Hamersley Iron Pty. Limited

ABN: 49 004 558 276

Eastern Range Closure Plan

Order of magnitude stage

September 2019

Mineral Field: 47 – West Pilbara
FDMS No: RTIO-HSE-0307601

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EXECUTIVE SUMMARY

Overview

The Eastern Range iron ore mine is located in the Pilbara region of Western Australia, with the closest town being Paraburdoo, 8 km to the north. It falls within the local authority of the Shire of Ashburton. The mine is operated by Rio Tinto as part of the Greater Paraburdoo mining hub. Operations at Eastern Range span deposits at 23-24 East, 32 East, 37-42 East, 42 East and future mining at 42EE and the 47E deposit which are subject to environmental assessment under Part IV of the Environmental Protection Act, 1986. The deposits are generally topographically elevated and all mining is above the water table.

Ore is extracted using traditional open pit, drill and blast and load and haul methods. Run of mine ore is tipped into the primary crusher prior to being discharged to the primary stockpile. Ore is extracted from beneath the stockpile, conveyed to a secondary crusher and then onto the Paraburdoo plant area where it is combined with other Greater Paraburdoo ore, crushed and screened into lump and fine product, then transported via train to port.

Purpose

In accordance with the Rio Tinto Closure Standard, operations are required to commence formal closure studies when they are approaching the end of mine life. This includes an order of magnitude study, a prefeasibility study and a feasibility study before implementation of closure can commence. This Eastern Range Closure Plan has been prepared to capture the outcomes of an order of magnitude closure study for Eastern Range. It has also been prepared to support an environmental approval being sought under Section 38 (s38) of the Environmental Protection Act, 1986 (EP Act) and the Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act) for mining at 42EE and 47E at Eastern Range as part of the Greater Paraburdoo Iron Ore Hub Proposal. This plan builds upon the 2016 closure plan for the operation and reflects the current knowledge and requirements for closure of the mine. It also outlines actions required to continue to progress towards a planned and managed closure of the site. Closure implementation is currently expected to commence in approximately 2024.

This closure plan has been developed to meet the requirements of the joint Department of Mines and Petroleum and the Office of Environmental Protection Authority Guidelines for Preparing Mine Closure Plans (2015). This plan supersedes all previous closure, decommissioning and rehabilitation plans for Eastern Range.

Scope

For the purposes of this closure plan, Eastern Range has been delineated by the following tenure and other boundaries[1]:

- State Agreement tenure ML4SA (AML70/00004) Section 236;
- State Agreement tenure ML4SA (AML70/00004) Section 237;
- a small portion of land on which the 23E and 24E deposits are located within State Agreement tenure ML246SA (AML70/00246). This area is delineated by the sealed access road which runs back to Paraburdoo town; and

[1] Note the scope of this closure plan was reviewed during the OoM study and has been amended since the 2016 Eastern Range closure plan was prepared.

- a small portion of land on which conveyor CV604 sits at Paraburdoo upon State Agreement tenure ML246SA. This conveyor is the connection point between CV555 (Channar) and the Paraburdoo plant and is owned by the Eastern Range joint venture[2].

Post-mining land use

An assessment of final land use options was undertaken during the closure study process which identified a number of potential alternative closure options for the site. The proposed post-mining land use assumes that the site will be rehabilitated to create a safe, stable and non-polluting landscape vegetated with native vegetation of local provenance, to maximise environmental and cultural heritage outcomes and ensure the site minimises adverse impacts on the current surrounding land use. The post-mining land use will be confirmed prior to closure, during final planning phases and in consultation with relevant stakeholders.

Closure objectives

The following closure objectives have been developed for Eastern Range:

- cultural heritage values have been preserved where possible;
- public health and safety hazards have been appropriately managed;
- contamination risks have been appropriately managed;
- final landform is stable and considers hydrological factors;
- vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use; and
- infrastructure has been appropriately managed.

These objectives have remained generally consistent with the 2016 closure plan for the site, with the exception of the objective ‘Cultural heritage values have been preserved where possible’ which has been added in this closure plan in response to feedback from Yinhawangka representatives, who are the Traditional Owners of the land upon which the Eastern Range operation is located. These are expected to continue to be amended during future reviews of the plan based on stakeholder feedback.

Anticipated closure outcome

Waste landforms will be made safe and stable and vegetated with native species of local provenance, where appropriate. In the base case, three landbridges are proposed for removal, however this will continue to be investigated during ongoing studies to ensure the most appropriate final landform strategies are implemented. Waste dumps inside of pits will not be rehabilitated unless they have a connection to the adjacent environment (i.e. the pit is externally draining).

