averaging 0.37 $\mu Gy.h^{-1}$ over the deposits, but ranging up to 1.26 $\mu Gy.h^{-1}$.

Table 12: Ground Survey - Gamma

Location	Average ($\mu Gy.h^{-1}$)	Maximum ($\mu Gy.h^{-1}$)	Minimum ($\mu Gy.h^{-1}$)	Number of Locations
Bald Hill – over mineralisation	0.41	1.15	0.19	129
Fraser's – over mineralisation	0.31	1.26	0.20	65
On Deposit (combined)	0.37	1.26	0.19	194
Processing Plant area	0.22	0.35	0.18	140
Camp area	0.25	0.34	0.19	28
Airstrip area	0.21	0.42	0.16	30
Off Deposit (combined)	0.23	0.42	0.16	198
Background	0.20	0.24	0.15	24
Exploration	0.29	0.42	0.22	47

An aerial geophysical survey was conducted in 2016, which included radiometrics. The aerial radiometrics measured the gamma radiation from radionuclides in the uranium and thorium decay chains, along with gamma from potassium 40 and cosmic radiation. RadPro (2016a) highlight that the radiometric survey provides a contextual rather than qualitative analysis and shows the wide variation in natural gamma radiation levels in the Project region, however, higher gamma levels are associated with the outcropping ironstone.

Gamma levels were also monitored at passive monitoring locations using Thermoluminescent Dosimeters (TLDs) badges supplied by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Personal Radiation Monitoring Service. Monitoring commenced in 2015 at three initial locations, with the program expanded in 2016 to include all passive monitoring stations. Results of monitoring are presented in Table 13.

The positional TLDs support gamma survey data, indicating a higher dose rate over the near surface and outcropping mineralisation. Radiation Professionals (2016a) report that the average gamma dose rates are analogous to those reported for other operations with similarly enhanced radionuclides.

Table 13: Positional Monitoring - Gamma

Location	Average (µGy.h-1)	Monitoring commencement date
Gifford Creek Homestead	0.08	June 2015
Yangibana North (adjacent to sample storage yard)	0.18	June 2015
Yangibana North (over mineralisation)	1.21	November 2015
Bald Hill South*	0.34	May 2016
Bald Hill East*	0.37	May 2016
Fraser's East*	0.19	May 2016
Fraser's South*	0.20	May 2016
Fraser's North*	0.18	May 2016
Hatchet West*	0.14	May 2016
Bald Hill North A*	0.22	May 2016
Fraser's West A*	0.61	May 2016

Note: * Result based on a single monitoring period

7.5.2 Dust

Baseline environmental dust sampling was conducted across the project area from 2015 onwards using low volume pumps to collect samples over a sampling period of at least four hours to determine values for alpha activity concentration in air. Methodologies used for collection and analysis of samples are reported in RadPro (2016a), presented in Appendix E.

Monitoring sites were selected away from active exploration drilling to avoid sampling mechanically generated dust, but generally corresponded with passive monitoring points (where positional gamma monitoring by TLD badge and radon and thoron monitoring). In some areas of the Project where passive monitoring had not yet been established, sampling was conducted at a representative point and located by GPS.

All results returned alpha activity concentrations below the minimum detection level (MDL). To estimate values for airborne alpha activity concentration, RadPro (2016a) assumed that any result below the MDL was equivalent to the MDL value, thus using a very conservative approach, and results are clear over-estimations.

Table 14: Airborne Activity Concentration

Location	Average (adps.m-3)	Maximum (adps.m-3)	Minimum (adps.m-3)	Number of Locations
On Deposit	0.010	0.019	0.005	15
Off Deposit	0.009	0.013	0.005	9

Results, presented in Table 14, are given in adps.m^{-3}, where adps is alpha decays per second (alpha Becquerels) from airborne material captured by sampling. Airborne alpha activity concentrations are similar for all areas of the project, both over the prospects and in areas away from radiologically enhanced mineralisation.

7.5.3 Radon and Thoron Concentrations

Passive radon monitoring commenced in 2015 at four locations around the Project. Monitors were placed in pairs, one measuring radon (Rn222) only and the other measuring radon (Rn222) and thoron (Rn220). Subtraction of the radon only exposure value from the combined exposure allowed measurement of both radon and thoron at each monitoring location. These single use devices provide a measure of the average concentration for the exposure period, ranging from 144 days up to 173 days.

Many of the radon-only monitors returned results below the MDL. For estimation of values for radon and thoron concentrations, RadPro (2016a) assumed that any result below the MDL is equivalent to the MDL value. This approach has been necessary to derive thoron concentrations. This approach is conservative and radon results presented in Table 15 are over-estimations, however RadPro (2016a) conclude that this assumption is realistic based on a comparison with radon data from real time monitoring, presented in Table 16.

Table 15: Passive Radon and Thoron Monitoring

Location	Average Radon ($Bq.m^{-3}$)	Average Thoron ($Bq.m^{-3}$)
Gifford Creek Homestead	9.1	15.5
Yangibana North	10.4	16.9
Bald Hill	9.9	24.6
Fraser's	9.9	29.1

Real time monitoring was conducted using a portable radon detector, which was left in the field for five runs of approximately two days each, sampling air every 30 minutes. Radon results returned an average radon concentration of 20.3 $Bq.m^{-3}$, which is consistent with average radon concentrations across much of Australia (RadPro 2016a).

Table 16: Real-time Radon and Thoron Monitoring

Location	Average Radon ($Bq.m^{-3}$)	Two-sigma Uncertainty*
Gifford Creek Homestead	5.04	1.1
Bald Hill South	14.6	1.8
Bald Hill Central	7.56	1.4
Exploration Camp	32.5	2.8
Proposed Camp Area	43.8	3.4

Note: * Standard Deviation

7.5.4 Soil

Analysis of subsurface materials (up to 1 metre depth) was completed by RadPro (2016a) from samples collected by Hastings during exploration drilling. Assessment of topsoils across the Project has not yet occurred.

The results, summarised in Table 17, indicate that uranium concentrations are relatively consistent across mineralised areas of the Project, while thorium concentrations show a greater variability. This variability is attributed to the association of thorium to the mineralisation. It is important to note samples only represent mineralised areas over deposits, and therefore uranium and thorium concentrations are expected to be lower off-deposit. Average concentrations are considerably higher than the global averages of 10 ppm thorium and 3 ppm uranium (UNSCEAR 2000), again indicative of mineralisation.

Table 17: Surface Materials – Uranium and Thorium

Location	Uranium (ppm)			Thorium (ppm)		
	Average	Maximum	Minimum	Average	Maximum	Minimum
Bald Hill	10.2	44.6	2.4	142.8	1134.5	18.1
Fraser's	6.7	14.1	1.9	52.5	132.7	20.2
Yangibana North	10.7	26.4	2.5	321.6	1472.5	21.4

RadPro (2016a) report that a correlation between recorded the surface gamma dose rate and surface soil radionuclide concentrations exist, supporting the indication that the surface dose rate is highly influenced by the mineralisation.

7.5.5 Water

As discussed in Section 7.2.6.1, Hastings collected two surface water samples from intermittent pools which formed following a rain event in October 2016. Thorium concentrations were below laboratory detection limits, while uranium was reported at concentrations just above detection limits, recording 0.001 mg/L and 0.004 mg/L (RadPro 2016a). Full results of surface water analysis are presented in Table 11.

While groundwater from bores within the ore bodies and nearby pastoral bores reported thorium concentrations below, or close to, laboratory detection limits, uranium concentrations were reported between 0.004 mg/L and 0.079 mg/L. In a number of pastoral bores uranium exceed the Australian Drinking Water Guidelines (NHRMC 2011). Table 18 presents results of groundwater uranium and thorium analysis. Full results of groundwater analysis are presented in Table 10.

Table 18: Regional and Project Groundwater Analysis – Uranium and Thorium

Sample Location	Sample Date	Sampled By	Uranium (mg/L)	Thorium (mg/L)
Minga Well	June 2015	ATC Williams (2015)	0.004	<0.001
Contessi Bore			0.020	<0.001
Edmund Well			0.038	<0.001
Yangibana Production Bore (YGBW1)			0.016	<0.001
Drill hole (RC082)			0.014	<0.001
Fraser's Well			0.025	<0.001
Yangibana Bore			0.029	<0.001
Woodsys Bore			0.009	<0.001
Red Hill 2			0.079	<0.001
Fraser's Well	October 2016	Hastings	0.029	0.002
Windmill Bore			0.038	0.001
Bald Hill			0.029	<0.001
Australian Drinking Water Guideline			0.017	-

Note: Shading indicates uranium concentrations above Australian Drinking Water Guideline (2011).

7.6 SOILS

Soil characterisation was undertaken by Landloch Pty Ltd (2016a) in accordance with DMP (2016) *Guidelines for Mining Proposals in Western Australia*. The report is presented in Appendix K.

Two main soil types were recorded within the proposed disturbance footprint, distribution of each unit dependent on geology, geomorphology and topographical features, as detailed following:

- Dark brown sandy duplex soils ("Hills soils"): associated with the extensive granite geology that forms the low hills and rises across the site, specifically the stone mantles and outcrops of granite and ironstone. This soil type can be divided into an A and B horizon overlying a C horizon of decomposing granite. Soil depths vary from ~20cm up to 50cm. It is considered neutral to slightly acidic that does not vary much through the profile or between sample locations. It is characterised by low salinity levels and a maximum exchangeable sodium percentage below 6%, indicating it is a non-sodic soil.

- Dark brown sandy loam over clay loam soils (“Plains soils”): associated with low relief areas and flood plains of drainage lines. This soil type can be divided into A and B horizons - a thin sandy loam topsoil over clay loam with an overall shallow depth (<30cm). It is strongly alkaline, saline and sodic. Two variations within this soil unit were identified. One variation, associated with drainage lines, will not be impacted by the Project. The second variation has a deeper profile, saline, sodic and clay-rich and has greater mottling. This soil unit variation will interact with proposed mine infrastructure and has the potential to be difficult to manage.

Typical soil unit profiles are presented in Figure 17, and the distribution of soil units is presented in Figure 18.

Indicative soil characteristics are presented in Table 19. The Hills soil unit included a subset of soils located around the Bald Hill deposit which reported some variation in physical and chemical parameters compared to the other Hills soils; a slightly higher pH and higher dispersion index (more dispersive). The management implications of this subset of the Hills soil are discussed in 7.9.4.

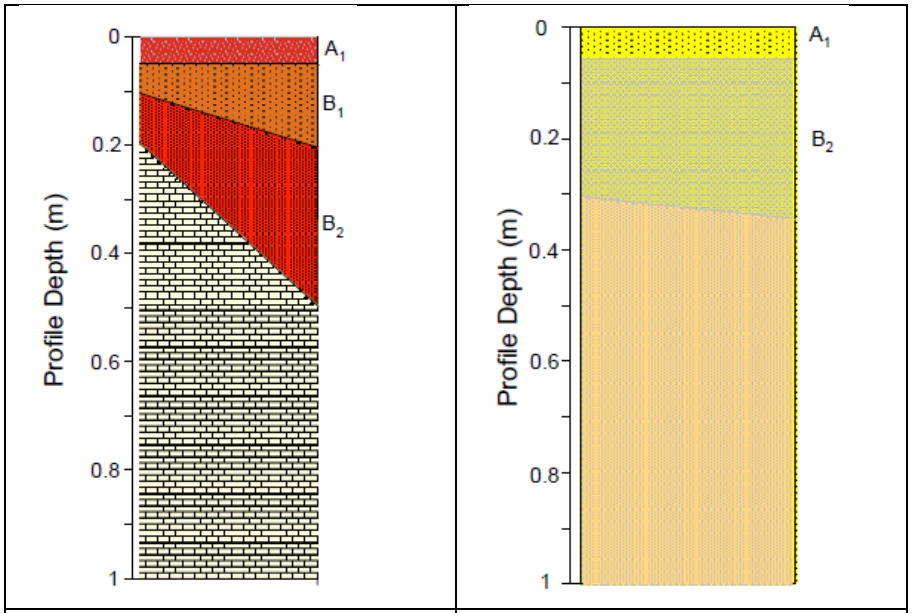
Landloch (2016a) summarise the soil properties as follows:

- Both soils have low fertility (normal for arid zone soils), are clay rich, poorly or not well structured, and represent an erosion risk if used on constructed slopes;
- Limiting factors for each soil type include:
    - Hills soil – presence of a clay-rich subsoil will impact on methods employed for stripping, stockpiling and respreading; and
    - Plains soil – high sodicity has the potential for clay dispersion once free salts are leached from the profile.
- Management requirements of each soil include:
    - Hills soil – treatment for low fertility;
    - Plains soil – specific treatment for sodicity, dispersion risk and low fertility. It has been recommended that this soil type not be disturbed.

The management requirements and implications for use of stockpiled soils of each unit are discussed in 7.9.4.

Table 19: Average Soil Characteristics – Chemical and Physical

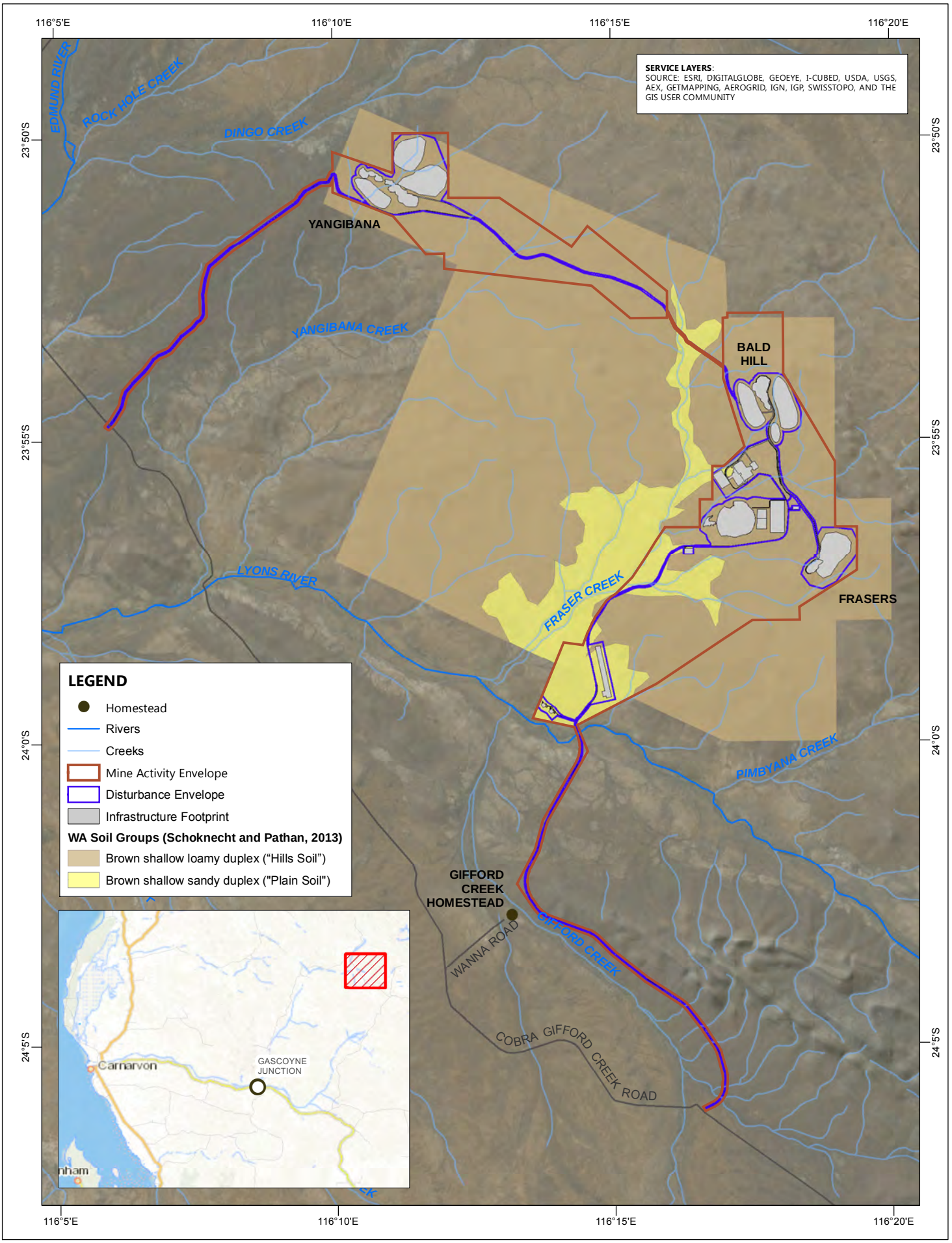
Analyses		Unit	Hills Soil	Hills Soil – Bald Hill area	Plains Soil
$pH_{1:5}$ – Water		pH units	6.60	7.70	8.30
Electrical Conductivity ($EC_{1:5}$)		dS/m	0.01	0.04	4.5
Total Nitrogen		mg/kg	315	390	275
Total Phosphorus		mg/kg	360	340	230
Organic Carbon		mg/kg	0.17	0.23	0.6
Plant Available Nutrients	Phosphorus	mg/kg	21.9	9.6	10.3
	Potassium	mg/kg	215	265	480
	Sulphur	mg/kg	3.9	5.0	20
	Copper	mg/kg	0.7	1.0	0.5
	Iron	mg/kg	13.5	12.6	8.5
	Manganese	mg/kg	6.4	13.4	0.8
	Zinc	mg/kg	0.8	0.5	0.3
Exchangeable Cations	Calcium	meq/100g	2.5	3.5	9.0
	Magnesium	meq/100g	1.8	2.5	1.0
	Potassium	meq/100g	0.3	0.18	0.4
	Sodium	meq/100g	0.15	2.6	1.0
	Aluminium	meq/100g	0.01	0.01	0.01
	Effective Cation Exchange Capacity	meq/100g	4.7	6.6	11.5
	Exchangeable Sodium Percentage	%	3.4	5.4	17.4
Particle Size Distribution	Coarse sand	%	50	37	35
	Fine sand	%	32	42	29
	Silt	%	6	11	13
	Clay	%	12	10	23
Dispersion Index		Class	2	2 - 7	2 - 7



A typical Hill soil unit profile | A typical Plain soil unit profile

Figure 17: Typical Soil Profiles of the Yangibana Project

(Source: Landloch 2016a)



SCALE: 1:150,000 @ A4

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES:
TOPOGRAPHIC LAYERS: GEOSCIENCE AUSTRALIA
SOIL MAPPING: LANDLOCH, NOVEMBER 2016
(DATE OF SURVEY 24 TO 27 JULY 2016)

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	17/01/2017

N

0 1 2 3 4 km

MAPPED SOIL TYPES OF THE YANGIBANA PROJECT

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 18

7.7 WASTE ROCK AND TAILINGS CHARACTERISATION

Waste rock characterisation was undertaken by Graeme Campbell and Associates and preliminary tailings characterisation by the Hastings metallurgical team. Results of both geochemical characterisation was reviewed and reported on by Trajectory on behalf of Hastings (2016). Additional waste rock and tailings characterisation was undertaken by Radiation Professionals (2016b), focusing on radionuclide concentrations in the waste streams in order to determine specific management of materials.

Results of the characterisation reports are summarised in the following sections, and implications for closure are discussed in Sections 7.8.1 and 7.9.5. Appendix L presents the waste rock and preliminary tailings characterisation report and Appendix M presents the radiation waste characterisation report.

7.7.1 Waste Rock Characterisation

In general, characterisation reported waste rock lithologies to be non-acid forming (NAF), and benign with respect to elemental enrichment, circum-neutral to alkaline with varying salinity.

Total Sulphur values less than 0.1% were reported, but were generally less than 0.01%, indicating the absence of sulphide minerals. Sulphur from the sulphate mineral gypsum may occur locally within the range of 0.1-1.5% in the surficial colluvium and waste-saprolite zone.

The absence of sulphide minerals also points to the reason for low enrichment of minor elements in the waste lithologies. Concentrations of trace elements were below or close to those typically recorded for soils, regoliths and bedrocks free from mineralisation influences. The Ironstone-Saprock samples stood out with the highest degree of trace element enrichment.

Geochemically, the colluvium, waste saprolite, waste saprock and waste bedrock lithologies are benign and will not impact on water quality or rehabilitation success. Water extraction testwork showed minor element concentrations were either below or close to the respective detection limits. Fluoride concentrations were 1.0-5.9 mg/L and may reflect occurrences of 'tracefluorites' (CaF_2).

Physically, the colluvium, waste saprolite, waste saprock and waste bedrock lithologies comprise varying clay contents with the cation-exchange complex of the clay-mineral suites being variously sodic. The presence of gypsum may offset the dispersion potential of the clay minerals. One sample, a Fenitic-Granite-Saprock from Fraser's Pit dispersed. This represented a deep saprock sample and during mining it is likely that units such as this will be mixed with adjoining bedrocks, thereby reducing the overall dispersive tendency of this stratum when tested in isolation.

Approximately 8-9% of the mined waste rock will have radionuclide concentrations higher than 1 Bq/g and will be classified as radioactive material. These zones are thought to be generally proximal to the orebody, primarily in the ironstone (RadPro 2016b).

The comprehensive exploration programme conducted by Hastings, reports that the majority of waste rock does not have naturally occurring radioactive material (NORM) above 1 Bq/g. However, the small proportion of the waste rock with NORM above 1 Bq/g, will be subject to a monitoring and management (Hastings 2016c).

The mineralogy associated with the project is not one which is associated with asbestiform minerals.

7.7.2 Tailings Characterisation

Three tailings streams were generated from bench scale testwork, providing a preliminary, and reasonably indicative, characterisation of tailings.

TSF1 is expected to be geochemically benign, NAF and with only slight enrichments of metals in both the tailings solids and contact waters. Trace element concentrations are either below or close to those typically recorded for soils, rocks and sediments derived from non-mineralised terrain. The TSF1 tailings stream is expected to have radionuclide levels less than 1 Bq/g based on radiation waste characterisation (RadPro 2016b), and will not be classified as radioactive material.

TSF2 is expected to be geochemically benign, and slight to moderate enrichments of metals in both the tailings solids and contact waters. Trace element concentrations are either below or close to those typically recorded for soils, rocks and sediments derived from non-mineralised terrain. TSF2 tailings will have radionuclides levels exceeding 1 Bq/g, and will be classified as radioactive material. Radionuclides in these tailings will not be water soluble.

TSF1 and TSF2 tailings slurry waters were alkaline (pH 9-10) and slightly brackish (TDS 1,100-1,400 mg/L) corresponding mostly to chlorides and sulphates of sodium. Carbonate-alkalinities are likely to be in the low hundreds of mg/L range. Trace element concentration were typically below detection limits pertinent to environmental contexts.

TSF3 tailings solids are expected to be NAF, though strongly gypsiferous (Total-S ~10%) due to neutralisation of the acidic raffinate with calcite. The tailings may be slow or difficult to drain and consolidate to a trafficable surface. TSF3 tailings will have radionuclide levels exceeding 1 Bq/g and will be classified as radioactive material. RadPro (2016b) report that chemical constituents in these tailings will be water soluble due to the mineral cracking during the baking and sulphuric acid treatment in the hydrometallurgical process.

A pilot plant is expected to be constructed during the detailed engineering design phase of the Project, where samples of all three tailings streams will be characterised to determine management requirements. The next revision of this MCP will be updated with the results of tailings characterisation.

7.8 OTHER CLOSURE RELATED DATA

7.8.1 Landform Design Considerations

As discussed in Section 5.4, a conceptual final landform design for the TSFs and WRLs will be developed as a component of the detailed engineering phase of the Project. A future revision of the MCP will include details of these conceptual designs, with figures and cross-sections to illustrate all necessary parameters to meet the proposed post mining land use.

Landloch (2016b) completed a preliminary landform surface erodibility assessment on the WRLs designs generated during the pre-feasibility study by Snowden Group, assessing three rock types for use as rock armour on rehabilitated landforms. The three rock types were ironstone, weathered granite and fresh granite.

Physical characteristics of surface rock material reported by Landloch (2016b) are summarised in Table 20.

Table 20: Physical Characterisation of Surface Rock

Analyse	Unit	Ironstone	Surface Granite	Weathered Granite
Rock particle density	g/cm^3	3.8	2.9	2
Rock water absorption	%	1.3	3.4	17.1
Slake durability (2nd cycle)	%	99.5	95.5	88.5
Thorium-232	ppm	188	25.4	23.7

A WEPP model was developed to assess slope (batter) erosion potential. Methodologies, assumptions and inputs are detailed in Landloch (2016b), presented in Appendix N. The preliminary findings of the assessment indicate that a combination of Hills soil and rock produces a more erosion resistant surface cover than soils alone. It is important to note that rock materials assessed were those available at surface and had varying degrees of weathering, therefore, the model results have limited applicability in determining landform heights and slope angles. Landloch (2016b) recommend further sampling and assessment of fresh granite and other competent waste rock during the first two years of mining commencing.