On closure, infrastructure will be removed either via salvage or demolition. All disturbed areas outside of the mine voids will be stabilised and rehabilitated with native species of local provenance. Mining at the site is above water table (AWT) therefore permanent pit lakes are not expected to form post closure.

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[2] Ownership of this asset at the time of Eastern Range closure may change to enable ongoing utilisation by other Greater Paraburdoo operations

CLOSURE PLAN CHECKLIST

The following table provides cross reference to the requirements of the Department of Mines and Petroleum / Environmental Protection Authority Guidelines for preparing mine closure plans (2015).

	Mine closure plan (MCP) checklist	Y/ N/ NA	Page No.	Comments	Change from previous version (Y/N)	Page No.	Comments
1	Has the Checklist been endorsed by a senior representative within the operating company?	Y	vii				
Public Availability							
2	Are you aware that from 2015 all MCPs will be made publically available?	Y	N/A				
3	Is there any information in this MCP that should not be publicly available?	N	N/A				
4	If “Yes” to Q3, has confidential information been submitted in a separate document / section?	N	N/A				
Cover page, table of contents							
5	Does the MCP cover page include: Project Title, Company Name, Contact Details (including telephone numbers and email address) Document ID and version number, Date of submission (needs to match the date of this checklist)	Y					
Scope and purpose							
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirement)	Y	1				
Project overview							
7	Does the project summary include land ownership details, location of the project, comprehensive site plans and background information on the history and status of the project?	Y	6				
Legal obligations and commitments							
8	Does the MCP include a consolidated summary or register of closure obligations and	Y	16, Appendix A				

	commitments been included?						
Stakeholder engagement							
9	Have all stakeholders involved in closure been identified?	Y	17				
10	Does the MCP included a summary or register of historic stakeholder engagement been provided, with details on who has been consulted and the outcomes?	Y	Appendix B				
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	19				
Post mining land use(s) and closure objectives							
12	Does the MCP include agreed post-mining land use, closure objectives and conceptual landform design diagram?	Y	26, 120-121, Appendix E	Post mining land use is proposed but is not yet agreed with all relevant stakeholders.			
13	Does the MCP identify all potential (or pre-existing) environmental legacies which may restrict the post mining land use (including contaminated sites)?	Y	71	Preliminary Site Investigation will be undertaken in Prefeasibility stage			
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?	N	N/A	No contamination is currently known or suspected. Preliminary Site Investigation will be undertaken in Prefeasibility stage			
Development of completion criteria							
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y	28				
Collection and analysis of closure data							
16	Does the MCP include baseline data (including pre-mining studies and environmental data)	Y	32-75				
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y	40				

18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	N		Will be included in PFS closure plan. Rehabilitation outcomes are being progressively monitored and evaluated.			
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	76				
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	114				
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	76, Appendix D				
22	Does the MCP include the process, methodology and has the rationale been provided to justify identification and management of the issues?	Y	76-107				
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	112				
24	Does the MCP include a closure work program for each domain or feature?	Y	114				
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	-	MRF not applicable to this site.			
26	Does the MCP contain a schedule of research and trial activities?	Y	108				
27	Does the MCP contain a schedule of progressive rehabilitation activities?	N	-	Information is provided regarding when mining landforms will be			

				completed, as well as rehabilitation activities to be undertaken for each landform. Opportunities for progressive rehabilitation during remaining operations will continue to be sought.			
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	119				
29	Does the MCP contain a schedule of decommissioning activities?	Y	114	Decommissioning activities and schedule will be further refined in PFS closure plan.			
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	122				
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	122				
Financial provisioning for closure							
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	125				
33	Does the MCP include a process for regular review of the financial provision?	Y	125				
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	127				

Corporate endorsement:

I hereby certify that to the best of my knowledge, the information within this Eastern Range Closure Plan is true and correct and addresses the relevant requirements of the Guidelines for Preparing Mine Closure Plans approved by the Director General of the Department of Mines, Industry Regulation and Safety.