7.8.1.1 Waste Rock Landforms

The WRLs will be constructed from NAF waste rock. The volumes of ironstone and fresh granite waste rock dominate the waste inventory and it is expected that the outer surfaces of the WRLs will be primarily of armouring with low erodibility material (Hastings 2016c). WRLs can be water harvesting and concentration of runoff in drains or benches should be avoided, unless benches are very wide. Hill soils should be preserved for respreading on the batter surfaces. Plain soils or suitable subsoils should be spread on top/flat surfaces. Soils should be spread at 100-150mm and integrated into the waste rock with ripping or scarification (Hastings 2016c).

The primary waste lithologies to be mined are ironstone, fresh granite, transitional granite/ironstone (saprock) and weathered granite (saprolite) (Hastings 2016c).

7.8.1.2 TSF 1

As the tailings stream reporting to TSF1 is benign, there are no special requirements to limit seepage or pore water or to encapsulate tailings beyond the requirements to ensure dust control and revegetation outcomes. Armouring of the low outer embankment is proposed.

7.8.1.3 TSF2 and TSF3

As tailings reporting to TSF2 and TSF3 will contain radionuclide levels above 1 Bq/g, both TSFs will require covers of suitable depth for the purposes of mitigating radionuclide readings to acceptable levels, revegetation establishment and armouring of the outer embankment. Should either TSFs be synthetically lined (currently proposed for TSF3), the closure top cover will need to be water shedding and limit infiltration.

7.8.2 Visual Impact

A visual impact assessment of the Project region was completed by Ecoscape (Australia) Pty Ltd (2016a), and presented in Appendix O.

The Project area is characterised by relatively flat and uniform landforms and low vegetation. Results of the visual impact assessment indicate that relatively small proportions of infrastructure associated with the Project will be visible from public roads and the neighbouring homesteads (Edmund and Gifford Creek). The Project will be visible from Mount Augustus, which is the highest point within the 100km buffer and a tourist attraction, but due to the distance from the site this is regarded as having minimal visual impact.

In summary, due to the remoteness of the Project area and the comparatively low local population and visitor numbers, Project infrastructure and associated mining operations are expected to have very low visual impacts.

7.8.3 Rehabilitation Materials Balance

Indicative soil volumes have been determined for each soil type within the Project proposed disturbance footprint. Table 21 summarises volumes based on a harvesting depth of 100 mm for topsoil and 300 mm for subsoil.

Table 21: Indicative Soil Volumes from Harvesting

	Unit	Hills Soil	Plains Soil
Area	ha	1,173	61
Topsoil	m^3	1,173,000	61,000
Subsoil	m^3	3,519,000	183,000

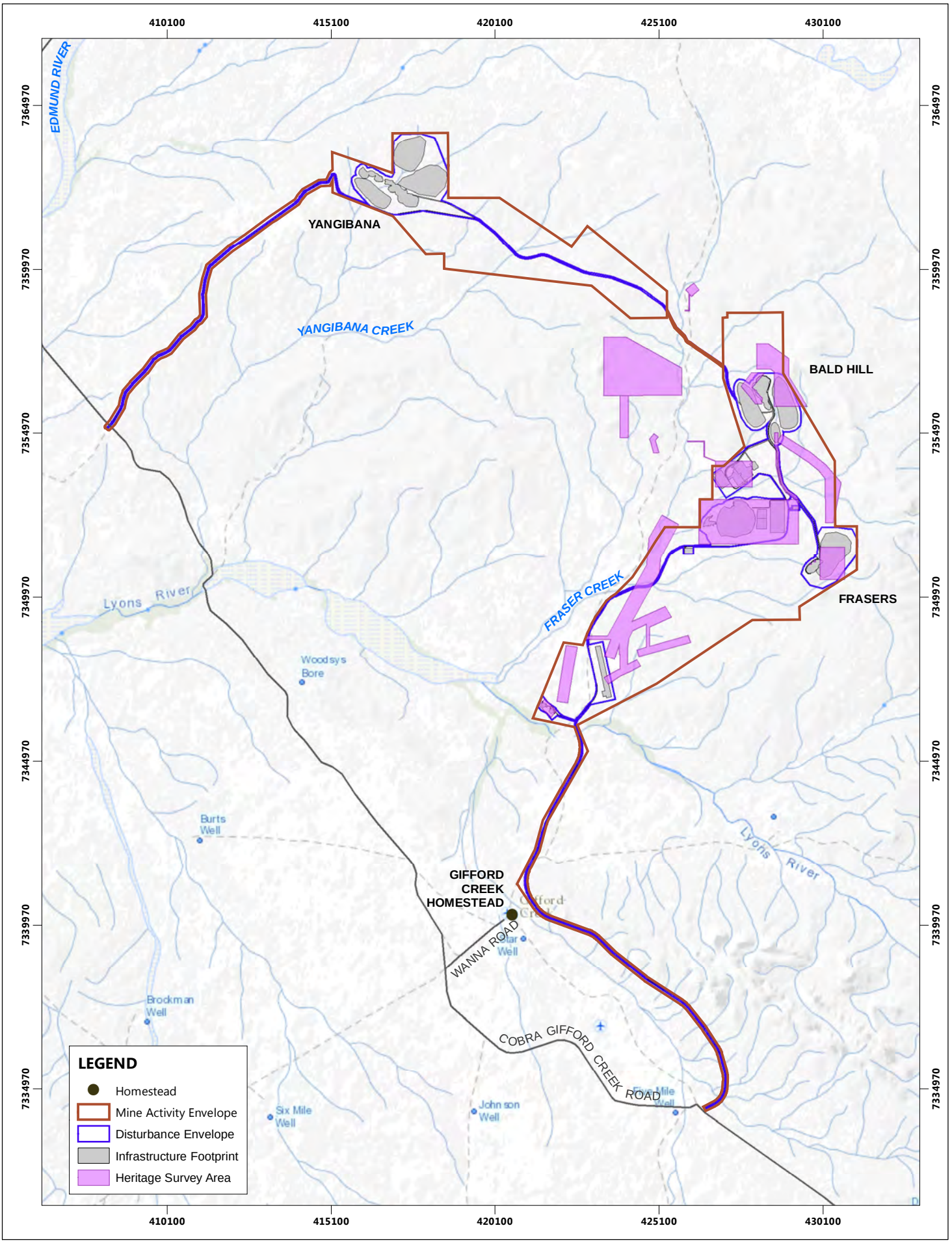
Availability and volumes to meet rehabilitation requirements of benign competent waste rock (rock armour) and low permeability clays (for use in TSF 2 and TSF3 liners / covers) have not been determined at this stage in the Project development. The next revision of the MCP will include a detailed rehabilitation materials balance, including mine scheduling of these materials, locations of separate stockpiling and use in progressive rehabilitation.

7.8.4 Cultural Heritage

Hastings works closely with the TOs (Thin-Mah Warianga, Tharrikari, Jiwarli) to identify indigenous cultural heritage values. The majority of proposed Project disturbance have been surveyed, as shown in Figure 19. All surveys conducted to-date have met requirements of the *Aboriginal Heritage Act 1972* (WA).

One site of heritage significance is listed on the (WA) Department of Aboriginal Affairs register, however other sites have been identified during the surveys. The majority of sites of heritage significance occur outside the mine activity envelope and are closely associated with the Lyons River.

Heritage sites which occur within the mine activity envelope, or in the near vicinity, are presented in Figure 20.



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COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES:
TOPOGRAPHIC LAYERS: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: GEOSCIENCE AUSTRALIA

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	17/01/2017

N

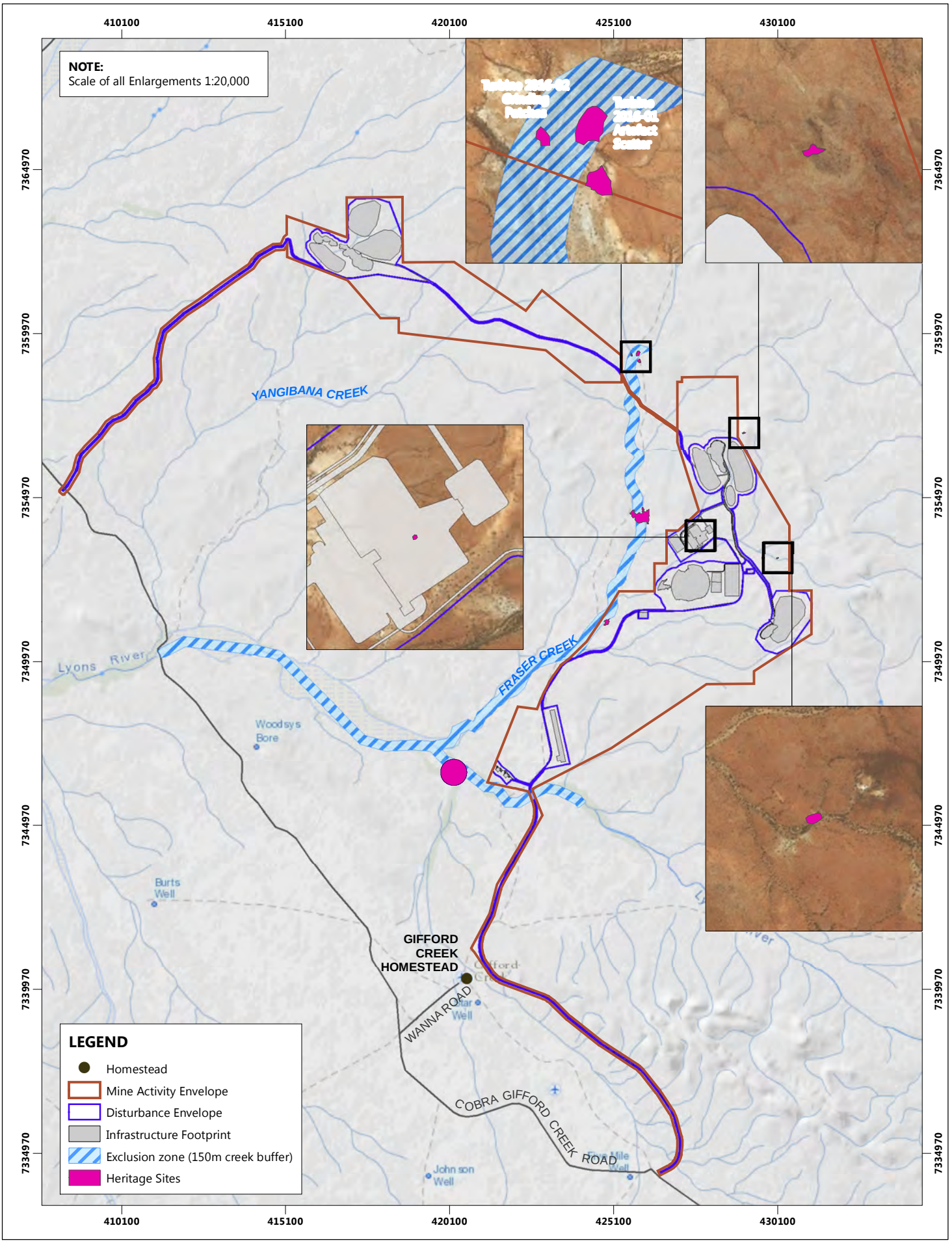
0 1 2 3 4 km

HERITAGE SURVEY AREA AND MINE ACTIVITY ENVELOPE

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 19



SCALE: 1:150,000 @ A4

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES :
TOPOGRAPHIC LAYERS: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: GEOSCIENCE AUSTRALIA

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	17/01/2017

N

0 1 2 3 4 km

HERITAGE SITES OF THE YANGIBANA PROJECT

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 20

7.9 DATA ANALYSIS AND IMPLICATIONS FOR MINE CLOSURE

7.9.1 Surface Water Diversion and Bunds

Based on preliminary hydrological assessment completed by JDA (2017), a Surface Water Management Plan (SWMP) will be required to detail post closure surface water and sediment retention structures in and around open pits, WRLs and TSFs.

The locations and design of management structures required post closure will be determined in the next stage of the hydrological assessment. This MCP will be updated with the outcomes of the further assessment.

7.9.2 Post Mining Groundwater Drawdown

Model simulated drawdown contours post mining for the Yangibana, Bald Hill and Fraser's pits are presented in Figure 21. The asymmetrical drawdown reflects the geometry of the aquifer, which extends above the water table up-dip (pers comms Kathy McDougall, Groundwater Resource Management 2017).

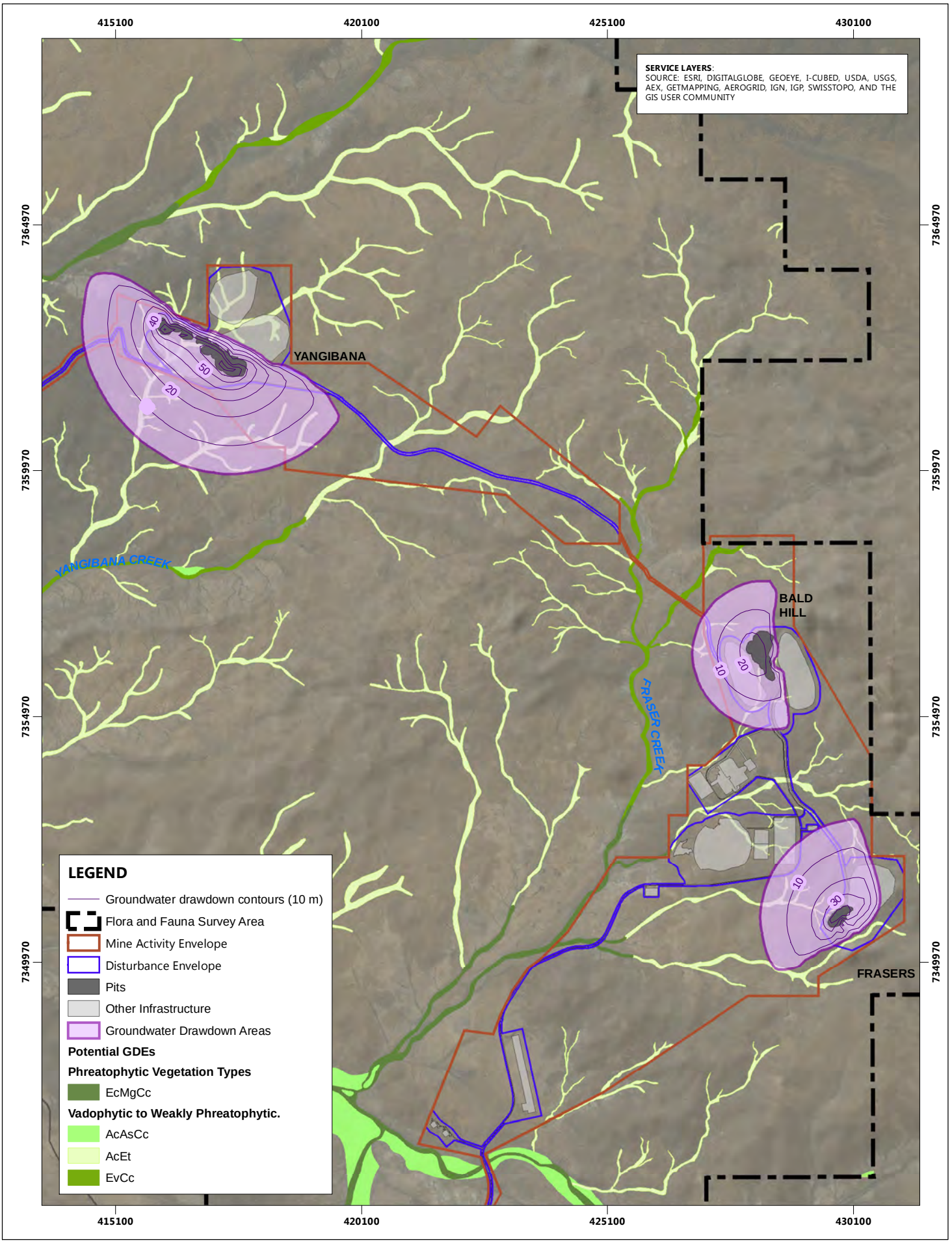
Known and possible GDEs within the vicinity of the proposed open pits are shown in Figure 21. The modelled cone of depression, associated with the pit lakes forming permanent groundwater sinks, interacts with approximately 142 Ha of vegetation type AcEt, characterised as a possible GDE due to the presence of *Eucalyptus vitrix*. Ecoscape (2017b) conducted a desktop assessment of impact to GDEs from post mining, as presented in Appendix P. The AcEt vegetation type is primarily dominated by *Acacia cyperophylla* which is not known or considered to be a groundwater dependant species. This vegetation type was only occasionally observed to contain scattered or isolated individuals of *Eucalyptus victrix*; more commonly this species was absent. Therefore, it is considered unlikely that the AcEt vegetation type represents a groundwater dependant ecosystem, at least in most cases. The potential impact of post mining groundwater drawdown on GDEs is therefore considered likely to be negligible or nil.

7.9.3 Weed Management

The presence of a number of pest species (Section 7.3.1) in the Project proposed disturbance footprint requires the development and implementation of a Weed Management Plan to ensure completion criteria associated with revegetation are met.

Weed management will occur during different stages of the Project, particularly prior to vegetation stripping and soil harvesting, prior to application of soils during rehabilitation, and post-closure.

The management techniques employed are likely to be species specific, and as such trials may be required to inform the Weed Management Plan and develop workable strategies.



SCALE: 1:100,000 @ A4

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES:
GROUNDWATER DRAWDOWN: GROUNDWATER RESOURCE MANAGEMENT, JANUARY 2017

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	25/01/2017

N

0 1 2 3 km

GROUNDWATER DRAWDOWN POST MINING AND GDES

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 21

7.9.4 Soil Management

Based on the physical and chemical characteristics of each soil type, specific management of each soil unit will be required in order to preserve this resource for rehabilitation. A Soil Management Plan will be developed and implemented to retain soil resources and enhance physical and chemical characteristics for successful revegetation.

Landloch (2016a) detailed specific soil handling techniques required to avoid compaction, nutrient depletion, loss of soil microbes and seed resource. Where direct re-spreading of soils is not practical or possible, the following principles should be applied:

- Soil harvesting:
    - Prior to harvesting soils, inspection for the presence of pest species should occur, and management of weeds where required;
    - Harvesting soils when wet should be avoided to minimise soil structure decline and compaction;
    - Harvesting of soils following spring where possible, to increase the soil seedbank;
    - Avoid the use of scrapers to harvest soils, as this machine type increases soils degradation;
    - Soil stripping depths: topsoil stripped to depth of 100mm and subsoils stripped to depth of 300mm.
- Soil stockpiling:
    - Optimal topsoil stockpile heights should be no greater than 1 metre and have either slightly domed or flat topped;
    - Stockpiling soils greater than 1 metre may require additional soil amendments (seed and fertiliser);
    - Where soils are stockpiled for longer than 12 months, application of fertiliser and seed mixes are recommended to reduce erosion, maintain soil organic matter and increase seedbank;
    - Fertiliser application rates should be based on field trials;
    - Where seed mixes are used, they should contain fast growing, leguminous species to increase nitrogen levels, however low fertility of soils may limit seed mixes to local provenance species;
    - Clay rich subsoils require careful management due to dispersion risk, however as subsoils do not contain seedbank, and compaction can be reversed during re-spreading, subsoils can be stockpiled at heights greater than 1 metre.
- Soil re-spreading:
    - Once soil has been respread, and directly prior to seeding, the final soil surface will require light ripping to break any surface crusting.
- Soil amendments:
    - Characterisation of soil stockpiles prior to respreading to determine the nutrient status and type and level of amendments required so harvested soils are comparable to undisturbed soils of the same unit;
    - Incorporation of fertiliser into the soil profile is recommended, rather than application on the surface;

- It is recommended that the Plains soil unit should not be disturbed due to the dispersion risk this soil unit poses. Where this unit is disturbed and harvested, Landloch (2016a) suggest the application of gypsum to stabilise the soil, application rates based on stockpile characterisation compared to undisturbed soils.

Vegetation communities associated with the different soil units also differed (Landloch 2016a). The Hills soil were associated with scattered low woodlands and shrublands of Acacia species with grasses, while the Plains soil was associated with scattered grass and shrubs, or extensive bare sandy patches. This indicates that completion criteria may need to consider the ability for each soil type to support required vegetation species.

7.9.5 Radiation Waste Management

The Radiation Waste Management Plan (RWMP) meets the requirements set out in the following documents:

- Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA 2005); and
- Managing naturally occurring radioactive material (NORM) in mining and mineral processing guideline. NORM 4.2. Management of radioactive waste (DMP 2010) (NORM Guideline 4.2).

The key elements of the RWMP (as set out in NORM Guideline 4.2) include:

- An outline of the processes generating waste;
- Description of waste including nature of material (chemical, physical and radiological), contaminants, and quantities and rate of production;
- Description of the environment into which the waste will be discharged or disposed (climate, terrain, soils, vegetation, hydrology), including the baseline radiological characteristics;
- Heritage (social and cultural) and land use (present and post mining);
- A description of the proposed system for waste management including the facilities and procedures involved in the handling, treatment, storage and disposal of radioactive waste;
- Predictions of environmental concentrations of radionuclides and radiation doses to the public from the proposed waste management practice, including demonstration that the statutory radiation protection requirements will be met both now and in the future;
- A program for monitoring the concentration of radionuclides in the environment and assessment of radiation doses to members of the public arising from the waste management practices;
- Contingency plans for dealing with accidental releases and the circumstances which might lead to uncontrolled releases of radioactive waste in the environment;
- Contingency plan to cover cases of early shutdown or temporary suspension of operations;
- A schedule for reporting on the waste disposal operation and results of monitoring and assessments;
- A plan for the decommissioning of the operation and associated waste management facilities, and for the rehabilitation of the site; and
- A system of periodic assessment and review of the adequacy and effectiveness of the RWMP to take account of potential improvements consistent with best practicable technology.

8.0 IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

The risk management process used for the MCP is based on that set out in the *Leading Practice Sustainable Development Program for the Mining Industry - Risk Assessment and Management* (Department of Resources, Energy and Tourism (DRET) 2008). This process corresponds with the principles detailed in the DMP (2016) *Guideline for Mining Proposals in Western Australia*.

Hastings will demonstrate, throughout all phases of the Project, regular review of the risk assessment by relevant personnel and key stakeholders, progressive implementation of priority treatment measures, and evaluation of performance.

8.1 RISK ASSESSMENT

8.1.1 Risk Workshops

The risk assessment has been undertaken in a staged manner, with workshops held with relevant groups of specialists. A preliminary risk register was developed prior to the workshops, based on the findings of baseline and targeted assessments, and issued to all attendees to review prior to the workshop. This series of workshops allowed technical specialists from key areas to discuss risks that were interrelated (i.e. groundwater and subterranean fauna).

The complete risk assessment is presented in Appendix Q.

8.1.2 Context and Objective

The context of the risk assessment for the MCP is the decommissioning, closure and post closure phases of the Project, for activities occurring specifically within the mine activity envelope (Figure 2), and detailed in Section 2.3.

The objective of the risk assessment was to identify risk pathways (unwanted event and the associated environmental receptor / factor), which may cause material impact to environmental factors specified by the DMP (2016) and the EPA (2016). Additionally, in order to focus management efforts, the risk assessment has been used to determine:

- The relative risk of identified risk pathways; and
- Treatments and critical controls (using the hierarchy of controls).

Material impact, in the context of this risk assessment, has been defined as substantial irreversible damage to local environmental factors.

8.1.3 Risk Identification

The risk identification process entailed a systematic listing of risk pathways specific to the Project (DRET 2008).

Each knowledge gap identified in the development of this MCP has been considered in the risk assessment in order to apply the precautionary principle to limit potential environmental impact. Once these knowledge gaps have been filled the risk assessment will be reviewed.

8.1.4 Risk Analysis and Evaluation

A semi-quantitative risk assessment (SQRA) methodology has been used for the MCP, enabling prioritisation of risk pathways by calculating the relative risk of an occurrence (Joy & Griffith 2007, DRET 2008).

The risk criteria adopted for this Project includes the risk matrix, measure of likelihood table and measure of consequence table (Appendix Q).

The risk matrix has five levels - from “very low” to “extreme”. As a SQRA methodology has been employed, each level of likelihood and consequence has a unique number with an order of magnitude difference between each subsequent level. This enables the relative magnitudes between risk pathways to be determined (DRET 2008).

The measure of likelihood and consequence have five levels in each – “rare” to “almost certain” likelihood and “insignificant” to “severe” consequence. Each measure of likelihood has frequency and probability defined to best determine which level is most applicable. The measure of consequence table is more detailed as it includes unique definitions for a number of environmental factors of interest to the DMP (2016). Consequence descriptors have been based on those detailed in the *Guideline for Mining Proposals in Western Australia* (DMP 2016), with some amendments and additions specific to the Project.

Risk criteria, including definitions of each level of likelihood and consequence, are presented in Appendix Q.

Some risk pathways may have consequences on multiple environmental receptors. To provide a meaningful and manageable risk register, these potential impacts were grouped as a risk pathway with each potential impact assessed separately. Some environmental receptors take into account secondary impacts e.g. surface water groups the Lyons River (only flows after heavy rainfall events) and heritage (water courses are of significant value).

The inherent risk rating considered the consequence and likelihood of the risk pathway with no treatments in place. In some cases, it was unrealistic to apply a true “no controls” scenario (i.e. tailings disposal to drainage lines” as the inherent risk would be extreme, and not realistic in the current regulatory environment. However, in such cases it was assumed that a minimum standard was met (i.e. disposal of tailings to some type of storage facility). The residual risk considered the consequence and likelihood of the risk pathway once treatments were implemented within the post closure phase until tenement relinquishment is achieved. In this preliminary MCP, residual risk does not include the post closure period following tenement relinquishment.

In addition to the risk ratings, the assessment applied a certainty level to each overall risk rating based on the validity and completeness of information and data available. Where a low level of certainty was recorded, the limitation was noted in the risk assessment so these could be addressed in future revisions of the risk assessment.

8.1.5 Risk Treatments

In applying treatments, the DMP (2016) require Hastings to demonstrate that the residual risk is ‘As Low As Reasonably Practicable’ (ALARP) and to meet environmental objectives detailed in the DMP (2016) and the EPA (2016) guidelines. To achieve this, treatment measures have been evaluated using the hierarchy of control (DRET 2008):

1. Eliminate the risk;
2. Minimise or replace the risk;
3. Control the risk with engineered devices;
4. Control the risk by using physical barriers;

5. Control the risk with procedures;
6. Control the risk by using personal protective equipment; and
7. Control the risk with warnings and raising awareness.

Most of the treatments applied in the risk assessment to manage inherent risk involve *controlling the risk* through engineering, physical barriers and procedures (management plans). In addition, further characterisation / investigation of materials (tailings, pore water, waste rock, soils), modelling (pit shells, final voids) and environments (geotechnical drilling, soil mapping), have been applied to increase the level of certainty in the outcomes of the risk assessment.

8.2 CLOSURE ISSUES

Risk pathways with **medium** residual risk, and the resultant mitigation strategies, are provided below. Risk pathways with low residual risk are presented in Appendix Q. No high or extreme residual risks were reported for any of the risk pathways in the post closure period prior to tenement relinquishment.

8.2.1 Tailings Storage Facility 1

Risk Pathway:

- Post-closure failure of embankment results in exposure and release of tailings and leachate.

Environmental Receptors / Factors:

- Flora and vegetation – medium risk;
- Land (soils) – medium risk; and
- Surface water – medium risk.

Main reasons for Risk:

- TSF1 design and hazard assessment is pending;
- TSF1 closure strategy and final landform is pending;
- Characterisation of tailings solids and pore water pending construction of the pilot plant.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- TSF design based on ANCOLD risk category;
- Approved decommissioning and closure strategy;
- Decommissioning Report and Closure Report detailing works undertaken to specification; and
- Post closure monitoring until tenement is relinquished including: stability, rehabilitation, erosion and surface water.

8.2.2 Tailings Storage Facility 2

Risk Pathways:

- Post-closure failure of embankment results in exposure and release of tailings and leachate; and
- Failure of TSF2 containment liner results in seepage.

Environmental Receptors / Factors:

- Land (soils) – medium risk;
- Groundwater – medium risk.

Main reasons for Risk:

- Hazard is underestimated and TSF is not designed according to appropriate hazard rating;
- TSF2 closure strategy and final landform design is pending creating a high level of uncertainty;
- Characterisation (physical, chemical and radiological) of tailings solids and pore water pending construction of the pilot plant.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- TSF allowed to drain down and consolidate prior to final covers being constructed;
- Approved decommissioning and closure strategy, detailing fit-for-purpose containment liner and capping requirements to restrict seepage, infiltration and gamma dose rate
- Decommissioning Report and Closure Report detailing works undertaken to specification;
- Installation of groundwater recovery system (bores, trenches etc.), or low permeability barriers (grout curtain) where required; and
- Post closure monitoring until tenement is relinquished including: gamma dose rate, stability, rehabilitation, erosion, surface water and groundwater.

8.2.3 Tailings Storage Facility 3

Risk Pathways:

- Post-closure failure of embankment results in exposure and release of tailings and leachate; and
- Failure of TSF2 containment liner results in seepage.

Environmental Receptors / Factors:

- Land (soils) – medium risk;
- Groundwater – medium risk.

Main reasons for Risk:

- Hazard is underestimated and TSF is not designed according to appropriate hazard rating;
- TSF3 closure strategy and final landform design is pending creating a high level of uncertainty;
- Characterisation (physical, chemical and radiological) of tailings solids and pore water pending construction of the pilot plant.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Peer review of TSF design report;

- Leak detection monitoring (moisture probes etc.);
- TSF allowed to drain down and consolidate prior to final covers being constructed;
- Approved decommissioning and closure strategy, detailing fit-for-purpose containment liners and capping requirements to restrict seepage, infiltration and gamma dose rate;
- Decommissioning Report and Closure Report detailing works undertaken to specification;
- Installation of groundwater recovery system (bores, trenches etc.), or low permeability barriers (grout curtain) where required; and
- Post closure monitoring until tenement is relinquished including: gamma dose rate, stability, rehabilitation, erosion, surface water and groundwater.

8.2.4 Operational Groundwater Abstraction

Risk Pathway:

- Operational groundwater abstraction results in post closure drawdown in a calcrete aquifer of the Gifford Creek PEC.

Environmental Receptors / Factors:

- Fauna (subterranean) – medium risk.

Main reasons for Risk:

- Borefield location and configuration is pending;
- Final void and groundwater model are pending; and
- Hydraulic connection between the fractured ironstone aquifers of the deposits and a calcrete aquifer of the Gifford Creek PEC is uncertain.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Subterranean Fauna Management Plan, detailing monitoring requirements;
- Avoid groundwater abstraction from the calcrete aquifers;
- Develop groundwater model to predict lateral and vertical extent of drawdown around operational and post-closure pits;
- Post closure monitoring of regional bores within the Gifford Creek Calcrete PEC until tenements are relinquished.

8.2.5 Mine Closure

8.2.5.1 Risk Pathway - Stakeholders

- Stakeholders request compensation for areas of Project which do not meet post mining land use.

Level of Risk: Medium

Main reasons for Risk:

- Landform design, characterisation of materials and closure strategies are pending; and

- Consultation and engagement is on-going, with no finalised agreements in place.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Negotiated post-mining land use with targets;
- Stakeholder Engagement Strategy, with on-going consultation; and
- Treatments listed under all items in Section 6 of the risk assessment (Appendix Q).

8.2.5.2 Risk Pathway - Landforms

- Constructed landforms do not perform as intended, resulting in failure or ineffective implementation.

Level of Risk: Medium

Main reasons for Risk:

- Landform design, characterisation of materials and closure strategies are pending.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Landform surface erosion stability assessment once mining has commenced to provide fresh competent materials;
- TSF closure study, which informs Mine Closure Plan; and
- Post closure stability and erosion monitoring.

8.2.5.3 Risk Pathway – Tailings Storage Facilities

- Failure of post closure TSF covers and/or batters, results in erosion, exposure of tailings or seepage.

Level of Risk: Medium

Main reasons for Risk:

- TSF designs, characterisation of materials and closure strategies are pending.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Fit for purpose cover system, may include store and release, engineered, geotextile membrane;
- Characterisation of tailings and clay materials on-site to determine chemical compatibility;
- Sufficient rock cover to allow for erosion;
- Rehabilitation with shallow-rooted local provenance species; and
- Post closure stability, erosion and rehabilitation monitoring.

8.2.5.4 Risk Pathway – Unexpected Closure

- Unexpected temporary or early closure of the Project.

Level of Risk: Medium

Main reasons for Risk:

- Inadequate mine planning, or drop in market value of REEs; and
- Inadequate closure planning and provision.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Mine Closure Plan, updated periodically based on significant changes to mine plan and as required by DMP / EPA;
- Mine Closure Plan, detailing activities for each domain in the event of unexpected or early closure; and
- Closure cost estimate in accordance with Accounting Standards.

8.2.5.5 Risk Pathway – Closure Provision

- Insufficient funds for decommissioning and closure activities.

Level of Risk: Medium

Main reasons for Risk:

- Closure cost estimate is pending; and
- Accounting standard for closure provision is pending.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Closure cost estimate in accordance with Accounting Standard, and provisional closure budget;
- 6 monthly review of the closure budget against mine plan;
- Progressive rehabilitation and decommissioning (where practicable).

8.2.5.6 Risk Pathway – Stochastic Event

- Stochastic event (flood, drought, bushfire) results in failure of revegetation.

Level of Risk: Medium

Main reasons for Risk:

- Completion criteria are preliminary; and
- Closure cost estimate is pending.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Completion criteria based on realistic revegetation targets; and

- Provisional budget includes allowance for undertaken additional rehabilitation activities.

8.2.5.7 Risk Pathway – Gamma Dose Rate

- Unable to meet background gamma dose rate for TSF2 and TSF3.

Level of Risk: Medium

Main reasons for Risk:

- TSF designs, characterisation of materials and closure strategies are pending.

The risk assessment will be revised once results of the above knowledge gaps are available.

Mitigation Strategies:

- Approved TSF decommissioning and closure strategy;
- Decommissioning Report and Closure Report detailing works undertaken to specification;
- Post closure gamma dose rate monitoring until tenement is relinquished.

8.3 RESPONSIBLE PARTIES

The Hastings Chief Operating Officer (COO), and delegates, is the responsible party for ensuring that all risks have been identified, adequately assessed and the identified treatments are applied. As part of the implementation of treatments and mitigation strategies, actions and tasks will be delegated to line managers and external specialists as required.

8.4 KNOWLEDGE GAPS

As the Project is in the DFS phase a number of knowledge gaps exist, which require further studies and investigation to allow for a greater level of certainty, when assessing risks of the Project on mine closure. Key knowledge gaps, which have been identified within this MCP and during the risk assessment process, include:

- Pending designs and geotechnical assessments for TSFs, WRLs and pit shells;
- Chemical and physical characterisation of tailings streams from pilot plant, including characterisation of tailings pore water;
- Determination of waste rock volumes above 1 Bq/g, associated lithologies and strategies to manage these materials;
- Pit lake post-mining water quality, and potential land use opportunities for pastoral stakeholders; and
- Soil unit mapping and field trials to determine success of amendments and seed mixes.

9.0 CLOSURE IMPLEMENTATION

9.1 CLOSURE IMPLEMENTATION STRATEGIES

Closure implementation will occur progressively throughout the life of mine, and will be integrated into mine planning, to ensure that resources (materials, machinery and personnel) are available to complete rehabilitation and closure tasks in accordance with the post mining land use.

The preliminary general closure strategies to be implemented are:

1. Collection of baseline data
    a. Baseline studies and investigations, presented in Section 7.0;
    b. Closure research, investigations and trials, as discussed in Section 9.3;
    c. On-going monitoring during operations.
2. Materials handling and utilisation
    a. Harvesting and stockpiling of soils for use during rehabilitation;
    b. Temporary stockpiling of competent benign waste rock for use during rehabilitation.
3. Design and construction of landforms
    a. TSF covers and / or encapsulation specific to each of the facilities.
4. Identification and management of site contamination
    a. Areas of site with the potential for contamination will be assessed and managed in accordance with DER requirements the *Contaminated Sites Act 2003*.
5. Decommissioning and removal of infrastructure
    a. Progressive removal of support infrastructure where possible;
    b. Potentially radioactive materials and/or equipment will be surveyed, and disposed of as per DMP and Radiological Council requirements;
    c. Placement of soils and shallow ripping. Dispersal of seed mixes containing local provenance species.
6. Rehabilitation of landforms
    a. Rehabilitation of TSFs will meet requirements specific to each facility, particularly relating to placement of covers and / or encapsulation layers, prior to cover with growth medium;
    b. WRLs will be reshaped prior to cover with growth medium;
    c. Construction of pit abandonment bunds and surface water diversion bunds;
    d. Dispersal of seed mixes containing local provenance species.
7. Post closure monitoring and maintenance
    a. Monitoring of rehabilitation performance as presented in Section 10.0;
    b. Maintenance of rehabilitation works, where required, as presented in Section 10.0.

9.2 CLOSURE WORK PROGRAMS

To aid implementation of the MCP, areas of the Project with similar features and with similar decommissioning, rehabilitation and closure requirements have been grouped into domains.

Each domain has an associated Closure Work Program summarising closure strategies and tasks required to meet closure objectives and completion criteria. It is intended that the Closure Work Programs presented in the following sections will form the basis of development of more detailed Rehabilitation Plans and Decommissioning Plans.

As detailed engineering designs have not been finalised, future revisions of the MCP will contain detail of conceptual designs, closure strategies and trials / studies.

9.2.1 Tailings Storage Facilities

There are three proposed TSFs for the Project, each to store a separate tailings stream with unique physical and chemical properties, as presented in Table 2. Therefore, each TSF will have different closure requirements, as summarised in Table 23, Table 24 and Table 25.

Table 22: Closure Work Program – Tailings Storage Facility 1

CLOSURE WORK PROGRAM – TAILINGS STORAGE FACILITIES	
Domain feature	TSF1 and Decant pond
Description	TSF1 will receive 91% of the tailings generated through the processing plant, from the rougher circuit of the beneficiation plant. Estimated radionuclide concentration <1 Bq/g.
Disturbance area	105 Ha
Rehabilitation status	To be constructed
Estimated closure date	2026
Post mining land use	Pastoral use – grazing
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 1.4) Apply soils that will promote and benefit rehabilitation • Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate 2.1) Construct safe, stable, non-polluting post mining landforms which support vegetation growth and are erosion resistant • Surface water management and drainage is incorporated into the landform design • Final surfaces do not significantly erode following heavy rainfall events 2.2) TSF1 will have a fit for purpose cover which will encourage evapotranspiration • Cover measures meet design criteria • Drain-down of TSF 1 does not result in impacts to GDEs 4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term

Specific closure assumptions	• TSF1 will operate until the end of life of mine • TSF1 will contain tails <1Bq/g and not classed as radioactive material • Residues from TSF1 decant pond will be disposed of to TSF1 before it is covered • TSF1 will be classified as a contaminated site under the *Contaminated Sites Act 2003*
Landform design	Conceptual final landform design pending
Investigations required	Identify suitable cover materials (including volumes), to be completed within the first two years of the commencement of operations
Knowledge gaps	Chemistry of tailings pore water
Rehabilitation materials	• Benign competent waste rock and Hills soil type. • Volumes to be determined during the detailed engineering phase of the Project.
Closure monitoring and maintenance	• Annual cover system monitoring • Post closure landform stability monitoring • 6 monthly groundwater monitoring of perimeter bores and down-gradient bores • Surface water monitoring down-gradient - opportunistic • Erosion maintenance
Closure Strategy – Key Tasks	
Progressive rehabilitation	Not applicable: • TSF1 will operate throughout the life of mine. • Due to a central tailings discharge point, progressive covering of consolidated beaches will not be possible
Planned decommissioning and closure	TSF1 • Remove infrastructure – pipes, pumps, signage, and fencing • Re-profile outside embankments • Rock armour embankments • Construct cover system • Construct TSF perimeter bunding • Spread topsoil • Rip and seed top surface and batters TSF1 decant pond • Remove residue from TSF1 decant pond to TSF1 surface • Remove decant pond walls for use in TSF1 cover (capillary break)
Premature closure	The TSF shall be made safe and stable and allow consolidation and drying of tailings prior to a cover (temporary or permanent) being emplaced.

Table 23: Closure Work Program – Tailings Storage Facility 2

CLOSURE WORK PROGRAM – TAILINGS STORAGE FACILITY 2	
Domain feature	TSF2
Description	TSF2 will receive 4% of the tailings generated through the processing plant, from the beneficiation cleaner circuit. Estimated radionuclide concentration ~7 Bq/g.
Disturbance area	8.2 Ha
Rehabilitation status	To be constructed
Estimated closure date	2026
Post mining land use	Pastoral use – grazing
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met

CLOSURE WORK PROGRAM – TAILINGS STORAGE FACILITY 2	
	1.4) Apply soils that will promote and benefit rehabilitation • Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate 2.1) Construct safe, stable, non-polluting post mining landforms which support vegetation growth and are erosion resistant • Surface water management and drainage is incorporated into the landform design • Final surfaces do not significantly erode following heavy rainfall events 2.3) TSF2 and TSF3 will have a fit for purpose liner and cover systems, which will limit infiltration and seepage • Cover measures meet design criteria • No alteration of groundwater system beyond the immediate vicinity of TSF2 and TSF3 4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term 7.3) Control radiation levels at the surface of rehabilitated landforms equivalent to pre-mining levels • Landforms do not emit radiation at surface exceeding thresholds determined through baseline monitoring
Specific closure assumptions	• TSF2 will operate until end of life of mine • Drain down and consolidation of tailings will occur after processing has ceased as an operational water cover is required to manage dust • TSF2 will contain radionuclides in tails of ~7 Bq/g • Radionuclides will not be water soluble • TSF2 will be classified as a contaminated site under the *Contaminated Sites Act 2003*
Landform design	Conceptual final landform design pending
Investigations required	• Identify suitable cover materials (including volumes), source, and storage, to be completed within the first two years of operations commencing • On-going materials characterisation (pilot plant, operations)
Knowledge gaps	• Chemistry of tailings pore water • Average radionuclide concentration of tailings
Rehabilitation materials	• Benign competent waste rock and Hill soil type • Volumes to be determined during the detailed engineering phase of the Project
Closure monitoring and maintenance	• Annual cover system monitoring • Gamma radiation dose monitoring • Post closure landform stability monitoring • 6 monthly groundwater monitoring of perimeter bores and down-gradient bores • Surface water monitoring down-gradient – opportunistic • Erosion maintenance
Closure Strategy - Key Tasks	
Progressive rehabilitation	Not applicable: • TSF2 will operate throughout the life of mine

CLOSURE WORK PROGRAM – TAILINGS STORAGE FACILITY 2	
Planned decommissioning and closure	• Remove infrastructure – pipes, pumps, signage, and fencing • Allow tailings to consolidate and remove decant to evaporation pond • Re-profile outside embankments • Rock armour embankments • Construct cover system • Construct TSF perimeter bunding • Rock armour internal slopes of perimeter bunds • Spread topsoil • Rip and seed top surface and batters • Ensure that runoff reports to local drainage lines
Premature closure	The TSF will be made safe and stable and allow consolidation and drying of tailings prior to a cover (temporary or permanent) being emplaced

Table 24: Closure Work Program – Tailings Storage Facility 3

CLOSURE WORK PROGRAM – TAILINGS STORAGE FACILITY 3	
Domain feature	TSF3
Domain description	TSF3 will receive 5% of the tailings generated through the processing plant, hydrometallurgical circuit. Estimated radionuclide concentration ~24 Bq/g.
Disturbance area	9.3 Ha
Rehabilitation status	To be constructed
Estimated closure date	2026
Final land use	Pastoral use – grazing
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 1.4) Apply soils that will promote and benefit rehabilitation • Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate 2.1) Construct safe, stable, non-polluting post mining landforms which support vegetation growth and are erosion resistant • Surface water management and drainage is incorporated into the landform design • Final surfaces do not significantly erode following heavy rainfall events 2.3) TSF2 and TSF3 will have a fit for purpose liner and cover systems, which will limit infiltration and seepage • Cover measures meet design criteria • No alteration of groundwater system beyond the immediate vicinity of TSF2 and TSF3 4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term 7.3) Control radiation levels at the surface of rehabilitated landforms equivalent to pre-mining levels • Landforms do not emit radiation at surface exceeding thresholds determined through baseline monitoring

CLOSURE WORK PROGRAM – TAILINGS STORAGE FACILITY 3	
Specific closure assumptions	• TSF3 will operate until end of life of mine • Drain down and consolidation of tailings will occur after processing has ceased as an operational water cover is required to manage dust • TSF3 will contain radionuclides in tails of ~24 Bq/g • Radionuclides will be water soluble • TSF3 will be classified as a contaminated site under the *Contaminated Sites Act 2003*
Landform design	Conceptual final landform design pending
Investigations required	• Identify suitable cover materials (including volumes), source, and storage, to be completed within the first two years of operations commencing • On-going materials characterisation (pilot plant, operations)
Knowledge gaps	• Chemistry of tailings pore water • Average radionuclide concentration of tailings
Rehabilitation materials	• Benign competent waste rock and Hill soil type • Volumes to be determined during the detailed engineering phase of the Project
Closure monitoring and maintenance	• Annual cover system monitoring • Monitoring of leachate from the underdrain • Post closure landform stability monitoring • 6 monthly groundwater monitoring of perimeter bores and down-gradient bores • Surface water monitoring – opportunistic • Erosion maintenance
Closure Strategy - Key Tasks	
Progressive rehabilitation	Not applicable: TSF3 will operate throughout the life of mine
Planned decommissioning and closure	• Remove infrastructure – pipes, pumps, signage, and fencing • Allow tailings to consolidate and remove decant to evaporation pond • Re-profile outside embankments • Rock armour embankments • Construct cover system that will need to be water shedding and limit infiltration into tails • Construct TSF perimeter bunding • Rock armour internal slopes of perimeter bunds. • Spread topsoil • Rip and seed top surface and batters • Ensure that runoff reports to local drainage lines
Premature closure	The TSF will be made safe and stable and allow consolidation and drying of tailings prior to a cover (temporary or permanent) being emplaced

9.2.2 Waste Rock Landforms

There are three proposed WRLs, each will be positioned next to the respective open pit. Additionally, there will be a ROM, COS and Low Grade Stockpile all located around the processing plant. Due to the similarities of material for these six landforms, it is presumed they will have similar closure requirements, as summarised in Table 26.

Table 25: Closure Work Program – Waste Rock Landforms

CLOSURE WORK PROGRAM – WASTE ROCK LANDFORMS	
Domain Feature	Bald Hill WRL Frasers WRL Yangibana WRL Run of Mine (ROM) Coarse Ore Stockpile (COS) Low Grade Stockpile
Description	WRLs will be NAF, predominantly competent materials, and located adjacent the source open pit ROM, COS and low grade stockpile will be constructed of NAF material
Disturbance Area	457 Ha for WRLs 4 Ha for ROM, COS and low grade stockpile
Rehabilitation status	To be constructed
Estimated closure date	2026
Post mining land use	Pastoral use - grazing
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 1.4) Apply soils that will promote and benefit rehabilitation • Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate 2.1) Construct safe, stable, non-polluting post mining landforms which support vegetation growth and are erosion resistant • Landforms are placed outside the pit void zone of instability • Surface water management and drainage is incorporated into the landform design • Final surfaces do not significantly erode following heavy rainfall events • Characterisation of waste and rehabilitation materials to determine appropriate placement / segregation in the final landform 3.1) Surface drainage structures will be constructed to an appropriate hydrology design standard to minimise erosion of permanent mining landforms and maintain ecosystem function • Surface drainage to downstream environments is maintained 4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term 7.3) Control radiation levels at the surface of rehabilitated landforms to levels within accepted thresholds • Landforms do not emit radiation at surface exceeding thresholds determined through baseline monitoring
Specific closure assumptions	• Waste rock will not be backfilled into final voids • Waste segregation via encapsulation or within purpose constructed containment cells is not warranted
Landform design	Conceptual final landform design pending
Investigations required	Review of geological exploration data to determine indicative volumes and waste lithologies exceeding 1 Bq/g
Knowledge gaps	Waste segregation / encapsulation required

CLOSURE WORK PROGRAM – WASTE ROCK LANDFORMS	
Rehabilitation materials	Benign competent waste rock and Hills soil type on batters Plain soil type on top/flat surfaces
Closure monitoring and maintenance	• Surface water monitoring - opportunistic • Post closure landform stability monitoring • Erosion maintenance • Periodically audit landforms against approved designs • EFA monitoring
Closure Strategy Key Tasks	
Progressive rehabilitation	Progressively shape, contour and spread suitable soil on WRLs Establish diversion drains at the toe of WRLs
Planned decommissioning and closure	• Final profile of WRL will be achieved during operation, no re-profiling will be required • Remove ramps • Rock armour slopes (where necessary) • Spread topsoil • Rip and seed top surface and batters • Reconfigure diversion drains to ensure they remain self-sustaining and non-eroding
Premature closure	The landforms will be made safe and stable

9.2.3 Final Voids

There are three proposed open pits for the Project. Key features of this domain are summarised in Table 27.