James Davison
General Manager – Studies & Technology
Date: 19th September 2019

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TABLES

FIGURES

ABBREVIATIONS

ABA	Acid base accounting
AEP	Annual exceedance probability
AHD	Australian Height Datum
ALUM	Australian Land Use and Management classification
ANC	Acid neutralising capacity
ANZMEC	Australian and New Zealand Minerals and Energy Council
AMD	Acid and metalliferous drainage
AWT	Above water table
BIA	Binding Initial Agreement
BIF	Banded iron formations
DMIRS	Department of Mines, Industry Regulation and Safety
DMP	Department of Mines and Petroleum
DSI	Detailed site investigation
DWER	Department of Water and Environmental Regulation
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Authority
EP Act	Environmental Protection Act, 1986
EPBC Act	Environment Protection and Biodiversity Conservation Act, 1999
FS	Feasibility study
GAI	Global Abundance Index
Ha	Hectares
HSE	Health, Safety and Environment
IBRA	Interim Biogeographic Regionalisation for Australia
ILUA	Indigenous Land Use Agreement
IOD	Indian Ocean Dipole
IODMS	Iron Ore Document Management System
LoM	Life of mine
m^3	Meters cubed
MCA	Minerals Council of Australia
MCS	Mount McRae Shale
MJ.mm/ha/hr/yr	Megajoule millimetre per hectare per hour per year
MNES	Matter of National Environmental Significance
MOC	Mine Operations Contract
MPA	Maximum potential acidity
MTS	Mount Sylvia Formation
NAF	Non-acid forming
NPR	Neutralisation Potential Ratio
OoM	Order of magnitude study
PA	Participation Agreement

PAF	Potential acid forming
PCO	Present Cost Obligation
PCSR	Potentially contaminated sites register
PEC	Priority Ecological Community
PFS	Prefeasibility study
PMP	Probable maximum precipitation
PSI	Preliminary site investigation
PUPEZ	Potentially unstable pit edge zone
RFD	Regional Framework Deed
SCARD	Spontaneous combustion and acid rock drainage
TEC	Threatened Ecological Community
TPC	Total Project Closure
WF	Wittenoom Formation
WYL	Wyloo Group
YAC	Yinhawangka Aboriginal Corporation
YEL	Yinhawangka Enterprises Limited
ZOI	Zone of Instability

PURPOSE AND SCOPE

1. Purpose

This closure plan is an output of an Order of Magnitude (OoM) closure study completed in 2018 for Eastern Range, and has been prepared to achieve the following goals:

- to meet the internal requirements of the Rio Tinto Closure Standard (2015) and the Closure Study Definition Guidelines which are mandated for all Rio Tinto businesses;
- to reflect the current knowledge, requirements and preferred strategies for closure of Eastern Range and identify the future requirements to continue to progress towards a planned and managed closure of the site;
- to support an environmental approval being sought under s38 of the EP Act and the EPBC Act for proposed mining at 42EE and 47E at Eastern Range as part of the Greater Paraburdoo Iron Ore Hub Proposal; and
- to ensure that the closure cost estimate for the site remains current.

It has been prepared in accordance with the 2015 Department of Mines and Petroleum (DMP) / Environmental Protection Authority (EPA) Guidelines for Preparing Mine Closure Plans (2015) (DMP/EPA Closure Guidelines).

2. Scope

The OoM closure study undertook a detailed review in order to define the scope and applicable footprint for this closure plan. This differs from the process normally adopted in conceptual closure plans, which are usually aligned more neatly to tenure boundaries.

The current footprint boundary is depicted in Figure 1 and also in Figure 4. A review of the footprint will be undertaken in the prefeasibility stage to confirm it remains appropriate. For the purposes of the OoM closure study, this Eastern Range Closure Plan has been delineated by the following tenure and other boundaries[3]:

- State Agreement tenure ML4SA (AML70/00004) Section 236;
- State Agreement tenure ML4SA (AML70/00004) Section 237;
- a small portion of land on which the 23E and 24E deposits are located within State Agreement tenure ML246SA (AML70/00246). This area is delineated by the sealed access road which runs back to Paraburdoo town; and
- a small portion of land on which conveyor CV604 sits at Paraburdoo upon State Agreement tenure ML246SA. This conveyor is the connection point between CV555 (Channar) and the Paraburdoo plant and is owned by the Eastern Range joint venture[4].

Exclusions from this plan compromise the following:

- the Turee Creek and Channar borefields (production and monitoring bores) located on Land Administration Act Easement L478326 to the south of Channar which supply water to Channar, Eastern Range and Paraburdoo (Channar borefield currently only supplies Channar, Turee Creek supplies

[3] Note the scope of this closure plan was reviewed during the OoM study and has been amended since the previous (2016) closure plan was prepared.