Table 26: Closure Work Program – Final Voids

CLOSURE WORK PROGRAM – FINAL VOIDS	
Domain feature	Bald Hill Open Pit Frasers Open Pit Yangibana Open Pit
Description	Consists of three final voids, ranging in depth from 70mBGL (Bald Hill) and 95 mBGL (Yangibana and Fraser's)
Disturbance Area	95 Ha
Rehabilitation Status	To be constructed
Estimated Closure Date	2026
Post mining land use	To be determined – exclusion
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 3.1) Surface drainage structures will be constructed to an appropriate hydrology design standard to minimise erosion of permanent mining landforms and maintain ecosystem function • Surface drainage to downstream environments is maintained 3.2) Impacts on the availability and quality of regional groundwater are minimised and do not limit the proposed post-mining land use • Pit water quality does not impact on areas beyond the immediate mining area • Groundwater levels in the vicinity of production bores will recover to pre-abstraction levels after mine closure 7.1) Leave the post mining landscape in a condition safe for humans and fauna

CLOSURE WORK PROGRAM – FINAL VOIDS	
	• Construct abandonment bunds around the perimeter of open pit void, outside the pit wall zone of instability • Block open pit ramps to restrict vehicle access
Specific closure assumptions	• Final voids to remain open, no backfilling will be undertaken • Final voids will develop into groundwater sinks • Surface flows will be directed around final voids to maintain environmental flows
Landform design	Final void pit shell design is pending
Investigations required	Development of groundwater final void model to determine pit lake quality and quantity and potential for solute transport
Knowledge gaps	Pit lake water quality
Rehabilitation materials	Stockpile benign competent waste rock to form abandonment bunds
Closure monitoring and maintenance	• Groundwater monitoring • Geotechnical monitoring to ensure pit stability
Closure Strategy - Key Tasks	
Progressive rehabilitation	Progressive closure of pits is possible based on mining schedule
Planned decommissioning and closure	• Removal of dewatering infrastructure • Construction of abandonment bund and restriction of access to pit ramps • Erection of signage around edge of final void
Premature closure	The voids will be made safe by erection of signage and emplacement of abandonment bunds

9.2.4 Industrial Infrastructure Processing

This domain includes a number of features which are all processing related infrastructure. These have been grouped together due to their relative exposure and potential to be contaminated with radioactive material, or use in the processing plant. Key features of these domains are summarised in Table 28.

Table 27: Closure Work Program – Processing Plant

CLOSURE WORK PROGRAM –PROCESSING PLANT	
Domain feature	Plant area and Crushers Sulphuric acid plant and sulphur stockpile Lime Storage Power Station Evaporation Pond Process water Pond Sedimentation Pond Tailings / Decant Return Pipelines Plant Workshop Metallurgical Assay Laboratory Truck and LV Tyre Wash
Description	Processing related infrastructure that has the potential to be in contact with radionuclides and warrants from a health, safety and environmental perspective, to be managed in accordance with relevant standards and guidelines.
Disturbance area	TBD
Rehabilitation status	To be constructed
Estimated closure date	2026
Post mining land use	Pastoral use - grazing

CLOSURE WORK PROGRAM –PROCESSING PLANT	
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 1.2) Remove all redundant infrastructure not required by relevant stakeholders prior to rehabilitation • Infrastructure contaminated with radionuclides will be buried on-site or decontaminated prior to handover • Retained infrastructure shall be left in a safe condition and transferred to a legally responsible entity • Redundant infrastructure will be removed from site 1.3) Ensure all general wastes are disposed of such that they are contained and isolated • Wastes shall be disposed of to the on-site landfill, contaminated waste area or transferred off-site to licenced waste disposal sites for salvage, recycling and/or disposal 1.4) Apply soils that will promote and benefit rehabilitation • Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate 3.2) Impacts on the availability and quality of regional groundwater are minimised and do not limit the proposed post-mining land use • Any groundwater contamination will be confined to the immediate mining area and will not impact on surrounding groundwater resource 4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term 6.1) Cultural heritage sites within the Project will be preserved • Access to cultural heritage sites within operational areas are re-established 7.2) Land contamination will be remediated as part of the decommissioning process • Contaminated site assessment in areas where hydrocarbons and chemicals have been stored, used, or where historic spills have occurred • Soil remediation, to agreed levels, shall occur where contamination is reported
Specific closure assumptions	• Areas may be classified as contaminated under the *Contaminated Sites Act 2003* pending site assessment • Where required, plant and equipment will be decontaminated (<1 Bq/g) prior to demolition / removal • No plant or equipment will remain on-site unless deemed to be safe or agreed upon in formal commitments with the pastoral landholder
Landform design	Pastoral use / rangelands landscape
Investigations required	Consult with DMP regarding NORM closure requirements
Knowledge gaps	-
Rehabilitation materials	Striped and stockpiled topsoil and subsoils
Closure monitoring and maintenance	• Groundwater monitoring
Closure Strategy - Key Tasks	
Progressive rehabilitation	Where available, redundant plant / equipment to be removed or disposed of appropriately

CLOSURE WORK PROGRAM –PROCESSING PLANT	
Planned decommissioning and closure	• Removal and disposal of infrastructure • Contaminated material to be remediated / removed to licenced facility • Contaminated sites investigation and remedial works • Area to be re-contoured (where applicable) • Areas to be spread with suitable stockpiled soil, ripped and seeded
Premature closure	Any contaminated areas that pose a significant or immediate risk to the public / environment will be managed as a priority

9.2.5 Industrial Infrastructure

This domain includes all industrial infrastructure that is not related to the processing plant or not likely to be contaminated or in contact with ore, or its milling processes. Key features of this domain are summarised in Table 29.

Table 28: Closure Work Program – Processing Plant

CLOSURE WORK PROGRAM – INDUSTRIAL INFRASTRUCTURE	
Domain Feature	Fuel Storage and Fuel Farm Lube Storage HV Workshop and Warehouse, Warehouse Freight Laydown, Laydown and Hardstand HV Washdown and Drying Bed Core Shed and Yard Go-line and carparks Solar Field Explosives Magazine and AN Yard Landfill and Waste Transfer Stations Sewage Treatment Plants (irrigation)
Description	Various industrial infrastructure to support the operation of the Project that is considered not contaminated with potential radionuclides from ore of its milled product
Disturbance Area	TBD
Rehabilitation Status	To be constructed
Estimated Closure Date	2026
Post mining land use	Pastoral use - grazing
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 1.2) Remove all redundant infrastructure not required by relevant stakeholders prior to rehabilitation • Infrastructure contaminated with radionuclides will be buried on-site or decontaminated prior to handover • Retained infrastructure shall be left in a safe condition and transferred to a legally responsible entity • Redundant infrastructure will be removed from site 1.3) Ensure all general wastes are disposed of such that they are contained and isolated • Wastes shall be disposed of to the on-site landfill, contaminated waste area or transferred off-site to licenced waste disposal sites for salvage, recycling and/or disposal 1.4) Apply soils that will promote and benefit rehabilitation

CLOSURE WORK PROGRAM – INDUSTRIAL INFRASTRUCTURE	
	• Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate 3.2) Impacts on the availability and quality of regional groundwater are minimised and do not limit the proposed post-mining land use • Any groundwater contamination will be confined to the immediate mining area and will not impact on surrounding groundwater resource 4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term 5.1) Ensure the interests of relevant stakeholders are considered during all stages of closure planning • Formal agreement with post closure land users for the retention of any infrastructure or service 6.1) Cultural heritage sites within the Project will be preserved • Access to cultural heritage sites within operational areas are re-established 7.2) Land contamination will be remediated as part of the decommissioning process • Contaminated site assessment in areas where hydrocarbons and chemicals have been stored, used, or where historic spills have occurred • Soil remediation, to agreed levels, shall occur where contamination is reported
Specific closure assumptions	• The landfill, and potentially other areas will be classified as contaminated sites under the *Contaminated Sites Act 2003* • All above ground infrastructure will be demolished and removed • Buried infrastructure will be left unless deemed by risk assessment to be unsafe or polluting
Landform design	Pastoral use / rangelands landscape
Investigations required	Liaise with Pastoral landholders regarding retaining facilities
Knowledge gaps	Identifying what infrastructure will be retained under formal agreements Final closure strategy to manage the landfill site
Rehabilitation materials	Striped and stockpiled topsoil and subsoils
Closure monitoring and maintenance	• Monitoring of rehabilitation (EFA) • Erosion monitoring
Closure Strategy - Key Tasks	
Progressive rehabilitation	Where available, redundant plant / equipment to be removed or disposed of appropriately
Planned decommissioning and closure	• Removal and disposal of infrastructure • Contaminated material (soils) to be remediated / removed to licenced facility • Contaminated sites investigation and remedial works • Area to be re-contoured (where applicable) • Areas to be spread with suitable stockpiled soil, ripped and seeded
Premature closure	Any plant / equipment that pose a significant or immediate risk to the public / environment will be managed as a priority

9.2.6 Water Infrastructure

This domain feature includes key water supply infrastructure and is summarised in Table 30.

Table 29: Closure Work Program – Water Infrastructure

CLOSURE WORK PROGRAM – WATER INFRASTRUCTURE	
Domain Feature	Borefield and water pipelines Raw water storage pond
Description	Water supply and transfer infrastructure
Disturbance area	TBD
Rehabilitation status	To be constructed
Estimated closure date	2026
Post mining land use	Pastoral use - grazing
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 1.2) Remove all redundant infrastructure not required by relevant stakeholders prior to rehabilitation • Retained infrastructure shall be left in a safe condition and transferred to a legally responsible entity • Redundant infrastructure will be removed from site 1.4) Apply soils that will promote and benefit rehabilitation • Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate 3.2) Impacts on the availability and quality of regional groundwater are minimised and do not limit the proposed post-mining land use • Any groundwater contamination will be confined to the immediate mining area and will not impact on surrounding groundwater resource • Groundwater levels in the vicinity of production bores will recover to pre-abstraction levels after mine closure 4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term 5.1) Ensure the interests of relevant stakeholders are considered during all stages of closure planning • Formal agreement with post closure land users for the retention of any infrastructure or service 6.1) Cultural heritage sites within the Project will be preserved • Access to cultural heritage sites within operational areas are re-established 7.1) Leave the post mining landscape in a condition safe for humans and fauna • All drill holes and bores shall be capped, filled or made safe
Specific closure assumptions	• All water infrastructure (specifically borefield) will be removed unless formal agreements state otherwise • Some water infrastructure may be required for post closure to assist with water treatment / management and/or potable supply • Below ground infrastructure to remain in situ unless environmental risk is deemed unacceptable
Landform design	Pastoral use / rangelands landscape
Investigations required	-

CLOSURE WORK PROGRAM – WATER INFRASTRUCTURE	
Knowledge gaps	The contaminated sites status of the raw water pond
Rehabilitation materials	Striped and stockpiled topsoil and subsoils
Closure monitoring and maintenance	• Groundwater monitoring • Monitoring of rehabilitation (EFA)
Closure Strategy - Key Tasks	
Progressive rehabilitation	Staged reduction / shutdown of borefield supply to suit water demands
Planned decommissioning and closure	• Removal of borefield infrastructure (monitoring bores to remain) • Removal and disposal of infrastructure • Area to be re-contoured (where applicable) • Areas to be spread with suitable stockpiled soil, ripped and seeded • Pond embankments to be pushed in and footprint re-shaped to match contours of area
Premature closure	Infrastructure to be made safe and secure

9.2.7 Support Infrastructure

Support infrastructure includes all buildings, structures and facilities with low potential for contamination. The features in this domain are summarised in Table 31.

Table 30: Closure Work Program – Support Infrastructure

CLOSURE WORK PROGRAM – SUPPORT INFRASTRUCTURE	
Domain feature	Camp Site Administration, Security and Crib Buildings Communications Tower Airstrip Haul Roads and Access Roads
Description	Auxiliary infrastructure that supports mining operations
Disturbance area	TBD
Rehabilitation status	To be constructed
Estimated closure date	2026
Post mining land use	Pastoral use - grazing
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 1.2) Remove all redundant infrastructure not required by relevant stakeholders prior to rehabilitation • Retained infrastructure shall be left in a safe condition and transferred to a legally responsible entity • Redundant infrastructure will be removed from site 1.3) Ensure all general wastes are disposed of such that they are contained and isolated • Wastes shall be disposed of to the on-site landfill, contaminated waste area or transferred off-site to licenced waste disposal sites for salvage, recycling and/or disposal 1.4) Apply soils that will promote and benefit rehabilitation • Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate

CLOSURE WORK PROGRAM – SUPPORT INFRASTRUCTURE	
	4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term 5.1) Ensure the interests of relevant stakeholders are considered during all stages of closure planning • Formal agreement with post closure land users for the retention of any infrastructure or service 6.1) Cultural heritage sites within the Project will be preserved • Access to cultural heritage sites within operational areas are re-established
Specific closure assumptions	• All roads will be rehabilitated unless formal agreements state otherwise • All support infrastructure will be removed unless formal agreements state otherwise • Some support infrastructure may be required in the closure phase to assist with rehabilitation activities (i.e. camp, airstrip etc)
Landform design	Pastoral use / rangelands landscape
Investigations required	Liaise with Pastoral landholders regarding retaining facilities
Knowledge gaps	Identifying what infrastructure will be retained under formal agreements
Rehabilitation materials	Striped and stockpiled topsoil and subsoils
Closure monitoring and maintenance	Monitoring of rehabilitation (EFA)
Closure Strategy - Key Tasks	
Progressive rehabilitation	• Rehabilitation of auxiliary roads that are no longer in use • Removal unnecessary equipment/buildings
Planned decommissioning and closure	• Removal and disposal of infrastructure • Contaminated material (soils) to be remediated / removed to licenced facility • Contaminated sites investigation program • Area to be re-contoured (where applicable) • Areas to be spread with suitable stockpiled soil, ripped and seeded
Premature closure	Infrastructure to be made safe and secure

9.2.8 Other Disturbance

Table 31: Closure Work Program – Other Disturbance

CLOSURE WORK PROGRAM – OTHER DISTURBANCES	
Domain feature	Surface Water diversion structures Topsoil Stockpiles Borrow Pits General Clearing Exploration Tracks Historic Exploration disturbance
Description	All other operational disturbances
Disturbance area	TBD
Rehabilitation status	To be constructed
Estimated closure date	2026
Post mining land use	Pastoral use - grazing

CLOSURE WORK PROGRAM – OTHER DISTURBANCES	
Preliminary closure objectives and associated completion criteria	1.1) Comply with all legally binding conditions and commitments relevant to rehabilitation and closure • All conditions and commitments are met 1.3) Ensure all general wastes are disposed of such that they are contained and isolated • Wastes shall be disposed of to the on-site landfill, contaminated waste area or transferred off-site to licenced waste disposal sites for salvage, recycling and/or disposal 1.4) Apply soils that will promote and benefit rehabilitation • Delineation of vegetation, topsoil and subsoil stockpiles • Application of soils in locations where soil type and harvested volumes of useable soils dictate 4.1) Rehabilitated areas support self-sustaining and resilient vegetation, with biodiversity trending towards analogue sites • Rehabilitated areas show trends that indicate long-term return to a functioning and sustainable ecosystem • Rehabilitated areas support revegetation with local provenance vegetation in the short-medium term 5.1) Ensure the interests of relevant stakeholders are considered during all stages of closure planning • Formal agreement with post closure land users for the retention of any infrastructure or service 6.1) Cultural heritage sites within the Project will be preserved • Access to cultural heritage sites within operational areas are re-established
Specific closure assumptions	• Surface water diversions to remain (where required) to enable stability of landforms • Topsoil stockpiles to be used progressively during operational life (where possible)
Landform design	Pastoral use / rangelands landscape
Investigations required	-
Knowledge gaps	Identify extent of historic exploration disturbance which requires rehabilitation Detailed closure designs for borrow pits
Rehabilitation materials	Striped and stockpiled topsoil and subsoils
Closure monitoring and Maintenance	• Monitoring of surface water diversion structure stability • Monitoring of rehabilitated sites (EFA) • Erosion monitoring
Closure Strategy - Key Tasks	
Progressive rehabilitation	• Rehabilitation of auxiliary roads / tracks and cleared areas that are no longer in use • Exploration drill pads that are deemed finished to be rehabilitated including sumps backfilled, drill holes cut below ground level and capped, soil spread, ripped and seeded
Planned decommissioning and closure	• Areas to be re-contoured (where applicable) • Areas to be spread with suitable stockpiled soil, ripped and seeded • Borrow pit access to be made safe, slopes battered to be consistent with surrounding area
Premature closure	Not applicable

9.3 RESEARCH, INVESTIGATION AND TRIALS

Due to the currently projected short mine life of the Project, there may be limited opportunities for rehabilitation trials. Regardless, Hastings commits to undertaking trials and investigations into key areas of risk for the post closure environment in order to refine completion criteria. Preliminary assessment of knowledge gaps indicates the following areas require further investigation:

- Assessment of cover materials for TSF2 and TSF3;
- Revegetation trials on Hills soil (Brown Shallow Loamy Duplex);
- Set-up analogue sites within each soil type;
- Trial amendments to soils, including:
    - Reducing the dispersion risk of the Plains soil;
    - Increasing the fertility of both soil types.

9.4 PROGRESSIVE REHABILITATION

Implementation of progressive rehabilitation will occur, where possible, during the operational phase of the Project. While progressive rehabilitation and closure will be prioritised, the short life of mine and sequential nature of mining deposits will limit these opportunities to exploration activities, WRLs, final voids and associated disturbance, following the cessation of mining activity in each area. Disturbance associated with exploration activities also represents opportunities for progressive rehabilitation.

Progressive rehabilitation will enable opportunities to undertake trials, reduce the Project's financial liability under the Mining Rehabilitation Fund (MRF), and demonstrate to key stakeholders Hastings commitment to meet the social and environmental licence to operate.

9.5 PREMATURE CLOSURE

Premature closure of the Project would likely result in modifications of the proposed mine closure strategies detailed in this MCP and its subsequent revisions.

To determine key areas for works in the event of unplanned, premature closure of the Project, the following will be undertaken:

- Revision and update of the environmental risk assessment to determine any change in residual risk from premature closure. Outcomes of the review will be used to prioritise closure tasks;
- Revision and update of the MCP and development of a final Decommissioning Plan to address changed circumstances of the Project and gain approval from relevant key stakeholders where strategies may need to be amended. These plans would require the following as a minimum:
    - Stakeholder engagement to communicate the strategy to be implemented and address concerns of key stakeholders.
    - Review closure objectives and completion criteria to determine any which may be difficult to achieve given premature closure. Communicate these with relevant key stakeholders to determine a way to resolve issues.
    - Amended landform design for TSFs and WRLs where proposed design could no longer be met.
    - Review of soil and other rehabilitation materials balances to determine any deficiencies in materials, and options to address this.

- Undertake contaminated land assessment, and where required, remediation works, of all areas of the Project used to manufacture, store or utilise hazardous materials. Report all known contaminated sites to the DER.
- Update the final void groundwater model where the proposed extent of mining did not occur to determine if the closure strategy requires amendment.
- Finalise any rehabilitation or closure trials to determine if findings are adequate to implement.
- Review and update monitoring and maintenance requirements.

- Revision and update of the closure cost estimate / closure provisional budget to determine any financial constraints associated with altered designs or deficient materials.
- Address all safety obligations required under Sections 42 and 88 of the *Mines Safety and Inspection Act 1994* (WA) relating to mine suspension or abandonment. One of those obligations is to notify the relevant DMP District Inspector before a mining operation is suspended or abandoned.

9.6 DECOMMISSIONING

A Decommissioning Plan will be developed based on the provisional closure budget and MCP for implementation and stakeholder approval where required.

Once ore processing has been completed, decommissioning of equipment and facilities prior to removal of those items not identified to remain post closure will be undertaken. Where appropriate, process circuits and storage vessels will be decontaminated, electrical distributions de-energised and stocks run down prior to decommissioning commencing.

Equipment and facilities that will not remain post closure will either be dismantled for reuse or resale, or demolished for on-site disposal, with the approach selected being based on economic conditions at the time of closure.

Contaminated land assessments will be undertaken following removal of infrastructure, or within the vicinity of infrastructure to be handed over to a stakeholder. Where required, remediation activities will occur and the monitoring and maintenance requirements within the MCP updated.

Final landforms will be constructed, including any drainage works, installation of covers, placement of growth medium (soil–rock armour), abandonment bunds and surface drainage structures. Where required, soil amendments will be made and seed mixes spread.

Groundwater production and monitoring bores not required for the post closure monitoring program, or being handed over to stakeholders, will be decommissioned to meet all DOW requirements.

Monitoring activities will commence within the required timeframes following completion of rehabilitation activities.

Revision and update of the closure cost estimate / closure provisional budget to determine any financial constraints associated with altered designs or deficient materials.

10.0 CLOSURE MONITORING AND MAINTENANCE

Each domain closure work program (Section 9.2) contains specific monitoring and maintenance activities that will be required during all phases of Project closure. These work programs, along with the closure objectives and completion criteria, must be consulted during the development of closure monitoring and maintenance programs.

A summary of the key closure monitoring and maintenance activities to be included are:

- Implementation of an EFA monitoring program, to track rehabilitation trends indicating a long-term return to a functioning and sustainable ecosystem compared to analogue sites;
- Quadrat based vegetation monitoring program to track progress of revegetation to support the revegetation with local provenance vegetation;
- Groundwater monitoring program to include final voids, TSFs and groundwater borefield. Parameters to be monitored include water chemistry and water levels. The hydrogeological model will be periodically calibrated and validated with additional monitoring data;
- Dust monitoring program of high risk activities such as reshaping WRLs and TSF1, placement of covers on TSF2 and TSF3, and decommissioning of the evaporation pond and sediment pond;
- GDE vegetation monitoring program to include the establishment of photographic monitoring sites and periodic vegetation assessments;
- Performance monitoring of TSF2 and TSF3 cover systems;
- Surface water monitoring program to:
    - Identify any seepage from TSFs; and
    - ensure surface drainage structures maintain surface flows to downstream environments
- Landform stability monitoring of TSFs, WRLs and final voids, including erosion and sediment loss monitoring and geotechnical stability; and
- Radiation monitoring will be undertaken in accordance with the RWMP.

A summary of the key maintenance activities:

- Maintenance of seepage recovery system at TSF3 until drain down of pore water reaches agreed targets;
- Maintenance of fences (excluding grazing animals) around TSF 2 and TSF3;
- Erosion maintenance of WRLs and TSFs embankments;
- Preservation of safety controls for final voids including abandonment bunds and ramp exclusion bunds; and
- General upholding of equipment and infrastructure that is associated with post closure implementation activities including camp facilities, airstrip, water and power services and access roads.

Environmental reporting will be undertaken through requirements set by the DMP via the Annual Environmental Report (AER). It is expected the Project will provide information on rehabilitation progress and performance. Additional reporting requirements will be associated with the annual MRF submission and a three-yearly review of the MCP.

11.0 FINANCIAL PROVISION FOR CLOSURE

Provision of adequate financial resources for closure is critical to ensure that all closure requirements are reached and to finalise the Project without leaving residual liability for the company or the community.

The ANZMEC/MCA *Strategic Framework for Mine Closure* (2000) objective for closure costing is to:

> *Ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability.*

Definitive financial closure provisions and detailed methodology, have not been determined at this stage of the Project and will be undertaken during the detailed engineering design phase. Once the closure cost estimate has been completed, details will be presented within the revised MCP.

11.1 ALLOWANCES AND ASSUMPTIONS

There are a number of general assumptions defined within the closure costs. The general assumptions are listed below:

- Closure and rehabilitation cost estimates are based on a projected overall operational life to 2026;
- All costs are based on proposed developments at the time of preparing the next revision of the MCP (for submission with the Mining Proposal) and incorporate the philosophies and commitments as described in the Mining Proposal. This includes volume calculations, haul distances and earth works calibrations based on rehabilitation and closure specification for landforms, ponds, roads and infrastructure;
- Closure costs are estimated using costs current at the date of preparing the closure cost assessment A contingency factor will be included, but this is yet to be determined. In the interim, a contingency of 10% has been added to the cost estimates;
- Costs are in 2017 Australian dollars and are based on the unit rates for similar activities at Yangibana;
- Closure costs do not include Goods and Services Tax;
- Contingency cost allowances have been made for failed rehabilitation or unexpected difficulties that may require rework of rehabilitation;
- Workforce management, including redundancy payments are not included in the calculation but allowed for elsewhere;
- Potential revenue from resale, scrap of salvage of material and equipment has not been factored in to the provision;
- Cost of removing transportable buildings owned by contractors has not been factored in to the provision;
- Demolition of fixed infrastructure is not calculated as an offset value. Provisions are made for demolition and cartage of non-salvageable / recyclable and non-contaminated waste to dedicated on-site waste facilities for disposal;
- Opportunities for progressive rehabilitation will be undertaken during operations with adequate risk prevention planning (e.g. developing final slopes of the WRL during dump development and progressive encapsulation of waste designated for segregation);

- Logistical facilities at Yangibana (accommodation, airstrip, mess, electricity, water etc.) and services will be maintained during decommissioning and rehabilitation activities. Costs of services such as electricity, flights, accommodation, meals etc. during decommissioning and closure are included in the administration allowances indicated below;
- Closure cost estimates include a provision for administration and management costs during closure at 15% of direct costs spread across 2 years;
- Closure cost estimates include a provision for post closure monitoring at 5% of direct costs spread across 5 years; and
- Closure cost estimates include a provision for post closure maintenance at 10% of direct costs spread across 5 years.

Specific assumptions relating to each domain are provided in Section 9.2.

11.2 MINING REHABILITATION FUND LEVY

The Project annual financial liability under the MRF will be calculated based on the finalised land disturbance areas determined during the detailed engineering design phase for inclusion in the next revision of the MCP.

A preliminary assessment of the MRF liability for the Project indicated that Hastings would be required to pay the MRF levy.

12.0 MANAGEMENT OF INFORMATION AND DATA

The Project will manage closure related information and data by integrating closure activities into the environmental management system (EMS). The EMS will be structured such that:

- It has a series of environmental management plans with associated work instructions;
- Objectives and targets will be established to track environmental performance and enable accountability;
- The development of a legal and obligations register;
- Periodic management review will be undertaken to document environmental performance and ensure management awareness and/or support of arising difficulties; and
- Regular audits of the EMS as per the auditing and reporting plan.

Key documentation within the EMS relevant to closure activities include:

- Mine Closure Plan;
- Stakeholder Engagement Strategy;
- Cultural Heritage Management Plan;
- Surface Water Management Plan;
- Land Management Plan;
- Flora and Vegetation Management Plan;
- Water Supply Operating Strategy;
- Water Management Plan;
- Radiation Waste Management Plan;
- Tailings Management Plan (and TSF operating manual);
- Waste Rock Management Plan; and
- Soils Management Plan.

Environmental monitoring data will be stored in fit-for-purpose databases to enable analysis and interpretation of data trends, and graphic reporting for annual reports.

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APPENDIX A - Closure Legal Obligations Register

Table A-1: Closure Legal Obligation Register for the Yangibana Project

Note: *These tables will be populated with conditions and commitments once licence to operate are issued by regulatory agencies.*

Relevant DMP Tenement Conditions		
Tenement	**Condition No.**	**Closure Condition**

Works Approval (# & Date)	
Condition	**Aspect Related to Closure**

Environmental Protection Act 1986 Licence: #		Category:
Condition No.	**Date**	**Aspect Related to Closure**

Licence To Take Water – GWL No.		
Tenement	**No.**	**Condition**

Mining Proposal	Title & Relevant tenements
Page No.	**Closure Commitment**

APPENDIX B - Stakeholder Engagement Register

Table B-1: Stakeholder Engagement Register for the Yangibana Project

Stakeholder	Date	Issues/topics raised	Proponent response/outcome
Commonwealth government			
Dept of Industry, Innovation and Science	6 October 2016	Roundtable discussion of rare earths and lithium mining in Australia	Provision of information.
DoEE	1 December 2016	Pre-referral meeting. Draft referral provided prior to the meeting. DoEE raised specific aspects that required additional information and referral process, timelines, fees.	Referral documentation revised based on DoEE advice.
State government			
DMP	4 February 2015	Briefing on the Proposal	
DMP	11 March 2015	Project update and DER advice	
DMP	1 December 2015	Briefing on Proposal, outline of potential environmental impacts. Seeking advice from DMP	
DMP and DSD	20 October 2016	Overview of current status of the Proposal, schedule, environmental studies and comparison with Browns Range EIA. Advice received from DMP regarding water balance and source, surface water mitigation, heritage sites, TSF design, and WRL to sit outside of pit zone of instability. DMP, as lead agency, to be the first point of contact.	Hastings will ensure these requirements are addressed in the Mining Proposal. A water source will be developed for the state Referral to the EPA.
DMP	26 October 2016	Invite to attend environmental risk assessment workshops (held as a series of workshops). DMP declined to attend due to schedule conflicts but would provide feedback on risk assessment.	Risk assessment to be provided to DMP for review.
DMP, Resources Safety	30 October 2016	Outcomes of radionuclide studies and monitoring to-date. DMP raised the following considerations: Cross-reference TSF designs with landfill specifications, combination of clay liner and membrane liner to ensure leaching of TSF doesn't occur, capping and drainage system, use of analogue sites in closure planning, keen to see holistic approach to waste characterisation with heavy metal assessment as well as radionuclide assessment, on-going waste characterisation with commitment to update RWMP annually, and note that rare earths have radionuclides that mainly emit Beta radiation.	Advice from DMP noted and provided to TSF design consultants. Focus on Gamma radiation baseline studies as the more intense form of radiation. Gamma baseline studies and monitoring has been undertaken which will inform closure planning. Radionuclides considered within the waste characterisation report to provide holistic approach.

Stakeholder	Date	Issues/topics raised	Proponent response/outcome
DMP, Resources Safety	25 January 2017	Change of DMP staff, briefing on proposal and aspects relating to radiation.	Preliminary advice received.
Radiological Council*	4 February 2015	Briefing on proposal.	Preliminary advice received.
DAA	9 May 2016	Advice sought on the selection of heritage survey participants	Advice received, (noting that there was no native title claim over the area at the time)
DAA	23 January 2017	Overview of the proposal and summary of heritage survey work undertaken to date	Advice from DAA on likely requirement for s18 approval for major river crossings
DAA	23 January 2017	Briefing on proposal and aspects relating to heritage.	Preliminary advice received.
DER	17 March 2015	Briefing on proposal, preliminary advice received.	
DER	14 December 2016	Briefing on proposal	Next meeting to be held for scoping of Part V approvals at the end of the EIA process.
DoW	6 October 2016	Overview of the proposal. Briefing on water requirements for the proposal. Advice received: Consider doing isotope analysis to further understand age of water source and potential for recharge; likely that more but brackish water exists closer to the Lyons River. Better quality water is likely available with distance from the River but at lower volumes; and TSF location appeared such that water would not flow into creeks or rivers except after heavy rainfall events.	Isotopic analysis is underway. DoW advice communicated to consultants.
DoW	13 October 2016	Requirement for 5C licence for test pumping to determine drawdown contours in each pit.	Project description and test pumping details provided to DoW, Geraldton. No 5C licence required.
DPaW	2 April 2015	Preliminary advice on flora & fauna survey requirements and design from DPaW.	
DPaW	30 September 2016	Overview of environmental survey outcomes, subterranean fauna assessments and on-going studies, consultation requirements with DPaW.	No further consultation required unless EPA formally request DPaW input. No subterranean fauna expertise in DPaW, so they would request input from WA Museum if required.

Stakeholder	Date	Issues/topics raised	Proponent response/outcome
OEPA	10 September 2015	Overview of Proposal, presentation of available environmental data particularly flora and fauna, hydrology and radiation assessments.	
OEPA	10 March 2016	Briefing on Proposal, outline of potential environmental impacts.	
OEPA	12 October 2016	Concern raised about whether or not referral of the Proposal could be given a level of assessment during the governments 'caretaker phase'. The OEPA officer seemed to think this was likely and recommended a pre-referral meeting ASAP.	Pre-referral meeting with OEPA was then scheduled for 19 October 2016. Plans to refer in mid-November.
OEPA	19 October 2016	Pre-referral meeting. Briefing on proposal, API level impact assessment requirements and timing of referral during caretaker phase. OEPA officers advised that the EPA could provide proponents with a level of assessment during caretaker phase. Key requirements: all studies to be completed with no information gaps, adequate stakeholder consultation with low community interest, high quality documentation.	Delay of referral in order to ensure all necessary studies have been completed.
OEPA	23 January 2017	Preliminary feedback re referral information included: inclusion of port and transport corridor in proposal, water drawdown impacts to GDE to be determined, height of waste rock landforms, risks associated with flora along access road, minor revisions to form and ERD	Address OEPA feedback in final referral form and ERD.
CASA	31 October 2016	Registration requirements and details for notification of an airstrip. CASA then provided a brief overview of their requirements highlighting the importance of have the correct consultants do the design and ensuring it is constructed to design specifications. No environmental issues were raised.	Noted. A formal letter was then sent showing the location of the airstrip, runway code and timeframes for construction.
AirServices Australia	7 November 2016	Location and overview of airstrip design intent was provided in a letter. AirServices noted that the airstrip was in a good location from a safety perspective. No environmental issues were raised.	Noted.
Local Government			
Shire of Upper Gascoyne	26 May 2016	Project overview and update on project status. Discussed access road options. The Shire provided information on council maintenance operations of the	Shire provided MRWA road assessment information.

Stakeholder	Date	Issues/topics raised	Proponent response/outcome
		Dairy-Creek Road and requirements during project operations.	
Shire of Upper Gascoyne	31 October 2016	Logistics for community forum and advertising. The Shire noted that the Gassy News was the best form of advertising in remote areas, pastoralists and everyone in town will be informed. Advertisement will be distributed as per the Gassy News to pastoralists as well as those in town.	Advertisement prepared and distributed.
Shire of Upper Gascoyne	30 November 2016	Briefing on the Proposal, non-committal until they know that Project will go ahead, concern for road condition with additional vehicle movements to and from the proposal	Hastings to keep the Shire updated of progress
Gascoyne Development Commission (GDC)	30 November 2016	Overview of Proposal, approvals status and requirements, environmental aspects. GDC discussed development initiatives in the Gascoyne region.	Hasting to keep GDC updated of progress and provide a copy of the presentation.
Traditional Owners			
Traditional owners field visits	2-4 August 2016 and 21 September 2016	Location of proposed mine areas, processing plant and associated infrastructure visited by TOs. TO's highlighted importance of story line associated with the Lyons River and its tributaries. Concerns raised to protect the River.	Refer to Appendix 8.2 report. Hastings has put a 150m exclusion buffer on either side of the Lyons river, Fraser Creek and Gifford Creek. Hastings has been able to avoid significant heritage sites identified to-date.
YMAC	1 December 2016	Introductory meeting and outline of likely future tenure requirements and engagement.	YMAC to seek instructions from the combined Thin-Mah Warianga, Tharrikari, Jiwarli native title claimants
Pastoralists			
Wanna station	2014 – to-date	Updates of exploration activities and feasibility studies conducted on Wanna station. Land access and logistics arrangements in consultation with Wanna station.	
Wanna Station	28 May, 2016	Site visit with station manager to look at infrastructure locations on the station via car and flying over the site in small aircraft. Gain understanding of pastoral activities and how to integrate with infrastructure planning.	Provision of infrastructure design plan as developed.
Wanna Station	5 October, 2016	Proposal overview. Concerns raised about infrastructure locations and ensuring water in pastoral bores does not become contaminated.	Advised that seepage of contaminants is regulated by several levels and departments of government including DoEE, EPA, DMP (environment and

Stakeholder	Date	Issues/topics raised	Proponent response/outcome
			resources safety), Radiological Council and DER. Field visit with station manager is planned to go over latest infrastructure plans. Baseline water quality sampling of nearest pastoral bores to the Project.
Wanna Station	26 October, 2016	Review infrastructure planning and location to address pastoral leaseholder concerns. High value pastoral country at the location where the airstrip and roads is proposed.	Revise location of the air strip and access road. On-going consultation with Wanna required.
Wanna Station	4 November, 2016	Project update. Request for revised infrastructure map with revised aerodrome and road locations.	Map provided.
Edmund Station	15 November, 2016	Request via phone and email to meet so that Hastings can provide a Project update. No response received.	
Wanna Station	1 December, 2016	Discuss land tenure and an access agreement.	Draft access agreement prepared by Hastings.
Edmund Station	6 January, 2016	Request via email to meet so that Hastings can provide a Project update. Environmental Fact Sheet attached to email.	
Community			
Gascoyne Junction	30 November 2016	Community forum held at community resource centre in Gascoyne Junction. Environmental fact sheet summarising environmental issues, proposal overview and invite to provide comment.	Despite advertising the event, the only two attendees raised no issues. The community resource centre will ensure residents are sent a copy of the environmental fact sheet and will maintain copies on display at the centre.

APPENDIX C - TSF 2 and TSF 3 Closure Considerations

HASTINGS
Technology Metals Limited

Yangibana Rare Earths Project

TECHNICAL NOTE

Closure Considerations – TSF2 and TSF3

Document	Technical Note: Closure Considerations TSF2 and TSF3		**Division**	App	**Status**	Approved	**Issued**	14/12/16
Number			**Author**	ERR	**Review Date**	13/12/16	**Version**	0

1 Introduction

1.1 Yangibana Rare Earths Project

Hastings Technology Metals Limited (Hastings) is proposing to develop the Yangibana Rare Earths Project (the Project), which is situated approximately 270 km north-east of Carnarvon and approximately 100 km north-east of Gascoyne Junction, in the upper Gascoyne region of Western Australia (Figure 1). Hastings is targeting rare earth elements in ferrocarbonatite veins in four deposits. An on-going exploration program across Yangibana tenements may discover other feasible deposits to mine. An open cut mining method will separate waste rock and ore. Waste rock landforms will be situated next to each pit. The ore will undergo processing: Beneficiation and Hydrometallurgy. Tailings from the process plant will be directed to three Tailings Storage Facilities (TSFs).

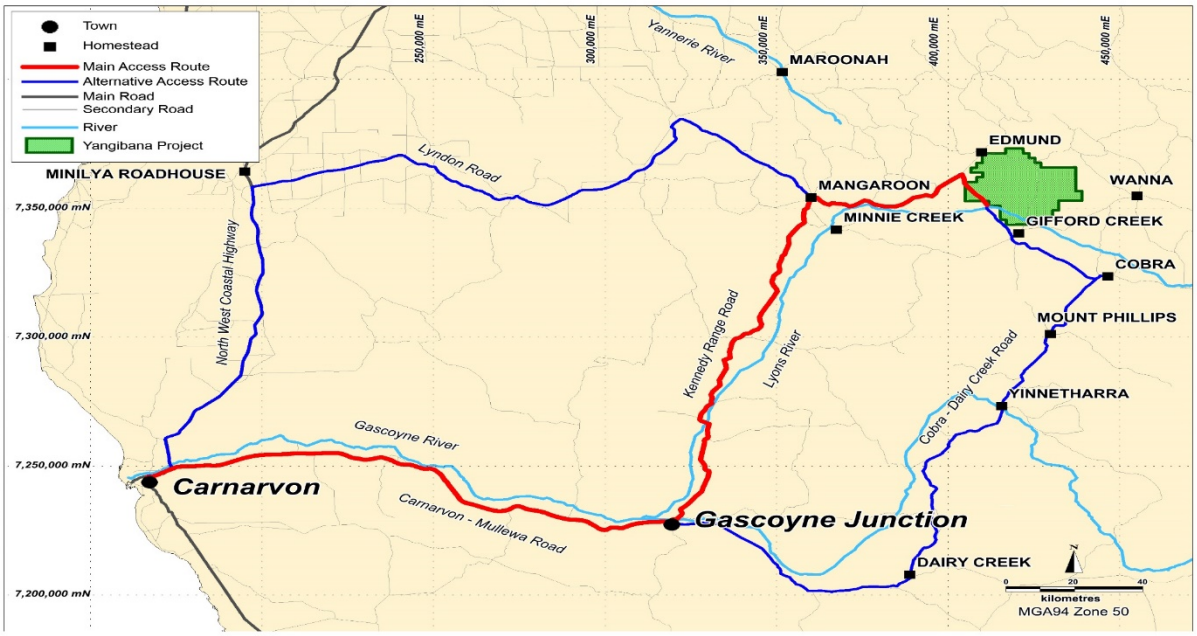

Figure 1 Location of the Yangibana Rare Earths Project

1.2 Scope and Purpose

The purpose of this technical note is to outline additional preliminary closure considerations for two TSFs (TSF2 and TSF3) which will be used for the disposal of tailings containing concentrations of radionuclides exceeding 1Bq/g. A number of closure requirements for TSF2 and TSF3 will be in addition to those required for TSF1, a facility with concentrations of radionuclides below 1Bq/g.

The designs and hazard assessments for TSF2 and TSF3 are currently underway.

1.3 Final Landform Design

A final landform design and closure strategy for TSF2 and TSF3 will be developed as a component of the Definitive Feasibility Study (DFS), with the intention that it be further refined in the detailed engineering phase of the Project. The specific TSF closure parameters to be determined, include:

- Sources of suitable materials for final encapsulation of TSF2 and TSF3;
- Source and storage of suitable rock cover materials;
- Specifications of encapsulation layer(s) to limit infiltration into tailings and potential seepage;
- Prescribed thickness of rock cover / batters to protect tailings against long-term erosion;
- Methods for minimisation of long-term radiation emissions;
- Final height and footprint;
- Outer slope geometry;
- Growth medium cover: soil-rock mulch blend – ratio of blending, thickness of cover and selection or competent benign waste rock; and
- Location and design of surface water drainage measures.

The final landform design and closure strategy will form a component of the Project Mine Closure Plan (MCP). The MCP will be subject to regulatory approval in Western Australia by the Department of Mines and Petroleum (DMP) Environment Branch, and the Office of the Environmental Protection Authority (OEPA).

MCPs are dynamic documents, with on-going revision identifying information gaps and being updated with the outcomes of on-going studies and/or trials during the operations phase. Benchmarking against closure of similar facilities will also be conducted to determine lessons learned. New technologies and research outcomes will also be identified and trialled, where appropriate, to ensure best practice in mine closure. Towards the end of the operations phase, the MCP will be finalised before being implemented.

2 Legislation and Guidance

Specific Western Australian legislation which governs all aspects of rehabilitation and closure includes:

- *Mining Act 1978*;
- *Mining Rehabilitation Fund Act 2012*;
- *Mines Safety and Inspections Act 1994* and subsidiary legislation *Mines Safety and Inspection Regulations 1995* (part 16);
- *Environmental Protection Act 1986; and*
- *Contaminated Sites Act 2003*.

Code of Practice and Guidelines which detail additional rehabilitation and closure requirements specific to tailings exceeding 1 Bq/g, and therefore applicable to TSF2 and TSF3, includes:

- Australian Radiation Protection and Nuclear Safety Authority (ARPANSA) (2005) *Code of Practice and Safety Guide: Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing*, Radiation Protection Series Publication No.9; and
- DMP (2010) *Managing Naturally Occurring Radioactive Material (NORM) in Mining and Mineral Processing – Guideline, NORM 4.2, Controlling NORM – Management of radioactive waste*.

Hastings will consult with, and seek approval from, key government stakeholders in relation to closure of TSF2 and TSF3, including:

- Department of Mines and Petroleum (Resources Safety and Environment Branches);
- Radiological Council; and
- Department of Environment Regulation.

Radiation legislation specific to mine sites in Western Australia is regulated through the *Mines Safety and Inspection Act 1994* and the *Mines Safety and Inspection Regulations 1995* administrated by the Department of Mines and Petroleum (DMP). The regulations include requirements for authorised limits, preparation of a radiation management plan, control of exposure to radiation, mining of radioactive material, stockpile management, waste management and mine closure. The WA DMP Resources Safety Branch approves and regulates the design, construction, operation and decommissioning of TSFs, and the WA DMP Environment Branch approves and regulates the rehabilitation and closure management of TSFs.

Additionally, in Western Australia the current legislative framework for the management of radioactive substances is the *Radiation Safety Act 1975*, administered by the Radiological Council. The Radiological Council issue to mine or mill radioactive substances and premise registrations when radioactive substances are manufactured, used or stored.

3 Closure Considerations

3.1 General Considerations

Prior to site closure, the approved Radiation Waste Management Plan (RWMP) will require revision to ensure relevance to decommissioning activities. A Decommissioning Plan will also require approval by the DMP and Radiological Council.

As with all industrial land uses and waste storage / disposal sites, TSF2 and TSF3 will be reported to the WA Department of Environment Regulation (DER) as a "known contaminated site" under the *Contaminated Sites Act 2003* (CS Act) (WA).

The NORM 4.2 guideline recommends that the post-mining land use for landforms containing NORM waste should be the same as the pre-mining land use, with unrestricted future use. The Baseline Radiation Report describes the radiation levels at the Project as a baseline of the pre-mining environment and land use.

3.1.1 Closure Objectives

Closure objectives will be determined as part of closure planning in the design and approval phase of the Project.

Preliminary closure objectives for TSF2 and TSF3 include:

- TSF2 and TSF3 will remain permanent features in the landscape;
- TSF2 and TSF3 will be a safe, stable and non-polluting landform, supporting local provenance vegetation;
- Tailings in TSFs will be securely stored within robust containment; and
- Post closure radiation levels will be consistent with pre-operational natural background levels.

3.2 Decommissioning Phase

Decommissioning of the TSFs will be in accordance with the approved Decommissioning Plan.

Management and monitoring during decommissioning works will include:

- Quality control systems;
- Dust control during earth works;
- Ongoing environmental monitoring as described in the RWMP;
- Ongoing occupational radiation monitoring as per the Operations Radiation Management Plan; and
- Traffic control will be established to control movements of waste and potentially contaminated equipment / materials. Vehicle inspection and wash-down / wheel wash may be required.

3.3 Rehabilitation Phase

Rehabilitation of TSFs will be in accordance with the approved RWMP and MCP. The DMP and Radiological Council will determine when the decommissioning phase is complete and rehabilitation may commence. As such, an "Authorisation to Rehabilitate" will be sought from the Radiological Council, as required under the ARPANSA (2005) *Code of Practice and Safety Guide: Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing*.

3.3.1 Rehabilitation Activities

Rehabilitation activities specific to TSF2 and TSF3 include:

- Tailings will be allowed to drain down and consolidate, with collection of seepage for evaporation, prior to placement of the final encapsulation layer(s);
- Once the tailings are trafficable, placement of covers will occur;
- Encapsulation layer(s) will be constructed over consolidated tailings to shed rainfall to minimise the potential for generation of leachate and seepage;
- TSF2 and TSF3 will be capped with an adequate cover thickness of competent benign waste rock to protect encapsulation layer(s) from surface erosion;
- Growth medium (soil-rock mulch blend) will be placed over capping layer to promote revegetation of shallow-rooted local provenance flora species;
- Construction of surface water management / drainage structures on the surface / slopes of the final TSF landform; and
- Construction of surface water management structures up-gradient of TSF2 and TSF3 to protect from erosion.

3.4 Post-Closure Phase

Post-closure environmental monitoring will include:

- Release rates of radon and thoron, dusts, leachate and surface runoff;
- Surface water sampling: monitoring program based on public access to water sources and exposure scenarios where relevant;
- Groundwater sampling: monitoring up-gradient and down-gradient of TSF leachate sources;
- Atmospheric monitoring: sample points determined on critical receptors and meteorological data, surrounding the TSFs and predominant downwind direction;
- Fauna monitoring: monitor the presence of burrowing fauna able to breach covers and mobilise tailings to the surface;
- Biological monitoring: concentrations of radionuclides in vegetation and fauna; and
- Rehabilitation monitoring: erosion rates, revegetation cover and composition.

4 References

ARPANSA (2005). Code of Practice and Safety Guide: Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing, Radiation Protection Series Publication No.9, August 2005.

DMP (2010). Managing Naturally Occurring Radioactive Material (NORM) in Mining and Mineral Processing – Guideline, NORM 4.2, Controlling NORM – Management of radioactive waste, Resources Safety, Department of Mines and Petroleum.

Government of Western Australian. *Contaminated Sites Act 2003*.

Government of Western Australian. *Environmental Protection Act 1986*.

Government of Western Australian. *Mining Act 1978*.

Government of Western Australian. *Mining Rehabilitation Fund Act 2012*.

Government of Western Australian. *Mines Safety and Inspections Act 1994*.

Government of Western Australian. *Mines Safety and Inspection Regulations 1995*.

Government of Western Australian. *Radiation Safety Act 1975*.