[4] In the November 2016 Life of Mine Plan, Channar continues production for approximately 1 year longer than Eastern Range. This asset and the land on which it sits is also utilised to feed Channar ore into the Paraburdoo plant so ownership of this asset at the time of closure may change.

Channar, Eastern Range and Paraburdoo). These borefields are planned to continue operating beyond the closure of Eastern Range to supply Paraburdoo and future mines within the region and are part of the Paraburdoo Closure Plan scope;

- the Eastern Range communications tower located east of the 32E6 waste dump. This tower provides control access via telemetry to the Channar and Turee Creek borefields which are part of the Paraburdoo Closure Plan scope;
- all overland conveyor sections including the section of CV555 which runs through ML4SA (AML70/00004) Section 236 (this is covered in the Channar Closure Plan scope), other than conveyors CV603 (located at Eastern Range) and CV604 which are included as outlined above;
- any other infrastructure not listed above which supports the Eastern Range operation but is located at Paraburdoo; and
- community impacts on Paraburdoo town, however these are being considered by Rio Tinto and relevant information is expected to be included in future iterations of this closure plan.

This closure plan supersedes all previous closure, decommissioning and rehabilitation plans for Eastern Range.

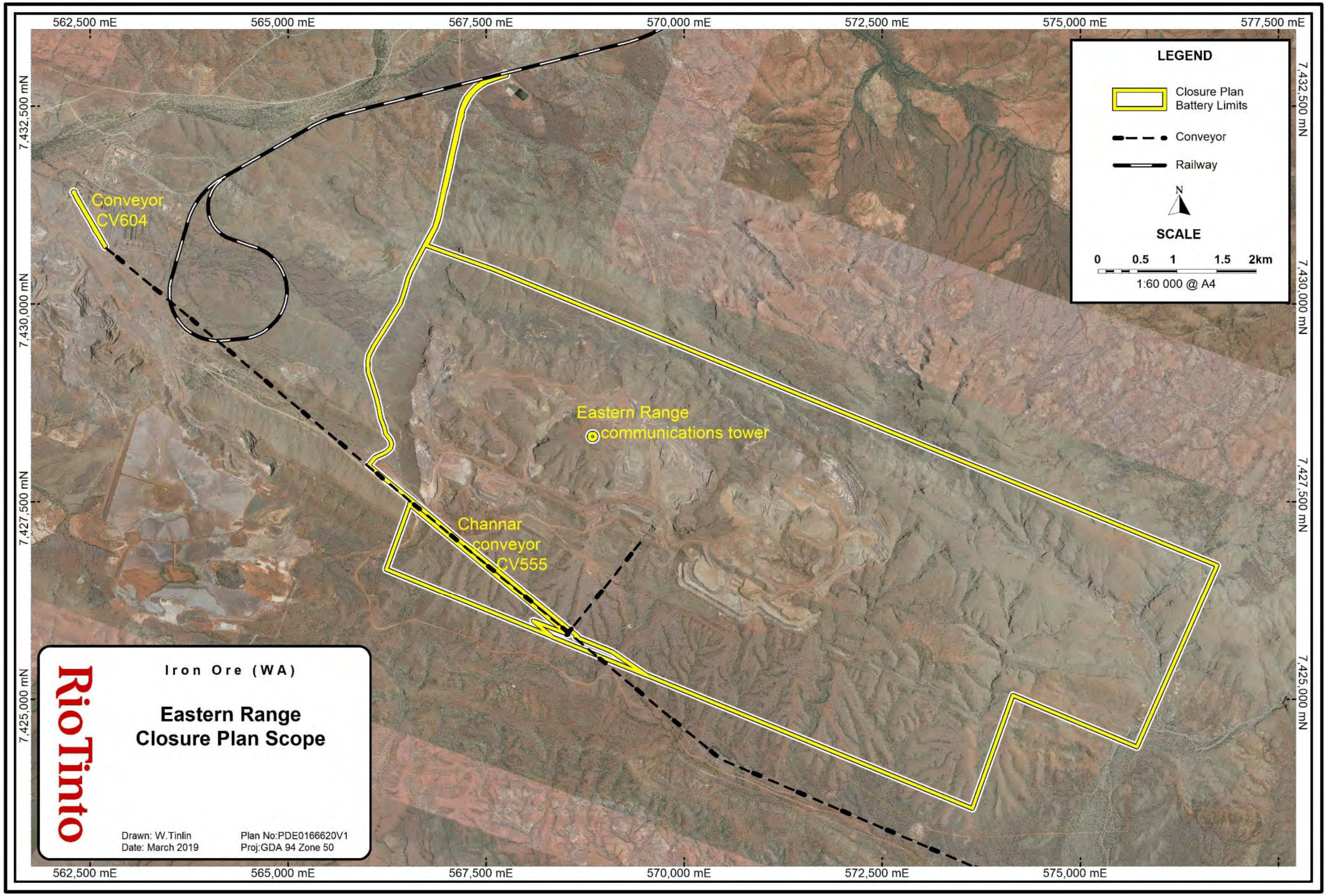

Figure 1: Eastern Range closure boundary (excludes communications tower and Channar conveyor CV555, includes CV604)

3. Closure planning process

In accordance with the Rio Tinto Closure Standard (2015), each site must develop a closure plan which is kept current by periodic updates over the life of the operation. Closure plans are updated to account for changes resulting from:

- amendments to the mine plan;
- improvements of the site closure knowledge base (e.g. through daily activities, technical studies and research actions, progressive rehabilitation);
- new or amended regulation;
- changes to surrounding land uses; and
- evolving stakeholder expectations.

The detail within each closure plan increases as the knowledge base develops. During operations the closure plan is updated periodically, nominally every three years, to meet internal and external regulatory requirements or commitments. When a site is approaching the end of mine life, formal closure studies commence, as outlined in Figure 2, which include an Order of Magnitude (OoM), Prefeasibility (PFS) and Feasibility (FS) study, prior to the commencement of closure implementation. At each of these stages the closure plan and closure cost estimate are refined. This closure plan is a key output of an OoM closure study completed in 2018 for Eastern Range. Closure implementation is currently expected to commence in approximately 2024.

The OoM, PFS and FS closure studies take the conceptual closure plan to a greater level of detail, increasing at each stage, with the intent that by the FS stage a sufficient level of detail exists to enable closure of the operation to commence. These studies include the preparation of detailed plans which prescribe how infrastructure, decontamination, rehabilitation, the workforce and stakeholder communications will be managed throughout the mine closure period (and beyond).

The FS culminates in the preparation of the final closure plan, with location specific management plans for each closure domain. This plan addresses the physical closure, dismantling and subsequent rehabilitation requirements, and the agreed post closure monitoring and relinquishment process. The supporting technical reports that have been used to predict the post-closure outcomes are appended to the final closure plan.