APPENDIX D - Conceptual Hydrogeological Appraisal

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX E - Baseline Radiation Assessment

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX F - Preliminary Hydrology Assessment

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX G - Flora and Vegetation Assessment

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX H – Preliminary Vegetation and Habitat Assessment – Proposed Access Road

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30 January 2017

Our ref: 11128-3397-15L Desktop Memo Access Road

Lara Jefferson
Environment Manager
Hastings Technology Metals
C/- Wave International
306 Murray Street, Perth
Western Australia 6000

Dear Lara

PRELIMINARY ASSESSMENT OF VEGETATION TYPES AND FAUNA HABITAT OF PROPOSED ACCESS ROAD

In 2015, Ecoscape conducted Level 2 flora, vegetation and fauna surveys within Hastings Technology Metals (Hastings), Yangibana Rare Earths Project (Yangibana) study area, in the Gascoyne region of Western Australia. The survey area included proposed sites for project infrastructure including an access road. The proposed access road has now been moved and extends south of the original study area by approximately 13 kilometres (km).

Hastings requested Ecoscape undertake a preliminary desktop assessment of vegetation types and fauna habitats that may occur along the new access road alignment.

VEGETATION TYPES

LAND SYSTEMS

The proposed access road alignment intersects six land systems: Nadara, Augustus, Gascoyne, George, Jamindie and Winmar (Wilcox & McKinnon 1972). Two of these land systems (George and Winmar) are not represented within the Yangibana study area. They are described as:

- George Land system: very stony lower slopes and interfluves below hill systems, supporting stunted acacia, eremophila and cassia shrublands.
- Winmar Land system: Stony plains with sandy banks supporting mulga and other acacia shrublands with eremophila and cassia low shrubs and wanderrie grasses on banks.

PRE-EUROPEAN VEGETATION ASSOCIATIONS

The proposed access road alignment intersects four mapped vegetation associations based on pre-European mapping (DAFWA 2012):

- 18: low woodland; mulga (*Acacia aneura*)
- 29: sparse low woodland; mulga, discontinuous in scattered groups
- 165: low woodland; mulga and snakewood (*Acacia eremaea*)
- 181: shrublands; mulga & snakewood scrub.

One of these vegetation associations, '29', was not present within the Yangibana study area that was surveyed during 2015. This vegetation association occupies a substantial proportion of the proposed access road outside of the main Yangibana study area.

ASSESSMENT OF AERIAL IMAGERY AND SITE PHOTOGRAPHS

Based on a preliminary assessment of aerial imagery and site photographs, the proposed access road may intersect vegetation types analogous with or similar to the following documented by Ecoscape:

- **AcEt**; '*Acacia cyperophylla* var. *cyperophylla* low open woodland over *Eragrostis tenellula, Eragrostis cumingii* and *Eriachne aristidea* low tussock grassland major drainage line'. This vegetation type is associated with mid to minor drainage lines and is considered likely to occupy such habitats along the proposed road corridor.
- **EcBp**; '*Eremophila cuneifolia* and *Scaevola spinescens* mid sparse shrubland over *Brachyachne prostrata* and *Sclerolaena eriacantha* low sparse grassland/chenopod shrubland'. This vegetation is considered likely to within the northernmost section of the proposed road, adjacent to the main Yangibana study area, associated with plains of the Nadara Landsystem.
- **AaEpDr**; '*Acacia aptaneura* low open woodland over *Eremophila phyllopoda* subsp. *obliqua*, *Acacia tetragonophylla* and *Dodonaea petiolaris* mid open shrubland over *Dysphania rhadinostachya, Bulbostylis barbata* and *Gomphrena cunninghamii* low open forbland/ sedgeland'. This vegetation type (or similar) may occupy the proposed road corridor based on an apparent continuation of the landform signature observed within the Yangibana study area.
- **EcMgCc**; '*Eucalyptus camaldulensis* mid woodland over *Melaleuca glomerata* and *Acacia coriacea* subsp. *pendens* tall shrubland over **Cenchrus ciliaris* mid tussock grassland'. This vegetation type (or **EvCc**) is considered likely to intersect this proposed road corridor near the southernmost extent based on the aerial imagery.
- **EvCc**; '*Eucalyptus victrix* and *Acacia citrinoviridis* mid open forest over **Cenchrus ciliaris* and **C. setiger* mid tussock grassland'. As with **EcMgCc**, this vegetation type may correspond with the drainage lines intersecting the southernmost extent of the proposed road corridor.
- **EpAc**; *Eremophila phyllopoda* subsp. *obliqua, Acacia tetragonophylla* and *Senna artemisioides* subsp. *helmsii* mid open shrubland over *Aristida contorta, Eriachne pulchella* subsp. *dominii* and *Portulaca oleracea* low grassland/forbland.

None of the vegetation types listed above were identified as Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs), (Ecoscape 2016). **EcMgCc** is considered to represent a Groundwater Dependent Ecosystem (GDE) and **EvCc** may be representative of a GDE. It is possible that other vegetation types may be present within the proposed access road.

POTENTIAL FOR CONSERVATION SIGNIFICANT FLORA

There is potential for the majority of conservation significant flora species identified by the 2015 Level 2 flora and vegetation assessments to occur within the proposed access road. Additionally, during the 2015 assessments, an area adjacent to the proposed access road was opportunistically assessed due to the observation of an unusual species of *Acacia*, subsequently identified as *Acacia atopa*. This species is listed as Priority 3. It dominates the linear ridgelines that occur immediately adjacent to the proposed access road. There is potential for the population of this species to extend within the boundary of the proposed access road.

CONCLUSION

The proposed access road contains both land systems and mapped pre-European vegetation associations that are not represented within the main Yangibana study area that was subject to a detailed Level 2 flora and vegetation assessment in 2015. The region surrounding the Yangibana study area remains relatively unsurveyed with regards to flora and vegetation. It is considered likely, based on an assessment of the aerial imagery and photographs provided by Hastings, that vegetation types may be analogous or similar to those encountered within the Yangibana tenements. There is the potential for conservation significant flora and vegetation (groundwater dependent ecosystems). This assumption is based on the presence of unique land systems and pre-European vegetation associations that did not occur within the Yangibana study area. A Level 1 flora and vegetation survey of the proposed access road is recommended.

FAUNA HABITATS

A desktop fauna assessment was undertaken that extrapolated the habitat mapping from the 2015 Level 2 fauna survey and compared the route of the proposed access road with similar habitats and landforms. The following fauna habitat types may occur along the proposed access road.

Rocky Plains and Hills

This habitat is characterised by gravelly/stony undulating hills of fine, red clay/loam soil with >70% cover of ironstone gravel or >40% of quartz stones with occasional granite rocks. The vegetation is sparse and consists of scattered *Acacia xiphophylla* and *Exocarpos psydrax* tall shrubs, over low *Eremophila fraseri*, *Ptilotus obovatus* and *Senna* spp shrubland. Some patches of *Dysphania rhadinostachya* open herbland and *Eriachne pulchella* subsp. *dominii* and *Aristida contorta* open tussock grassland can be found. It also comprises some undulating hills and smaller hillslopes in particular in the south of the study area as well as plains which were recorded throughout the study area. This habitat is the most common in the study area.

Sandy Plains

The sandy plain habitat type is dominated by an open layer of *Acacia xiphophylla* tall shrubs over scattered *Senna ferraria* mid shrubs over occasional *Maireana* spp. low, isolated chenopod shrubs. This habitat types is also characterised by sandy fine, orange clay/loam soil with occasional calcrete and quartz pebbles. Rocks were rarely encountered. Leaf litter and wood litter is rare but was sometimes observed accumulated underneath shrubs.

Major River

This habitat type consists of *Eucalyptus camaldulensis* trees over mid shrubland of *Acacia citrinoviridis* and *Acacia coriacea* over lower shrubs and *Cenchrus ciliaris* and *Eragrostis tenellula* closed tussock grassland. The substrate consists of coarse sand with occasional quartz/granite pebbles. Leaf and wood litter is usually accumulated against tree trunks, or in some cases entirely absent. After heavy rainfall events, semi-permanent water pools may be present to support a large number of fauna species.

The fauna assemblages associated with the habitats found along the access road are expected to comparable to those recorded from the initial study area.

CONCLUSION

Based on our preliminary desktop assessment and assessment of aerial imagery and photographs provided, it is considered likely that fauna habitat types may be analogous or similar to those encountered within the Yangibana tenements. Consequently, a Level 1 fauna survey of the proposed access road is recommended.

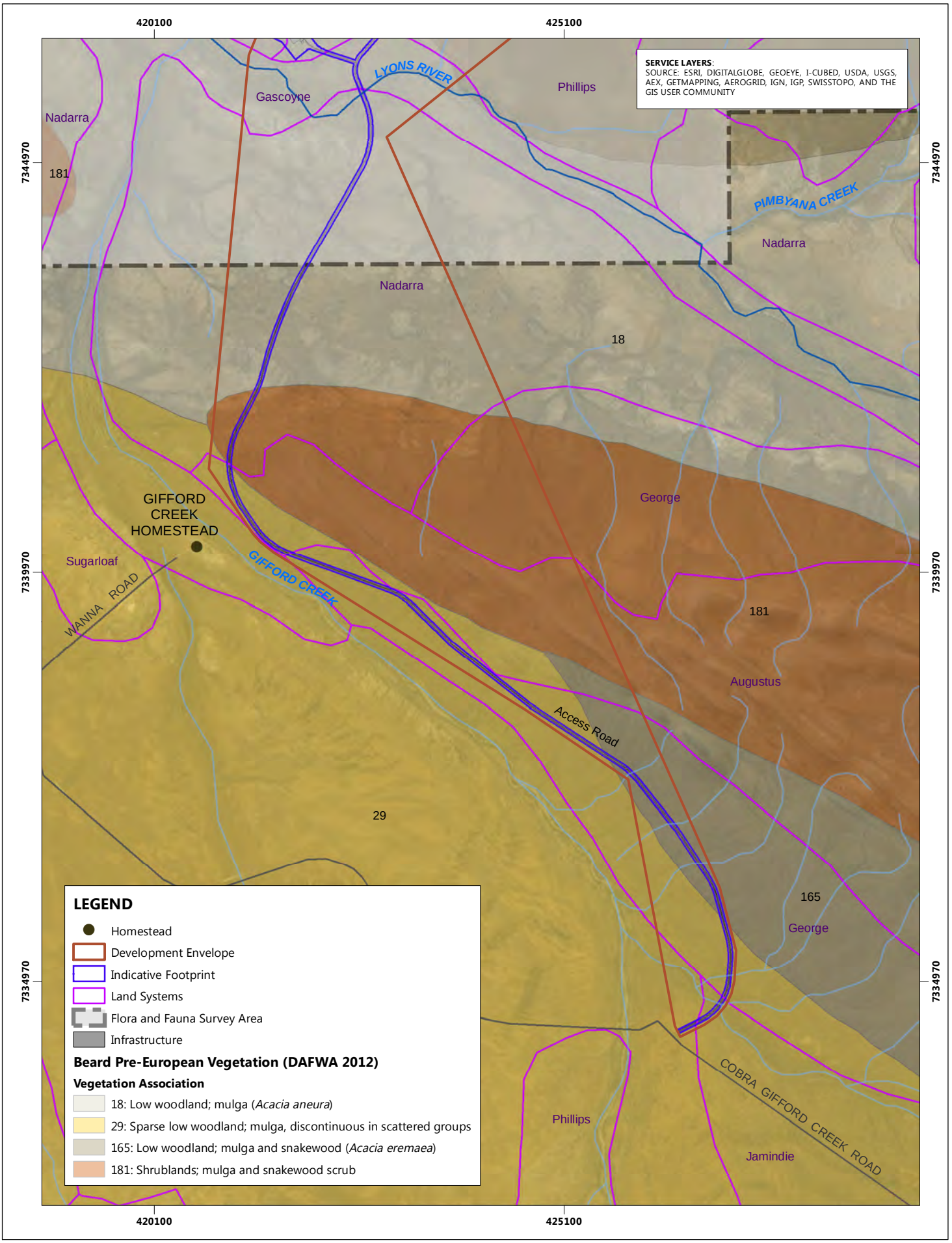
Yours sincerely

Ecoscape (Australia) Pty Ltd

Jared Nelson

Group Leader - Environment

QA Approved by:	Marc Wohling-Director, Environment		**Date:**	27/01/2017



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PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES:
TOPOGRAPHIC LAYERS: GEOSCIENCE AUSTRALIA

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	SK	30/01/2017

N

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PRELIMINARY ASSESSMENT OF VEGETATION TYPES AND FAUNA HABITAT OF PROPOSED ACCESS ROAD

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 01

APPENDIX I - Terrestrial Fauna Assessment

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX J - Local Subterranean Fauna Assessment

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX K – Soil Assessment

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX L – Waste Rock and Preliminary Tailings Characterisation

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX M – Radiation Waste Charaterisation

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX N – Preliminary Landform Surface Erodibility Assessment

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX O – Visual Impact Assessment

This report has not been included due to overall size of the document.

Please refer to relevant report appendix in the Hastings Yangibana Rare Earths Project Environmental Review Document.

APPENDIX P – Post Mining Impact - Groundwater Depedent Ecosystems

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30 January 2017

Our ref: 11133-3397-15L

Lara Jefferson
Environment Manager
Hastings Technology Metals
C/- Wave International
306 Murray Street, Perth
Western Australia 6000

Dear Lara

IMPACT OF POST MINING GROUNDWATER DRAWDOWN ON GROUNDWATER DEPENDANT ECOSYSTEMS

During 2015, Ecoscape conducted Level 2 Flora, Vegetation and Fauna assessments within Hastings' Yangibana study area, in the Gascoyne region of Western Australia. Since then, the post mining groundwater drawdown modelling has been conducted. This document presents the results of this modelling with regards to the potential impacts to Groundwater Dependant Ecosystems (GDEs).

As outlined by Ecoscape (2016), vegetation types with the phreatophytic species *Eucalyptus camaldulensis* were considered to represent a GDE whilst vegetation characterised by *Eucalyptus victrix* were considered potentially representative of a GDE. The **EcMgCc** vegetation type was dominated by *Eucalyptus camaldulensis* and is therefore considered as a GDE. The **EvCc** and **EvReMg** vegetation types were characterised by *Eucalyptus victrix* whilst the **AcEt** and **AcAsCc** occasionally contained this species and may therefore represent a GDE.

The modelled post mining groundwater drawdown is presented in the maps attached (**Figure 4**, **Figure 5**, **Figure 6** and **Figure 7**). This mapping demonstrates that, of the GDEs (or potential GDEs) identified within the Yangibana study area, only the **AcEt** vegetation type intersects the modelled post mining drawdown. This includes 19.05 ha at 'Bald Hill', 22.09 ha at 'Frasers' and 100.61 ha at 'Yangibana' (total of 141.74 ha).

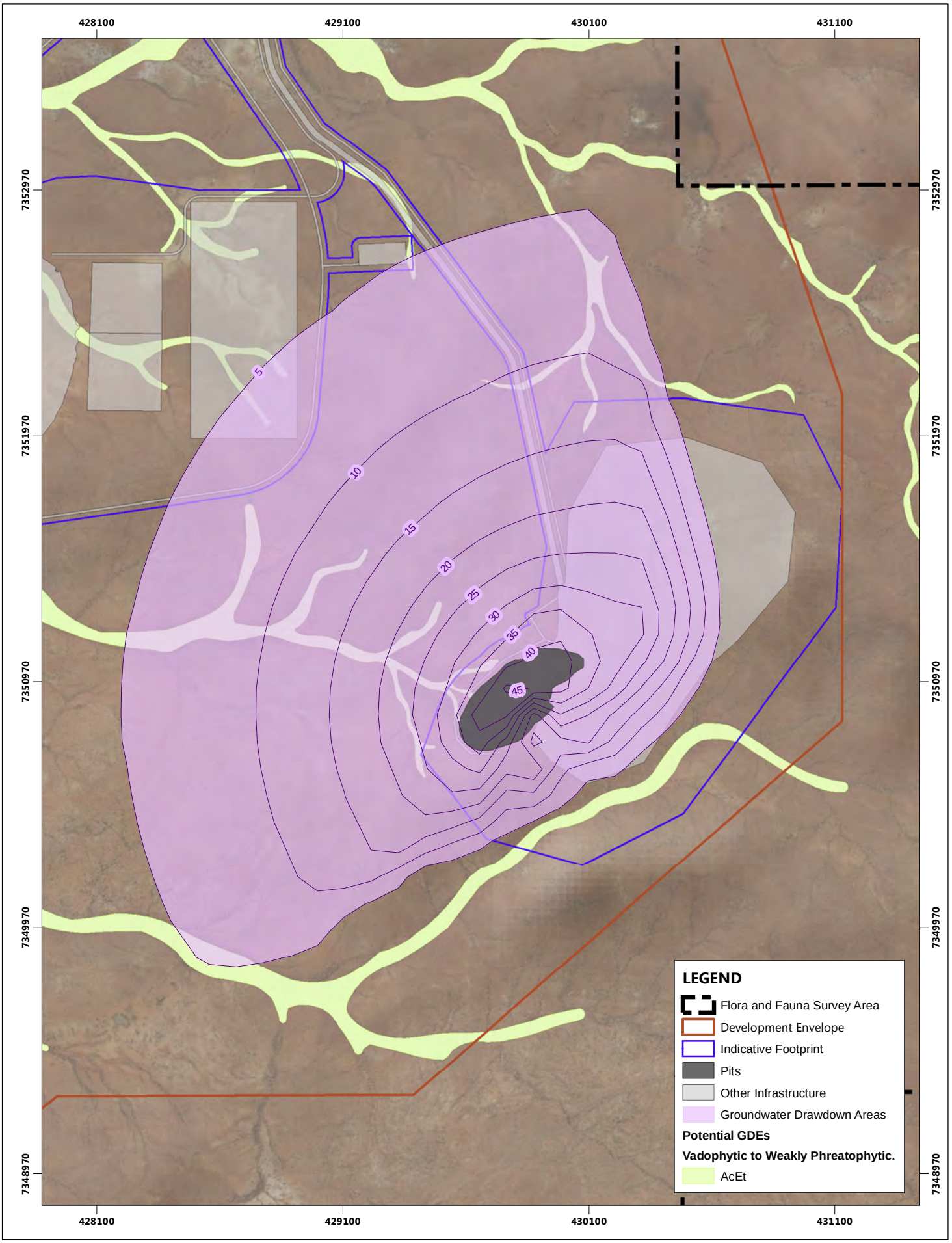
The **AcEt** vegetation type is primarily dominated by *Acacia cyperophylla* which is not known or considered to be a groundwater dependant species. This vegetation type was only occasionally observed to contain scattered or isolated individuals of *Eucalyptus victrix*, more commonly this species was absent. Therefore, it is considered unlikely that the **AcEt** vegetation type represents a groundwater dependant, at least in most cases. The potential impact of post mining groundwater drawdown on GDE's is therefore considered likely to be negligible or nil.

Yours sincerely
Ecoscape (Australia) Pty Ltd

STEPHEN KERN
Senior Botanist, Team Leader

QA Approved by:	Lyn Atkins Associate Environmental Scientist		**Date:**	30/01/2017

[science+design]



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COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES :
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	25/01/2017

N

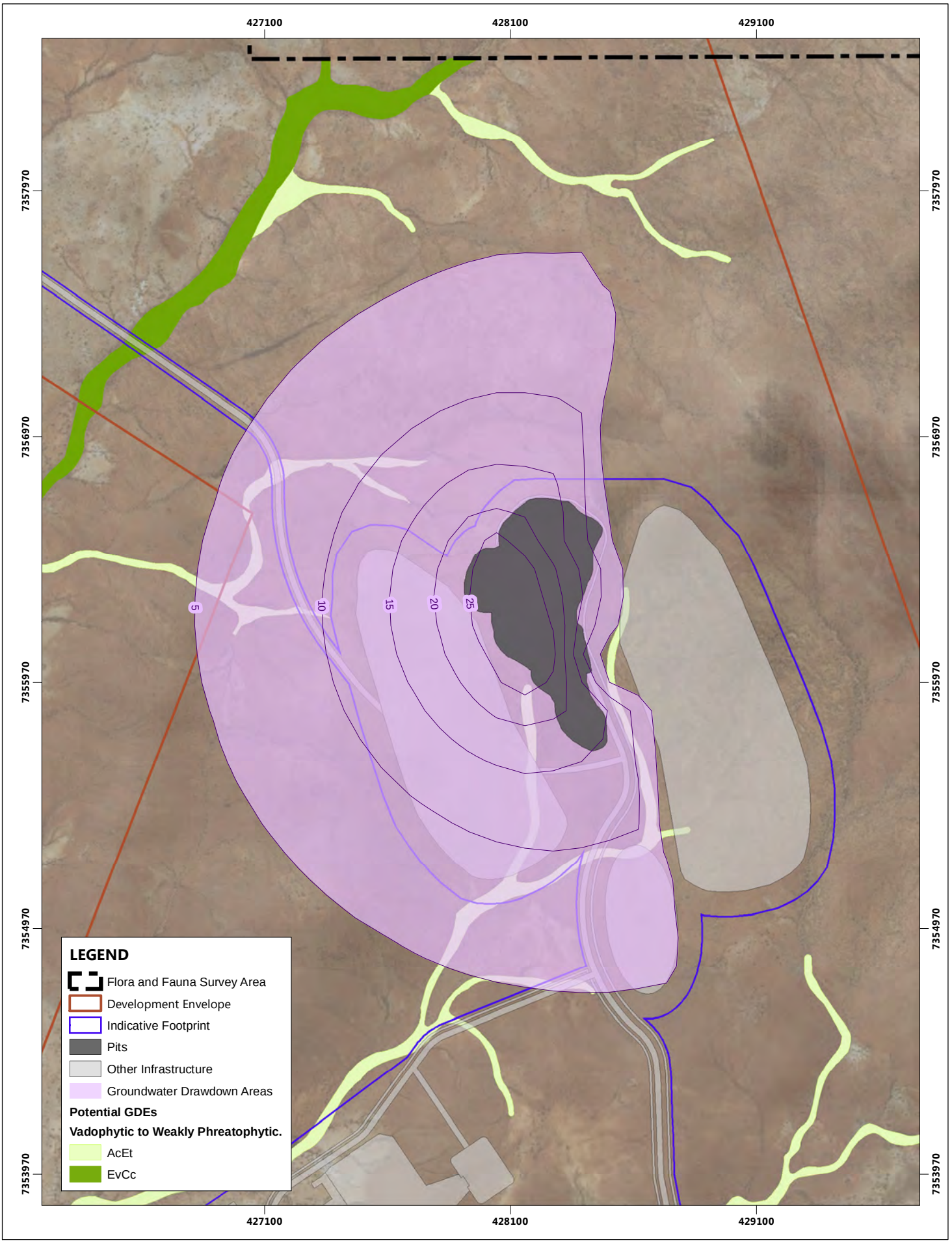
0 100 200 300 400 500 m

FRASERS POST MINING GROUNDWATER DRAWDOWN

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 04



SCALE: 1:20,000 @ A4

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES :
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	25/01/2017

N

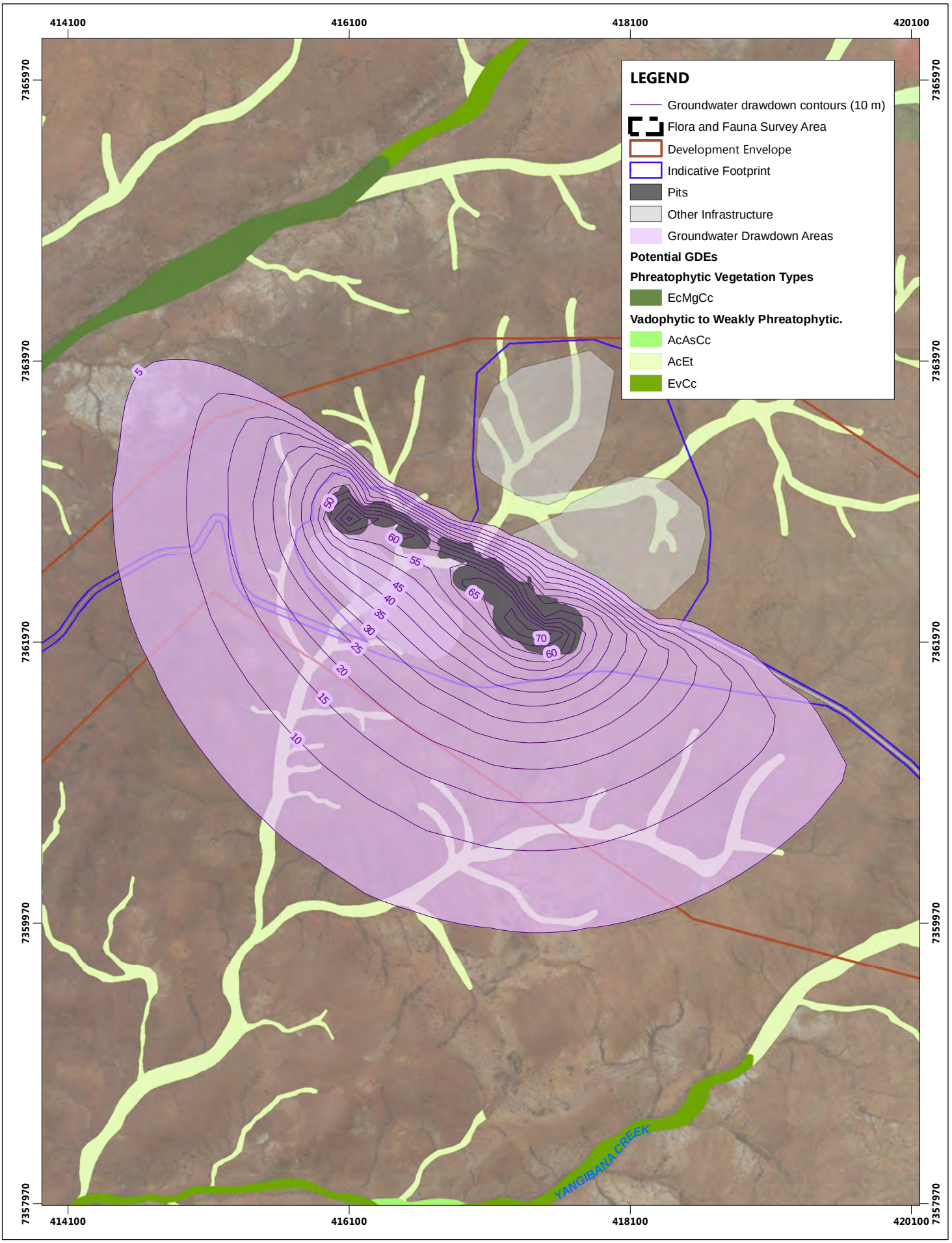
0 100 200 300 400 500 m

BALD HILL POST MINING GROUNDWATER DRAWDOWN

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 05



SCALE: 1:35,000 @ A4

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES :
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	25/01/2017

N

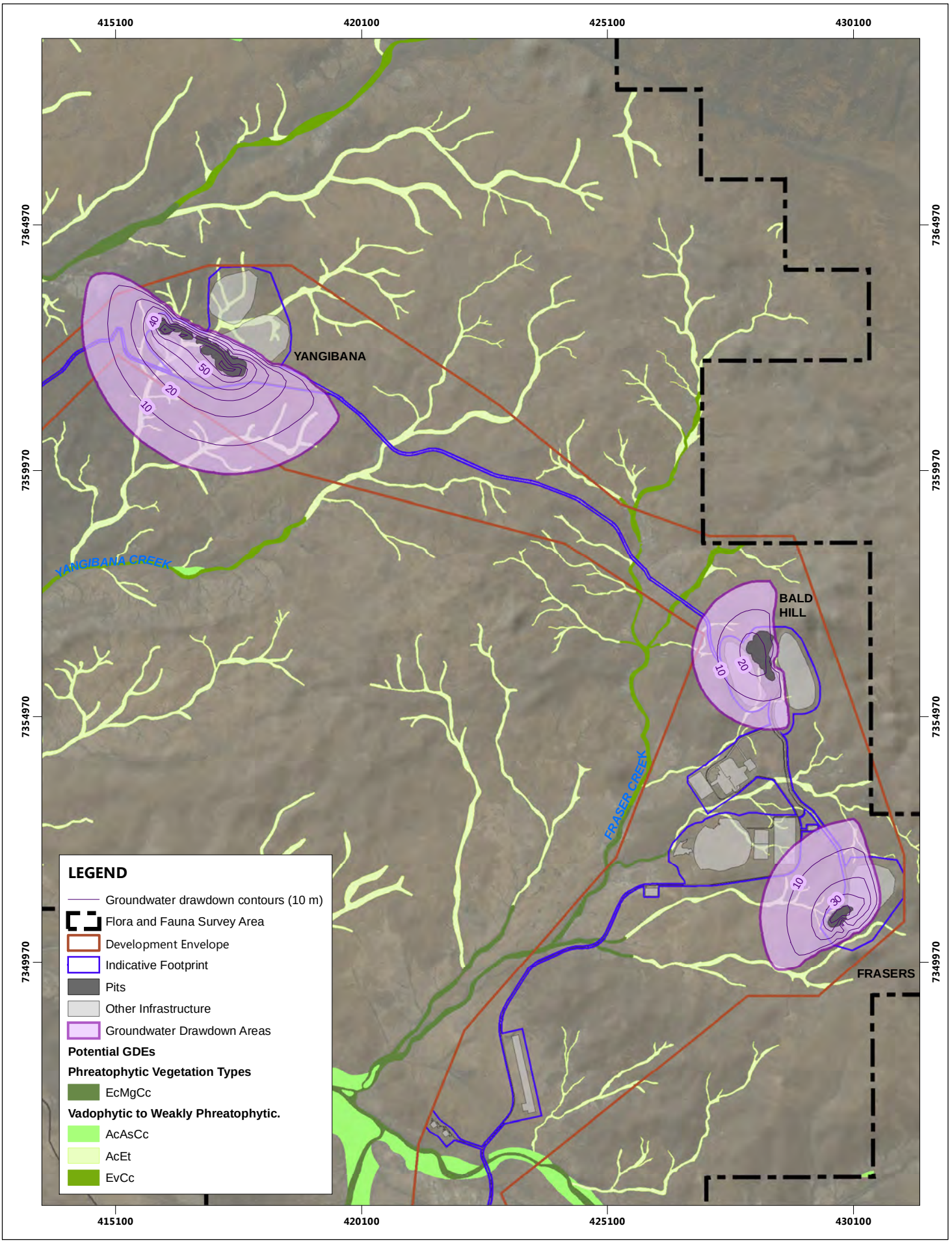
0 200 400 600 800 1,000 m

YANGIBANA POST MINING GROUNDWATER DRAWDOWN

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 06



SCALE: 1:100,000 @ A4

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

DATA SOURCES:
SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

ecoscape

PROJECT NO: 3402-15

REV	AUTHOR	APPROVED	DATE
0	JN	ERR	25/01/2017

N

0 1 2 3 km

POST MINING GROUNDWATER DRAWDOWN AND GDES

YANGIBANA RARE EARTHS PROJECT

CLIENT: HASTINGS

FIGURE 07

APPENDIX Q – Environmental Risk Assessment

Background

Hastings Technology Metals Limited intends to submit a Referral to the WA Environmental Protection Authority in early 2017. A preliminary Mine Closure Plan will be included in the submission, which requires a formal environmental risk assessment to identify and review risk pathways, treatments and prioritise risks to determine management efforts. The risk assessment will form the basis of the Yangibana EMS and as such is a "live document" which will be updated during key phases of the Project and where change management requires re-assessment of risks.

Risk Assessment Objective

The objective of the risk assessment is to identify risk pathways which may cause material impact to environmental factors specified by the DMP and EPA.

Risk Assessment Context

The context of the risk assessment is the closure and post closure phases of the Project, for activities occurring specifically within the mine activity envelope and more broadly the tenements within the mine activity envelope (development envelope).

Definitions

Material impact, in the context of this risk assessment, is a substantial irreversible damage to local environmental factors.

ALARP (As Low As Reasonable Practicable): where a treatment is practicable and demonstrates that the cost of the treatment (money, time, effort) is not grossly disproportionate to the benefit, then the treatment is considered ***reasonably practicable*** and should be implemented.

Risk Assessment Assumptions

1	Only plausible risk pathways are considered
2	Risks are assessed based on pre-treatment (inherent risk) and then post-treatment (residual risk)
3	Unwanted Events include unplanned events, incidents and accidents
4	Treatments must demonstrate "As Low As Reasonably Practicable" (ALARP)
5	Residual risk assessment considers the post closure phase up until Hastings legally relinquishes tenements.

Affiliation	Staged Workshop Participants
Ecoscape Australia Pty Ltd	Emma Ryan-Reid (Environmental Scientist, Facilitator)
Hastings Technology Metals Limited	Lara Jefferson (Environmental Manager)
Wave International	Stefan Wolmarans (Civil Engineer)
ATC Williams	John Leavy (Geotechnical Engineer)
Wave International	Waldo Dressel (Geotechnical Engineer)
Trajectory	Rory Haymont (Environmental Scientist)
Resources Health and Safety Services	Dean Crouch (Radiation Specialist)
JWS Consulting Pty Ltd	Jo Walker-Smith (Process Engineer)
Snowden Group	Frank Blanchfield (Mining Engineer)
Bennelongia Environmental Consultants	Stuart Halse (Invertebrate Zoologist)
Groundwater Resource Management	Robert Garnham (Hydrogeologist)
Groundwater Resource Management	Kathy McDougall (Hydrogeologist)

Risk Assessment Dates

Wednesday 16 November 2016	Mining, Processing and Operations
Thursday 17 November 2016	Groundwater and Subterranean Fauna
Wednesday 18 January 2017	Mine Closure

Risk Matrix		Most Credible Consequence Level				
		6	7	8	9	10
		Insignificant	Minor	Moderate	Major	Severe
Likelihood 5	Almost Certain	16	17	21	24	26
Likelihood 4	Likely	11	12	18	22	25
Likelihood 3	Possible	4	8	13	19	23
Likelihood 2	Unlikely	2	5	9	14	20
Likelihood 1	Rare	1	3	6	10	15

Extreme
High
Medium
Low

Level of Certainty - Baseline Information / Assessment of Risk

Descriptor	Explanation
Low level	Risk rating is based on subjective opinion or relevant past experience. Limitations in baseline data/information which results in general conclusions and/or further work is required.
Medium Level	Risk rating is based on similar conditions being observed previously. Baseline data/information has some gaps or minor further work required.
High Level	Risk rating is based on testing, modelling or experiments. Baseline data/information is complete and analysis appropriate for level of data.

Measure of Likelihood

Descriptor	Frequency	Probability	
Almost Certain	Twice or more per year	Event will occur during the Project / period under review. High number of known incidents.	>90%
Likely	At least once per year	Event likely to occur during the Project / period under review. Regular incidents known.	50% to <90%
Possible	At least once in 5 years	Event may occur in some instances during the Project / period under review. Occassional incidents known.	25% to <50%
Unlikely	Once in 10 years	Event is not likely to occur during the Project / period under review. Some occurances known.	10% to <25%
Rare	Once in 50 years	Event will occur in exceptional circumstances during the Project / period under review. Very few or no known occurences.	<10%

Measure of Consequence

Environmental Factor	Insignificant	Minor	Moderate	Major	Severe
Flora & Fauna, Biodiversity & Ecosystem	Alteration or disturbance to an isolated area that is unlikely to affect the habitat or ecosystem.	Alteration of disturbance to <5% of a habitat or ecosystem resulting in a minor, recoverable impact within 1 year.	Alteration or disturbance to 5-30% of a habitat or ecosystem resulting in a moderate, recoverable impact within 1-2 years.	Alteration or disturbance to 30-70% of a habitat or ecosystem resulting in a major, recoverable impact within 3-10 years.	Alteration or disturbance to 70-100% of a habitat or ecosystem resulting in a severe, recoverable impact greater than 10 years.
	Impact to single plant / animal, localised and contained.	Loss of multiple plants / animals, localised and contained.	Loss of half known local population, uncontained impact.	Loss of significant numbers of flora/fauna, with possible loss of entire local population.	Loss of conservation significant flora or fauna species. Extinction of a species.
Surface Water and Groundwater	Negligible change to hydrological processes, availability or modification of water quality.	Minor local and/or short-term modification of hydrological processes, availability and quality, but no change in beneficial use.	Minor impact outside the mine activity envelope or local long-term modification in hydrological processes, availability and quality. Able to be rectified in the short-term.	Significant impact outside the tenement boundary that can be rectified in the longer-term. Permanent modification within the mine activity envelope that cannot be rectified.	Regional long-term decline in water quality or availability. Widespread contamination or change that cannot be rectified.
Land - Soils	Rapid clean-up by site personnel.	Rapid clean-up by site personnel.	Clean-up by site personnel or contractor.	Clean-up requiring external specialist.	Clean-up requiring external specialist.
	Immediately rectified.	Very short term effect, <1 year for remediation.	Short term effect, 1-10 years for remediation.	Long term effect, 10 to <50 years for remediation.	Very long term effect, >50 years for remediation. Permanent, residual impact.
	Confined to immediate area around source.	Confined to operational area.	Some impact outside mine activity envelope. Some impact to topsoil stockpiles.	Significant impact outside mine activity envelope. Significant impact to topsoil stockpiles.	Impact outside development envelope (tenement) boundary.
Air Quality	No detectable impact.	Contained low impact, not impacting on any environmental value.	Uncontained impact that will materially affect an environmental value. Able to be rectified in the short-term.	Extensive hazardous impact on environmental value requiring long-term rectification.	Uncontained hazardous impact with residual impact.
Mine Closure	Site is safe, stable and non-polluting.	Site is safe, all major landforms are stable and any stability or pollution issues are contained and require no residual management.	Site is safe, and any ongoing stability or pollution issues require minor, ongoing maintenance by end land-user.	Site not considered safe, stable and non-polluting without long-term management or intervention.	Site is unsafe, unstable and/or causing pollution or contamination that will cause an on-going residual impact.
	Post mining land use is not adversely affected.	Post mining land use is not adversely affected.	Post mining land use is not adversely affected.	Post mining land use cannot proceed without ongoing management.	Post mining land use cannot be achieved.
Heritage	Minor repairable damage to cultural heritage sites.	Minor damage to sites / items of cultural heritage significance.	Moderate damage to sites / items of cultural heritage significance.	Significant or widespread damage to sites / items of cultural heritage significance. Infringement.	Irreparable and permanent damage to sites of cultural heritage significance.
Compliance	Very minor compliance issue, resolved within 48 hours. Reported internally only.	Minor compliance issue, resolved within one week. Reported to regulator within 48 hours.	Repeated or significant breach of compliance / regulation. Reported to regulator within 24 hours. Internal investigation.	Major breach of compliance / regulation resulting in external investigation. Reported to regulator immediately.	Prosecution, penalty or loss of permit/licence to operate. Reported to regulator immediately.
Reputation	No impact to company reputation.	Nuisance impact to neighbours with no complaints.	Nuisance impact to neighbours with complaints. Material impacts to neighbours with no complaints. Local media attention.	Material impact to neighbours with complaints. Strong community complaints / reactions. Compensation demands.	Operations ceased during compensation negotiations. Prolonged or widespread media attention.

Item Number	Risk Pathway		Description of Potential Impact	Phases the Unwanted Event likely to occur	Inherent Risk			Level of Certainty	Treatment - Existing or Proposed	Phase in which Treatments to be implemented	Residual Risk			Level of Certainty
	Unwanted Event	Environmental Factor / Receptor			Consequence	Likelihood	Risk Rating				Consequence	Likelihood	Risk Rating	
1.0 Mining Landforms														
1.1 Tailings Storage Facility 1 - beneficiation plant, rougher tailings														
1	Failure of TSF1 embankment results in exposure and release of tailings and leachate (Limitation: TSF1 design and hazard assessment is pending)	flora & vegetation	Immediate inundation of flora within flow path of failure. Longer term vegetation loss associated with soil and surface water contamination from elevated metals and salts.	Post Closure	Ma	L	High	L	- Approved decommissioning and closure strategy for TSF1; - TSF1 Decommissioning Report and Closure Report detailing works undertaken to specification; - Post closure stability, rehabilitation, erosion, surface water, and flora and fauna monitoring until tenements relinquished	Closure Post Closure	Ma	U	Medium	L
		fauna - terrestrial	Immediate inundation of habitats within flow path of failure. Longer term bioaccumulation of metals impacts population health. Mobilisation into ephemeral waterways impacts downstream aquatic and terrestrial fauna.		Mo	L	High	L			Mo	U	Low	L
		land - soils	Immediate inundation of soils within flow path of failure. Infiltration of leachate containing elevated metals and salts.		Ma	L	High	L			Ma	U	Medium	L
		heritage	Downstream impacts to cultural heritage values of Fraser's Creek. Impacts to story lines. Potential contamination of bush tucker foods (riparian or aquatic species).		Mo	P	Medium	L			Mo	U	Low	L
		surface water	Immediate inundation of ephemeral waterways down gradient of TSF1. Potential contamination of Fraser's Creek from sediment, elevated metals and salts.		Ma	L	High	L			Ma	U	Medium	L
2	Failure of TSF1 compacted soil layer results in seepage at toe of embankment or base of TSF (Limitation: TSF1 design and hazard assessment is pending)	groundwater	Seepage containing elevated metals and salts results in localised contamination of the shallow calcrete aquifer (Stygofauna Priority Ecological Community). Impact on beneficial use of groundwater.	Operations Post Closure	Mi	P	Medium	L	- Compaction of in-situ clayey subsurface materials to reduce permeability; - Installation of low permeability barriers; - Thickened tailings slurry (approx. 60%) to reduce volume of entrained water entering TSF1; - Decant drains to down-stream pond during operations for reclaim; - TSF1 Operations Manual detailing inspections of toe of embankment, evidence of seepage around TSF; - Water Management Plan, detailing surface water and groundwater monitoring program; - Approved decommissioning and closure strategy for TSF1, detailing capping requirements to limit infiltration; - Post closure surface water and groundwater monitoring.	Operations Closure Post Closure	Mi	U	Low	L
		surface water	Seepage containing elevated metals and salts results in localised contamination of ephemeral waterways and surface water draining to Fraser's Creek. Impact on beneficial use of surface water.		Mi	P	Medium	L			Mi	U	Low	L
1.2 Tailings Storage Facility 2 - beneficiation plant, cleaner tailings														
3	Failure of TSF2 embankment results in exposure and release of tailings and leachate (Limitation: TSF2 design and hazard assessment is pending)	flora & vegetation	Immediate inundation of flora within flow path of failure. Longer term vegetation loss associated with soil and surface water contamination from elevated metals, radionuclides and salts.	Post Closure	Mo	L	High	L	- Approved decommissioning and closure strategy for TSF2; - Recovery of process liquor during the decommissioning phase, to allow for consolidation and drying of tailings; - TSF2 Decommissioning Report and Closure Report detailing works undertaken to specification; - Post closure stability, rehabilitation, erosion, surface water, and flora and fauna monitoring until tenements relinquished	Closure Post Closure	Mo	U	Low	L
		fauna - terrestrial	Immediate inundation of habitats within flow path of failure. Longer term bioaccumulation of metals and radionuclides impacts population health. Mobilisation into ephemeral waterways impacts downstream aquatic and terrestrial fauna. Gamma radiation exposure.		Mo	L	High	L			Mo	U	Low	L
		land - soils	Immediate inundation of soils within flow path of failure. Infiltration of leachate containing elevated metals, radionuclides and salts. Gamma radiation above background.		Ma	L	High	L			Ma	U	Medium	L
		surface water	Potential contamination of ephemeral waterways from elevated sediment load, metals, radionuclides and salts. Potential downstream impacts to Fraser's Creek.		Mo	L	High	L			Mo	U	Low	L
		heritage	Downstream impacts to heritage exclusion zone along Fraser's Creek. Damage to story lines. Potential contamination of bush tucker foods (riparian or aquatic species).		Mo	L	High	L			Mo	U	Low	L
		air quality	Drying of exposed tailings results in mobilisation and dispersion of radionuclides via airborne dust.		Ma	L	High	L			Mo	U	Low	L
4	Failure of TSF2 containment liner results in seepage (Limitation: TSF2 design and hazard assessment is pending)	groundwater	Seepage containing elevated metals, radionuclides and salts results in localised contamination of the shallow calcrete aquifer (Stygofauna Priority Ecological Community). Impact on beneficial use of groundwater.	Operations Post Closure	Mo	L	High	L	- TSF2 Operations Manual detailing inspections of toe of embankment, evidence of seepage around TSF; - Recovery of process liquor during the decommissioning phase, to allow for consolidation and drying of tailings; - Installation of groundwater recovery system (bores, trenches etc.), or low permeability barriers (grout curtain); - Surface Water Management Plan and Water Supply Operating Strategy, detailing surface water and groundwater monitoring program; - Approved decommissioning and closure strategy for TSF2, detailing upper containment layer and capping requirements to limit infiltration; - Post closure surface water and groundwater monitoring; - Soil Management Plan, stating soil stockpiles placed up-gradient of TSFs	Operations Closure Post Closure	Mo	U	Low	L
		surface water	Seepage containing elevated metals, radionuclides and salts results in localised contamination of ephemeral waterways and surface water draining into Fraser's Creek. Impact on beneficial use of surface water.		Mo	P	Medium	L			Mo	U	Low	L
		land - soils	Seepage containing elevated metals, radionuclides and salts infiltrates soils. Gamma radiation above background. Potential impact to topsoil stockpiles.		Mo	P	Medium	L			Mo	U	Low	L