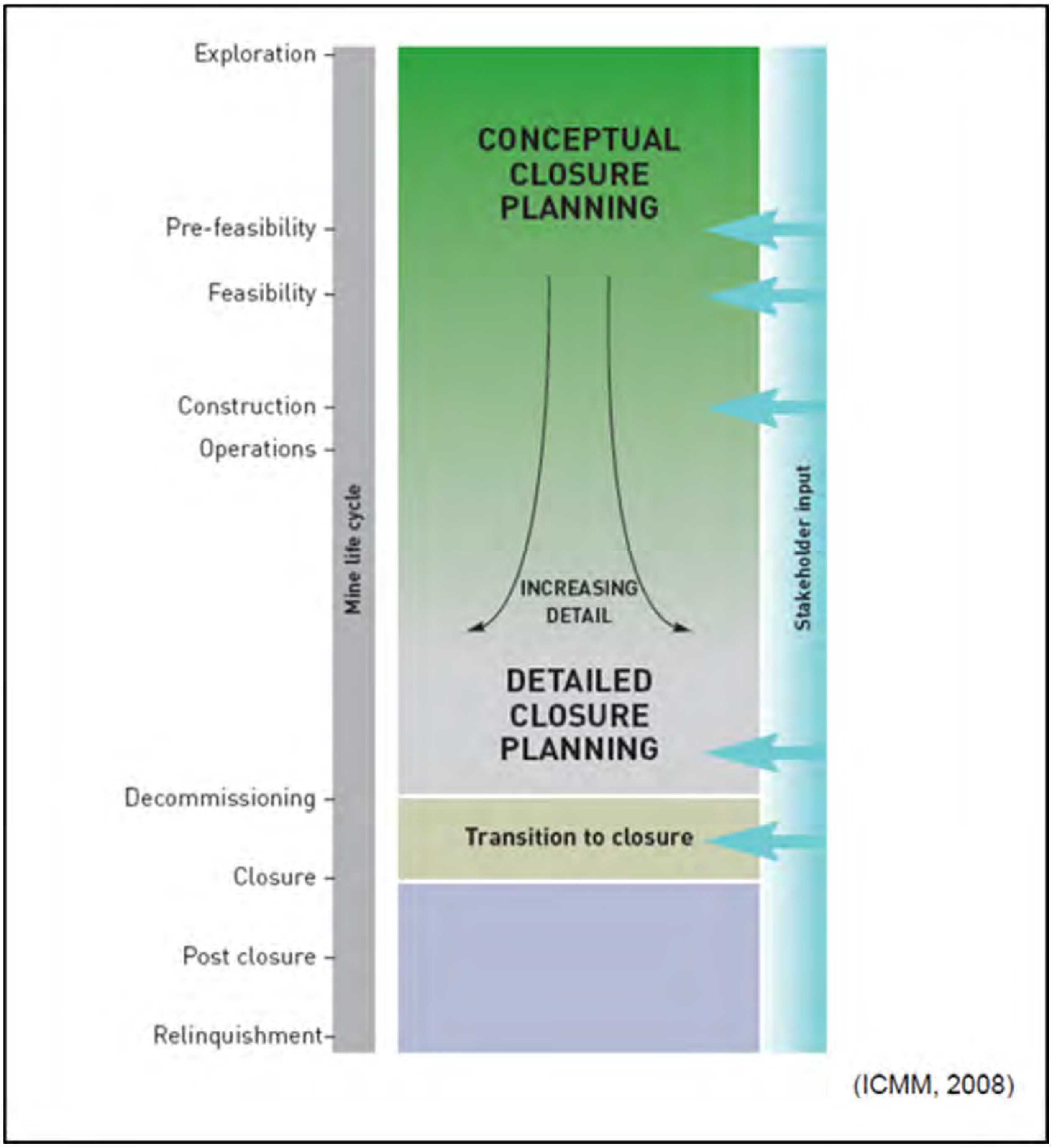

Figure 2: Progression of closure planning

PROJECT OVERVIEW

4. Description of the operation

4.1 Ownership

Eastern Range mine is operated under a Mine Operations Contract (MOC) by Ranges Management Company Pty Ltd, a wholly owned subsidiary of Hamersley Iron Pty. Ltd (HI) and hereafter referred to as Rio Tinto, on behalf of the Bao-HI Ranges Joint Venture (JV) of which Hamersley Iron holds the majority interest. The Bao-HI Ranges JV comprises:

- Ranges Mining Pty Ltd (54 per cent participating interest) – a subsidiary of Rio Tinto; and
- Baosteel Australia Mining Company Pty Ltd (46 per cent participating interest) – a subsidiary of the Shanghai Baosteel Group Corporation.

All closure obligations that are the responsibility of the JV have been subcontracted to Hamersley Iron (Rio Tinto) as part of the services it provides under the MOC.

4.2 Location

Eastern Range is located in the Pilbara region of Western Australia (WA) (Figure 3), approximately 980 km north east of Perth (direct line) and falls within the local authority of the Shire of Ashburton. It is in a remote region of the WA State, with the closest town of Paraburdoo 8 km to the north and the town of Tom Price 58 km to the north. Eastern Range is located within the traditional lands of the Yinhawangka People (Figure 6) who hold Native Title (determined on the 18th July 2017, they hold Native Title over lands covering a total area of 10,150 km^2. The nearest Aboriginal community is located at Bellary Springs which is approximately 30 km to the north of Paraburdoo town. The Wakathuni community is 50 km to the north of Paraburdoo town. There are no other towns in the immediate vicinity.

Eastern Range forms part of the Greater Paraburdoo Hub, which also includes the operational site of Paraburdoo 6 km to the northwest and proposed operations at Western Range, approximately 12 km to the west of Paraburdoo. The location of these relative to Eastern Range is shown in Figure 3. Channar operations are also located 9 km to the east of Eastern Range. The mines are managed as a collective operation, with the majority of supporting infrastructure located at Paraburdoo.

The mining leases are wholly underlain by unallocated Crown Land, however Rocklea, Mininer, Ashburton Downs and Turee Creek Pastoral Stations are located within the region (Figure 5).

4.3 Mine operations

Mining at Eastern Range commenced in 2004. Iron ore is extracted using traditional open pit, drill and blast and load and haul methods. Run of mine ore is tipped into the primary crusher prior to being discharged to the primary stockpile. Ore is extracted from beneath the stockpile, conveyed to a secondary crusher and then onto the Paraburdoo plant area where it is combined with other Greater Paraburdoo ore, crushed and screened into lump and fine product, then transported via train to the Cape Lambert and Dampier ports. The current mining area (shown in Figure 8) consists of three deposits spanning an area of approximately 6.5 km: 23E-24E, 32E and 37E-42E, and new deposits at 42EE and 47E, which are subject to an assessment under s38 of the EP Act and the EPBC Act. Mining areas are topographically elevated and are all above the water table (AWT).

The OoM study was based on the November 2016 Life of Mine (LoM) Plan which scheduled the completion of ex-pit mining in 2023 and completion of crusher feed in 2024[5]. The associated mining schedule is detailed in Table 1. Table 2 provides an overview of the corresponding waste landforms which support mining. The LoM Plan was being updated concurrently with progression of the OoM closure study and a new mine plan is expected to form the basis of the PFS for the site. The information in Table 1 and 2, particularly regarding completion years, should therefore be considered indicative.

[5] The life of a mine end date can vary for a range of factors. This date should be considered indicative only.