Item Number	Risk Pathway		Description of Potential Impact	Phases the Unwanted Event likely to occur	Inherent Risk			Level of Certainty	Treatment - Existing or Proposed	Phase in which Treatments to be implemented	Residual Risk			Level of Certainty
	Unwanted Event	Environmental Factor / Receptor			Consequence	Likelihood	Risk Rating				Consequence	Likelihood	Risk Rating	
1.3 Tailings Storage Facility 3 - hydrometallurgical plant tailings														
5	Failure of TSF3 embankment results in exposure and release of tailings and leachate (Limitation: TSF3 design and hazard assessment is pending)	flora & vegetation	Immediate inundation of flora within flow path of failure. Longer term vegetation loss associated with soil and surface water contamination from elevated metals, radionuclides and salts.	Post Closure	Mo	L	High	L	- Approved decommissioning and closure strategy for TSF3; - Recovery of process liquor during the decommissioning phase, to allow for consolidation and drying of tailings; - TSF3 Decommissioning Report and Closure Report detailing works undertaken to specification; - Post closure stability, rehabilitation, erosion, surface water, and flora and fauna monitoring until tenements relinquished	Closure Post Closure	Mo	U	Low	L
		fauna - terrestrial	Immediate inundation of habitats within flow path of failure. Longer term bioaccumulation of metals and radionuclides impacts population health. Mobilisation into ephemeral waterways impacts downstream aquatic and terrestrial fauna. Gamma radiation exposure.		Mo	L	High	L			Mo	U	Low	L
		land - soils	Immediate inundation of soils within flow path of failure. Infiltration of leachate containing elevated metals, radionuclides and salts. Gamma radiation above background.		Ma	L	High	L			Ma	U	Medium	L
		surface water	Potential contamination of ephemeral waterways from elevated sediment load, metals, radionuclides and salts. Potential downstream impacts to Fraser's Creek.		Mo	L	High	L			Mo	U	Low	L
		heritage	Downstream impacts to heritage exclusion zone along Fraser's Creek. Damage to story lines. Potential contamination of bush tucker foods (riparian or aquatic species).		Ma	L	High	L			Ma	U	Medium	L
		air quality	Drying of exposed tailings results in mobilisation and dispersion of radionuclides via airborne dust.		Ma	L	High	L			Mo	U	Low	L
6	Failure of TSF3 containment liner results in seepage (Limitation: TSF3 design and hazard assessment is pending)	groundwater	Seepage containing elevated metals, radionuclides and salts results in localised contamination of the shallow calcrete aquifer (Stygofauna Priority Ecological Community). Impact on beneficial use of groundwater.	Operations Post Closure	Mo	L	High	L	- Construction of a double lined TSF containment with leachate collection; - Leak detection monitoring (moisture probes etc.); - Installation of groundwater recovery system (bores, trenches etc.), or low permeability barriers (grout curtain); - Surface Water Management Plan and Water Supply Operating Strategy, detailing surface water and groundwater monitoring program; - TSF3 Operations Manual detailing inspections of toe of embankment, evidence of seepage around TSF; - Approved decommissioning and closure strategy for TSF3, detailing upper containment layer and capping requirements to limit infiltration; - Post closure surface water and groundwater monitoring; - Soil Management Plan, stating soil stockpiles placed up-gradient of TSFs.	Operations Closure Post Closure	Mo	U	Low	L
		surface water	Seepage containing elevated metals, radionuclides and salts results in localised contamination of ephemeral waterways and surface water draining into Fraser's Creek. Impact on beneficial use of surface water.		Mo	P	Medium	L			Mo	U	Low	L
		land - soils	Seepage containing elevated metals, radionuclides and salts infiltrates soils. Gamma radiation above background. Potential impact to topsoil stockpiles.		Mo	P	Medium	L			Mo	U	Low	L
1.5 Waste Rock Landforms														
7	WRLs slope failure / erosion results in unstable landform (Limitation: WRL final landform design is pending) (Limitation: diversion structure design is pending)	flora & vegetation	Immediate inundation of flora within path of failure / erosion. Loss of revegetation from rehabilitated landform. Potential longer term vegetation loss associated with soil contamination from elevated metals, radionuclides and salts.	Post Closure	Mi	L	Medium	M	- Approved Mine Closure Plan, detailing final landform design, rehabilitation activities and Post Closure surface water management structures; - Yangibana Ck diversion structure, limiting erosion at toe of WRL; - Rehabilitation materials balances (soils and benign, competent rock armour); - Closure Report, detailing as constructed final WRL designs with slope, drainage features and growth medium covers; - Post Closure stability, rehabilitation and erosion monitoring until tenements relinquished; - Post Closure surface water monitoring, flora and fauna monitoring until tenements relinquished.	Operations Closure Post Closure	Mi	U	Low	M
		fauna - terrestrial	Immediate inundation of habitats within path of failure / erosion. Longer term bioaccumulation of metals and radionuclides reduces population health.		Mi	L	Medium	M			Mi	U	Low	M
		land - soils	Immediate inundation of soils within path of failure / erosion. Gamma radiation above background.		Mi	L	Medium	M			Mi	U	Low	M
		surface water	Immediate inundation of ephemeral waterways down gradient of WRL. Potential downstream impacts from increased sediment load, elevated metals, radionuclides and salts.		Mo	AC	High	M			Mo	U	Low	M
8	Uncontrolled drainage from WRLs (Limitation: Characterisation of waste pending)	groundwater	Drainage containing elevated metals, radionuclides, fluoride and salts results in localised contamination of groundwater. Impact on beneficial use of groundwater.	Post Closure	Mo	L	High	M	- Waste rock characterisation study, including dispersion potential and radionuclides; - Waste Rock Management Plan, detailing mine schedule for critical waste types, encapsulation of NORM waste (where required); - Approved Mine Closure Plan, detailing final landform design, rehabilitation activities and post closure surface water management structures; - Closure Report, detailing as constructed final WRL designs with slope, drainage features and growth medium covers; - Capping of WRL to limit infiltration and control runoff or re-direction of drainage into an adjacent pit, if the pit can be maintained as groundwater sink; - Post closure stability, rehabilitation and erosion monitoring until tenements relinquished; - Post closure surface water monitoring, flora and fauna monitoring until tenements relinquished.	Operations Closure Post Closure	Mo	U	Low	M
		surface water	Drainage containing elevated metals, radionuclides, fluoride and salts results in localised contamination of ephemeral waterways and surface water. Impact on beneficial use of surface water.		Mo	L	High	M			Mo	U	Low	M
		land - soils	Drainage containing elevated metals, radionuclides, fluoride and salts infiltrates soils. Gamma radiation above background.		Mi	L	Medium	M			Mi	U	Low	M
		flora & vegetation	Inundation of flora down gradient of drainage source. Potential longer term vegetation loss associated with soil contamination from elevated metals, radionuclides and salts.		Mi	P	Medium	M			Mi	U	Low	M
		fauna - terrestrial	Inundation of habitats down gradient of source. Longer term bioaccumulation of metals, radionuclides and fluoride reduces population health.		Mi	P	Medium	M			Mi	U	Low	M

Item Number	Risk Pathway		Description of Potential Impact	Phases the Unwanted Event likely to occur	Inherent Risk			Level of Certainty	Treatment - Existing or Proposed	Phase in which Treatments to be implemented	Residual Risk			Level of Certainty
	Unwanted Event	Environmental Factor / Receptor			Consequence	Likelihood	Risk Rating				Consequence	Likelihood	Risk Rating	
2.0 Open Pits and Final Voids														
9	Open pit mining results in permanent removal of subterranean fauna habitat	fauna - subterranean	Loss of available habitat results in loss of representation, diversity and ecosystem function of subterranean fauna populations	Operations Post Closure	I	U	Low	L	- Subterranean Fauna Management Plan, detailing monitoring requirements	Operations Post Closure	I	U	Low	L
10	Exposed pit walls of final void generates uncontrolled drainage resulting in permanent source of saline / contaminated water (Limitation: final pit shell geometry pending) (Limitation: geochemical characterisation of exposed pit wall lithologies pending)	groundwater	Drainage containing elevated metals, radionuclides and salts, evapo-concentrate over the longer term. Watertable expected to rebound after cessation of groundwater abstraction and final void expected to become a groundwater sink. Impact to surrounding aquifer unlikely.	Post Closure	Mi	U	Low	L	- Install surface water controls (e.g. bunds, diversion channels and drains) to limit catchment areas and rainfall runoff; - Develop a final void groundwater model, including solute transport model; - Characterise lithologies exposed in final pit shell to determine likely load and flux of radionuclides in drainage reporting to pit lake; - Subterranean Fauna Management Plan, detailing monitoring requirements; - Fauna study to determine species likely to utilise pit lakes, and determine toxicity levels of likely pit lake chemical and radiological constituents	Approval Phase Operations	Mi	U	Low	L
		fauna - terrestrial	Drainage containing elevated metals, radionuclides and salts, evapo-concentrate over the longer term. Watertable expected to rebound after cessation of groundwater abstraction and final void pit lake expected to form. Immediate decline in health of bird species from elevated salinity, or bioaccumulation of metals and/or radionuclides.		Mi	U	Low	L			Mi	U	Low	L
		fauna - subterranean	Drainage containing elevated metals, radionuclides and salts, evapo-concentrate over the longer term. Watertable expected to rebound after cessation of groundwater abstraction and final void expected to become a groundwater sink. Impact to stygofauna unlikely.		I	U	Low	L			I	U	Low	L
11	Final void pit lakes result in permanent modification of groundwater flow and aquifer pressures	groundwater	Drawdown around the final void pit lakes results in drop in regional watertable.	Post Closure	Mi	U	Low	L	- Develop a final void groundwater model, predicting expected drawdown post mining, and rates of in-flow into the pit lake; - Subterranean Fauna Management Plan, detailing monitoring requirements; - Flora and Fauna Management Plan, detailing monitoring of GDE vegetation types; - Post closure monitoring of stygofauna and GDEs	Operations, Closure, Post Closure	Mi	U	Low	L
		flora & vegetation	Drawdown around the final void pit lakes results in impact to GDE vegetation types or susceptible species (i.e. *Eucalyptus vitrix*).		Mi	P	Medium	L			Mi	U	Low	L
		fauna - subterranean	Drawdown from the pit lake alters habitat conditions for stygofauna.		I	R	Low	L			I	R	Low	L
12	Failure of pit wall results in damage to abandonment bund and adjacent WRL	mine closure	Final pit shell wall failure results in loss of / damage to part of the pit abandonment bund. Longer term damage to pit wall stability from ingress of surface water over the pit crest. Instability in adjacent WRL, results in landform slope failure.	Post Closure	Mi	U	Low	L	- Geotechnical and structural drilling of expected pit shell zones; - Geotechnical assessment of final pit shell, including determining the zone of instability; - Placement of abandonment bunds outside the pit shell zone of instability; - Post closure monitoring of pit stability and erosion of abandonment bunds	Operations, Closure, Post Closure	Mi	U	Low	L
3.0 Support Infrastructure														
13	Uncontrolled seepage from landfill	land - soils	Release of leachate containing elevated metals and other contaminants results in surface / subsurface soil contaminants. Potential loss of soil stockpiles.	Operations Post Closure	Mo	L	High	M	- Construction of landfill to meet specification based on class of landfill; - Groundwater monitoring bores in vicinity of landfill; - Design and construction of a cover to limit infiltration into the landfill and minimise surface erosion; - Installation of groundwater recovery systems (bores, trenches etc.) or installation of low permeability barriers (grout curtain)	Operations Post Closure	Mo	U	Low	M
		groundwater	Release of leachate containing elevated metals and other contaminants results in residual soil impacts leading to groundwater contamination.		Mo	L	High	M			MO	U	Low	M

Item Number	Risk Pathway		Description of Potential Impact	Phases the Unwanted Event likely to occur	Inherent Risk			Level of Certainty	Treatment - Existing or Proposed	Phase in which Treatments to be implemented	Residual Risk			Level of Certainty
	Unwanted Event	Environmental Factor / Receptor			Consequence	Likelihood	Risk Rating				Consequence	Likelihood	Risk Rating	
5.0 Operations														
14	Operational groundwater abstraction results in drawdown in the calcrete aquifer of the Gifford Creek PEC	fauna - subterranean	Decline in water levels results in temporary loss of habitat for conservation significant species within the Gifford Creek Calcrete PEC.	Operations Post Closure	Mo	P	Medium	M	- Subterranean Fauna Management Plan, detailing monitoring requirements in regional bores within the Gifford Creek Calcrete PEC; - Avoid groundwater abstraction from the calcrete aquifers	Operations Post Closure	Mo	P	Medium	M
15	Operational groundwater abstraction results in decline in condition or extent of GDEs	flora & vegetation	Decline in groundwater availability to riparian vegetation associated with Fraser's Creek and Lyons River, and GDEs located within the mine activity envelope. Impact during operations and post closure.	Operations Post Closure	Mo	L	High	M	- Develop groundwater model to predict lateral and vertical extent of drawdown around operational and post-closure pits; - Monitor condition of GDE vegetation types within expected area of drawdown	Operations Post Closure	Mi	U	Low	M
16	Extreme weather event results in inundation of radionuclide sources, reagents or hydrocarbon storage	land - soils	Contamination of soils - surface and/or subsurface. Potential impacts to topsoil stockpiles. Potential longer term impact to groundwater and/or flora and fauna from residual soils impacts.	Construction Operations Decommissioning Post Closure	Mi	R	Low	M	- Hydrological investigation, determining catchments and probable maximum floods which could impact hazardous materials storage; - Surface Water Management Plan, detailing design of diversion structures and bunds; - Freeboard of TSF embankments designed to contain a 1 in 100 ARI; - TSF Operating Manual, detailing water management of decant / water covers and evaporation pond levels when rainfall forecast	Construction Operations Decommissioning Post Closure	Mi	R	Low	M
		flora & vegetation	Potential longer term vegetation loss associated with soil and surface water contamination.		Mi	R	Low	M			Mi	R	Low	M
		fauna - terrestrial	Immediate decline in health from exposure to hazardous materials, or bioaccumulation of radionuclides from residual soil contamination.		Mi	R	Low	M			MI	R	Low	M
		surface water	Contamination of waterways results in decline of water quality and aquatic ecosystem health. Dispersion of contaminants through dust deposition and sedimentation, or direct runoff of hazardous material.		Mo	R	Low	M			Mo	R	Low	M
17	Presence of WRL and TSFs reduces groundwater recharge	fauna - subterranean	Modification of recharge mechanisms beneath WRL / TSF results in reduced nutrient input to the unsaturated zone with potential impacts to health, abundance and diversity of troglofauna species.	Operations Post Closure	Mi	P	Medium	M	- Subterranean Fauna Management Plan, detailing monitoring requirements; - Augment water supplies for third party groundwater users	Operations Post Closure	Mi	U	Low	M
		groundwater	Modification of aquifer recharge mechanisms beneath WRD / TSF results in local lowering of the watertable impacting on other groundwater users		Mi	P	Medium	M			Mi	R	Low	M
18	Presence of project results in local impacts to visual amenity	amenity	Local regional impact from the visual presence of the Project, particularly to nearby residential receptors (Gifford Creek and Edmund Station Homesteads) and general public/tourists using the Edmund-Gifford Creek Road. Minor impact to Mt Augustus.	Operations Post Closure	Mo	U	Low	H	- Visual Impact Assessment to demonstrate extent and level of impact on local stakeholders and tourists; - Final landform design to be sensitive to visual amenity for pastoral stakeholders and tourists; - Location of operational infrastructure to be sensitive to visual amenity for pastoral stakeholders	Operations	Mo	U	Low	H
6.0 Mine Closure														
19	Stakeholders request compensation for areas of Project which do not meet post mining land use	reputation	Local media attention, complaints by local community. Delay relinquishing tenements.	Post Closure	Ma	P	High	M	- Negotiated post-mining land use with targets; - Stakeholder Engagement Strategy, with on-going consultation; - Treatments listed under all items in Section 6 of this risk assessment	Approvals Operations Closure	Mo	P	Medium	L
20	Inadequate closure designs results in poor decommissioning and closure execution	mine closure	Delays or inability to execute decommissioning, closure designs and effective rehabilitation. Completion criteria not achievable for some areas / landforms. Inability to relinquish tenement(s).	Decommissioning Post Closure	Ma	P	High	L	- Detailed design of constructed landforms in the approval phase, including geotechnical assessment of materials - Landform surface erosion stability assessment once mining has commenced to provide fresh competent materials; - TSF closure study, which informs Mine Closure Plan	Design Operations Closure	Mo	U	Low	L
21	Poor management of mining and processing wastes during operations results in closure plans being unachievable or costly	mine closure	Delays or inability to execute decommissioning, closure designs and effective rehabilitation. Completion criteria not achievable for some areas / landforms. Inability to relinquish tenement(s).	Operations Post Closure	Ma	P	High	L	-Waste Rock Management Plan, detailing management for any geochemically or physically problematic materials; - Radiation Waste Management Plan, detailing management of materials with activity grater than 1 Bq/g; - Waste characterisation study of tailings (from pilot plant) and waste rock lithologies; - Operational characterisation / assays - metallurgical tailings samples, open pit grade control, including assay of radionuclides of waste rock - Internal and external auditing; - Operational systems - mine scheduling, metallurgical processes	Design Operations Closure	Mo	U	Low	L
22	Contaminated sites inadequately assessed or remediated, results in residual soil and/or water impacts	mine closure	Delays to effective remediation results in residual soil / water contamination. Potential CS Act 2003 covenant placed on some landforms / site areas. Inability to meet post mining land use for some areas / landforms. Inability to relinquish tenement(s) due to on-going contamination.	Operations Decommissioning Post Closure	Mo	P	Medium	M	- Above ground fuel and chemical storage tanks, impermeable bunds; - Processing plant sediment pond to collect contaminated runoff from plant area; - Contaminated sites register; - Dangerous Goods licence; - Hydrocarbon and Chemical Management Plan, and associated spill clean-up procedures; - Incident reporting of spills and loss of containment; - Internal compliance audits of hazardous materials storage	Operations Closure Post Closure	Mo	U	Low	M

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	Unwanted Event	Environmental Factor / Receptor			Consequence	Likelihood	Risk Rating				Consequence	Likelihood	Risk Rating	
23	Ineffective implementation of rehabilitation activities results in completion criteria not being met	mine closure	Poor management or resources and execution of closure designs results in completion criteria not achievable for some areas / landforms. Inability to relinquish tenement(s).	Post Closure	Ma	P	High	M	- Soil Management Plan, detailing soil harvesting, stockpiling, monitoring, amendments and respreading; - Mine Closure Plan, detailing closure landform design and rehabilitation requirements; - Landform surface erosion stability assessment; - Rehabilitation materials balance; - Surface Water Management Plan, detailing surface water drainage structures	Design Operations Closure	Mo	U	Low	M
24	Constructed landforms do not perform as intended, resulting in failure or ineffective implementation	mine closure	Delays to effective rehabilitation of some landforms become unsafe, unstable or polluting with downstream impacts to environmental receptors. Inability to meet post mining land use for the entire site. Inability to relinquish tenement(s).	Decommissioning Post Closure	Ma	P	High	L	- Design to meet appropriate ANCOLD risk category for TSFs; - Landform surface erosion stability assessment once mining has commenced to provide fresh competent materials; - TSF closure study, which informs Mine Closure Plan; - Post closure stability and erosion monitoring	Design Operations Closure Post Closure	Ma	U	Medium	L
25	Failure of Post Closure TSF covers and/or batters, results in erosion, exposure of tailings or seepage (Assumes a cover that is not fit-for-purpose)	mine closure	Failure of TSF closure results in unsafe, unstable or polluting landforms with downstream impacts to environmental receptors. Potential CS Act 2003 covenant placed on some TSFs. Inability to meet post mining land use for the entire site. Inability to relinquish tenement(s).	Post Closure	S	L	Extreme	L	- Fit for purpose cover system, may include store and release, engineered, geotextile membrane; - Characterisation of tailings and clay materials on-site to determine chemical compatibility; - Sufficient rock cover to allow for erosion; - Rehabilitation with shallow-rooted local provenance species	Design Decommissioning Closure	Ma	U	Medium	L
26	Management of rehabilitation materials results in ineffective harvesting, preserving and/or use	mine closure	Delays to effective rehabilitation of some landforms / areas results in unsafe, unstable or polluting landforms with downstream impacts to environmental receptors. Inability to meet post mining land use for the entire site. Inability to relinquish tenement(s). Mixing or desired and undesired materials.	Operations Decommissioning Post Closure	Mo	L	High	M	- Soil Management Plan, detailing soil harvesting, stockpiling, monitoring, amendments and respreading; - Mapping of soil units prior to harvesting to allow separate stockpiling; - Application of Hills soil on slopes of landforms, with rock armour; - Identification and stockpiling of benign competent waste rock for rock armour; - Rehabilitation materials balance	Operations Decommissioning Closure Post Closure	Mo	U	Low	M
27	Use of high-risk dispersive soils on elevated landforms results in slope erosion and failure of revegetation	mine closure	Delays to effective rehabilitation of some landforms results in unsafe, unstable or polluting landforms with downstream impacts to environmental receptors. Inability to meet post mining land use for some landforms. Inability to relinquish tenement(s).	Decommissioning Operations	Mo	L	High	M	- Soil Management Plan, soil harvesting, soil management, segregation materials for rock armour, rehab material inventory - Mapping of soils units on-ground for harvesting phase - use of Hills soils on slopes	Construction Operations	Mo	U	Low	M
28	Unexpected temporary or early closure of the Project	mine closure	Delays to effective decommissioning and rehabilitation results in downstream impact to environmental receptors. Closure designs / strategies not yet finalised at time of temporary / early closure. Insufficient funds for mine closure.	Operations	Ma	P	High	M	- Mine Closure Plan, updated periodically based on significant amendments to mine plan and as required by DMP / EPA; - Mine Closure Plan, detailing activities for each domain in the event of unexpected or early closure; - Closure cost estimate in accordance with Accounting Standards	Operations	Ma	U	Medium	M
29	Insufficient funds for decommissioning and closure activities	mine closure	Incomplete decommissioning and rehabilitation results in local and downstream impact to environmental receptors, with unremediated areas / landforms potentially acting as ongoing hazard source. Worst credible consequence is involuntary administration, with WA Government to complete closure.	Decommissioning Closure Post Closure	Ma	P	High	L	- Closure cost estimate in accordance with Accounting Standards, and provisional closure budget; - 6 monthly review of the closure budget against mine plan; - Progressive rehabilitation and decommissioning (where practicable)	Approvals Operations	Ma	U	Medium	L
30	Stochastic event (flood, drought, bushfire) results in failure of revegetation	mine closure	Delays to effective rehabilitation of some areas / landforms results in unsafe, unstable or polluting landforms with downstream impacts to environmental receptors. Inability to meet post mining land use for the entire site. Inability to relinquish tenement(s).	Post Closure	Mo	P	Medium	M	- Completion criteria based on realistic revegetation targets; - Provisional budget includes allowance for undertaken additional rehabilitation activities	Operations Closure Post Closure	Mi	P	Medium	M
31	Post closure maintenance for protective structures and/or containment monitoring	mine closure	Delays in achieving post mining land use and relinquishing tenement(s).	Post Closure	Mo	P	Medium	M	- Structures (i.e. diversion bunds etc.) are designed to meet relevant design standards and Project regional climatic conditions; - Physical and chemical characterisation of materials to be used in constructing structures; - Monitoring and Maintenance Plan for the post closure phase, identifying structures or containment that poses a higher risk for requiring maintenance; - Closure provision with sufficient contingency for maintenance of structures and/or containment	Operations Post Closure	Mo	U	Low	M
32	Unable to meet background gamma dose rate for TSF2 and TSF3	mine closure	Gamma radiation levels above background at surface / immediate vicinity of final TSF2, TSF3 and/or evaporation pond, results in covenant under the CS Act. Inability to meet post mining land use for the entire site.	Post Closure	S	P	High	L	- Approved TSF decommissioning and closure strategy; - TSF Decommissioning Report and TSF Closure Report detailing works undertaken to specification; - Post closure gamma radiation monitoring until tenements relinquished.	Operations Decommissioning Closure Post Closure	Mo	P	Medium	L
33	Low recruitment of seedbank from stockpiled soils	mine closure	Delays in effective rehabilitation or inability to meet completion criteria. Delays in relinquishing tenement(s).	Operations Post Closure	Ma	P	High	M	- Application of fertiliser and other soil improvements prior to respreading; - Application of seed mixes containing local provenance species specific to soil unit; - Progressive rehabilitation showing performance of previously stockpiled soils	Operations Closure Post Closure	Mo	U	Low	M

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	Unwanted Event	Environmental Factor / Receptor			Consequence	Likelihood	Risk Rating				Consequence	Likelihood	Risk Rating	
8.0 Stakeholders - Regulatory & Community														
34	Closure strategy not accepted by regulators and/or community stakeholders	reputation	Requirement for additional studies or engineering designs to inform the mine closure plan. Delays in obtaining approvals.	Approvals, Design, Construction, Operations	Mo	P	Medium	H	- Stakeholder Engagement Strategy, with ongoing consultation	Approvals, Design, Construction, Operations	Mi	U	Low	H
8.0 Exploration														
35	Contaminated sites inadequately assessed or remediated results in residual soil and/or water impacts	land - soils	Surface or subsurface soils contamination from hydrocarbons or drilling residues.	Exploration Decommissioning Post Closure	Mo	L	High	M	- Hazardous materials stored in impermeable bunds; - All drilling fluids contained in a sump; - Sumps left to dry-out before residual materials are removed for disposal in landfill, and sump backfilled; - Groundwater bores and drill holes are capped; - Surface water management structures to protect sumps from inflows of rainfall runoff; - Hydrocarbon and Chemical Management Plan, and associated spill clean-up procedures; - Incident reporting of spills and loss of containment	Exploration Closure	Mi	U	Low	M
		surface water	Surface water contamination from residual soils impacts mobilised during rain events, transported down-stream.		Mo	L	High	M			Mi	U	Low	M
		groundwater	Groundwater contamination from residual soil impacts or surface water ingress from flood events associated with high rainfall events.		Mo	P	Medium	M			Mo	U	Low	M
		mine closure	Delays to effective remediation results in residual soil / water contamination. Delays in meeting post mining land use and delays relinquishing tenement(s).		Mo	P	Medium	M			Mi	U	Low	M
36	Ineffective implementation of rehabilitation activities results in completion criteria not being met	mine closure	Poor management or resources and/or execution of rehabilitation results in completion criteria not achievable. Inability to relinquish tenement(s).	Post Closure	Mo	P	Medium	M	- Soil Management Plan, detailing soil harvesting, stockpiling, monitoring, amendments and respreading; - Mine Closure Plan, detailing rehabilitation requirements; - Rehabilitation materials balance; - Surface Water Management Plan, detailing surface water drainage structures	Design Operations Closure	Mo	U	Low	M
37	Delay, or inadequate, decommissioning of drill holes results in contamination to groundwater or fauna entrapment	groundwater	Groundwater impact from open drill holes due to deliberate or accidental contamination with hazardous materials. Surface water ingress from flood events associated with high rainfall events.	Exploration Closure	Mo	P	Medium	M	- Drill holes to be decommissioned within 6 months of drilling, unless written approval has been received by the DMP Inspector to retain them; - Cap all drill holes at surface to preclude fauna ingress; - Development of suitable procedures to ensure decommissioning and abandonment of drill holes meets DMP requirements	Exploration Closure	Mo	U	Low	M
		fauna - terrestrial	Injury or fatality of fauna, particularly ground dwelling mammals and reptiles, due to ingress into open drill holes with no means of egress.		Mi	P	Medium	M			Mi	U	Low	M
38	Residual impact from soil contaminants in backfilled sumps	land - soils	Surface or subsurface soils contaminated from hydrocarbons or drilling residues.	Post Closure	Mi	L	Medium	M	- Sumps left to dry-out before residual materials are removed for disposal in landfill, and sump backfilled; - Exploration Environmental Management Plan, detailing management and closure of sumps	Operations Post closure	Mi	U	Low	M