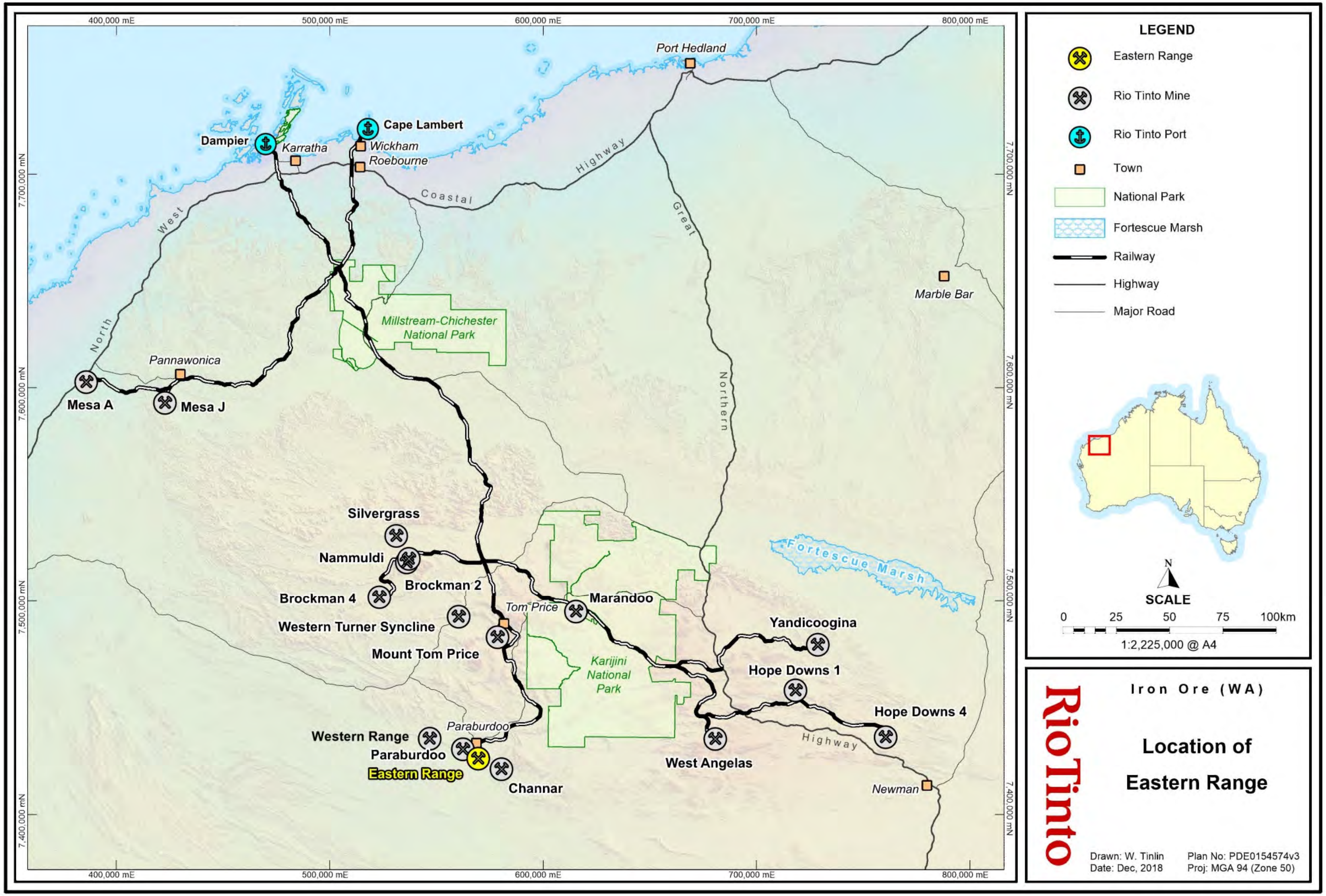

Figure 3: Regional location of Eastern Range

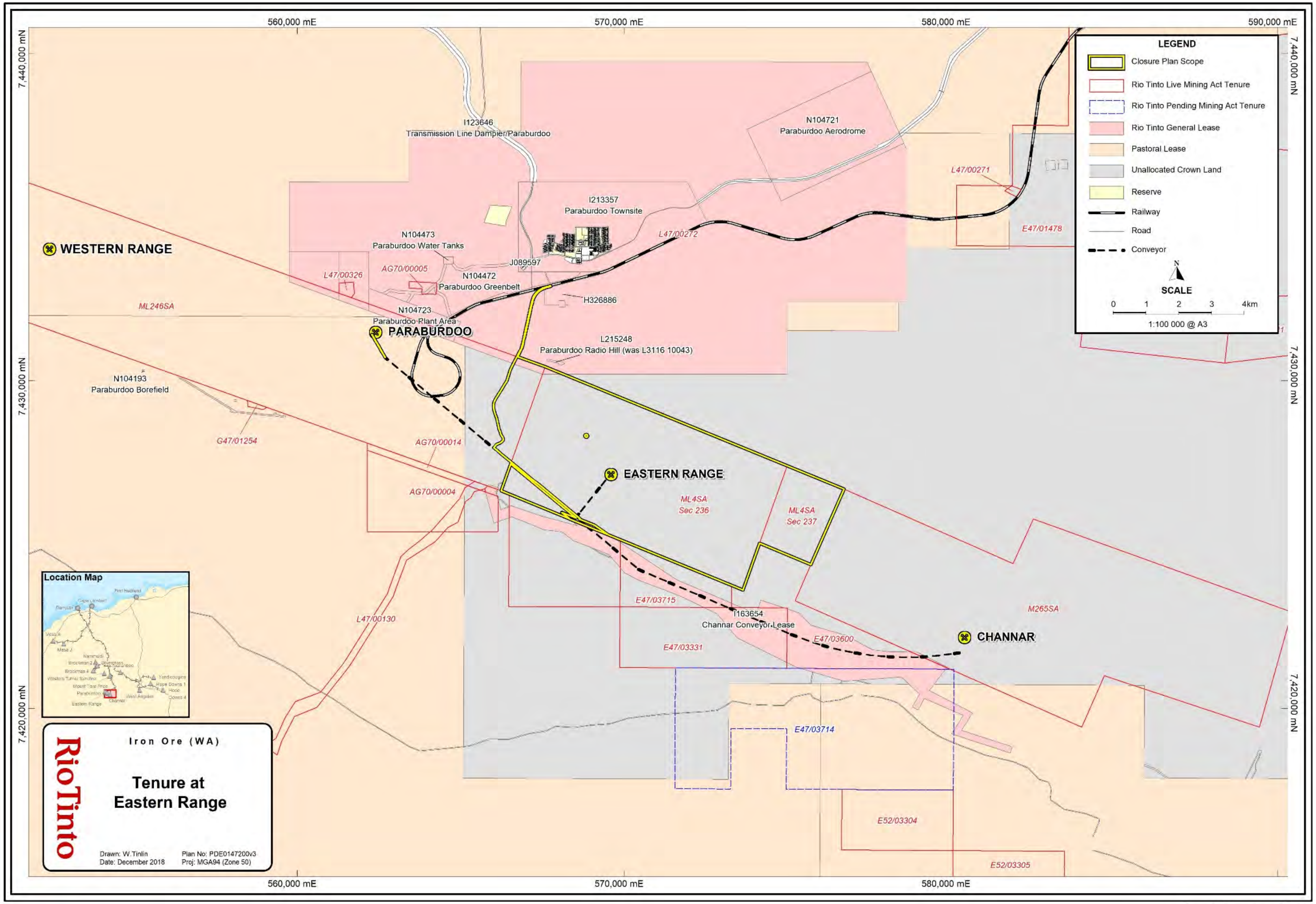

Figure 4: Tenure at Eastern Range

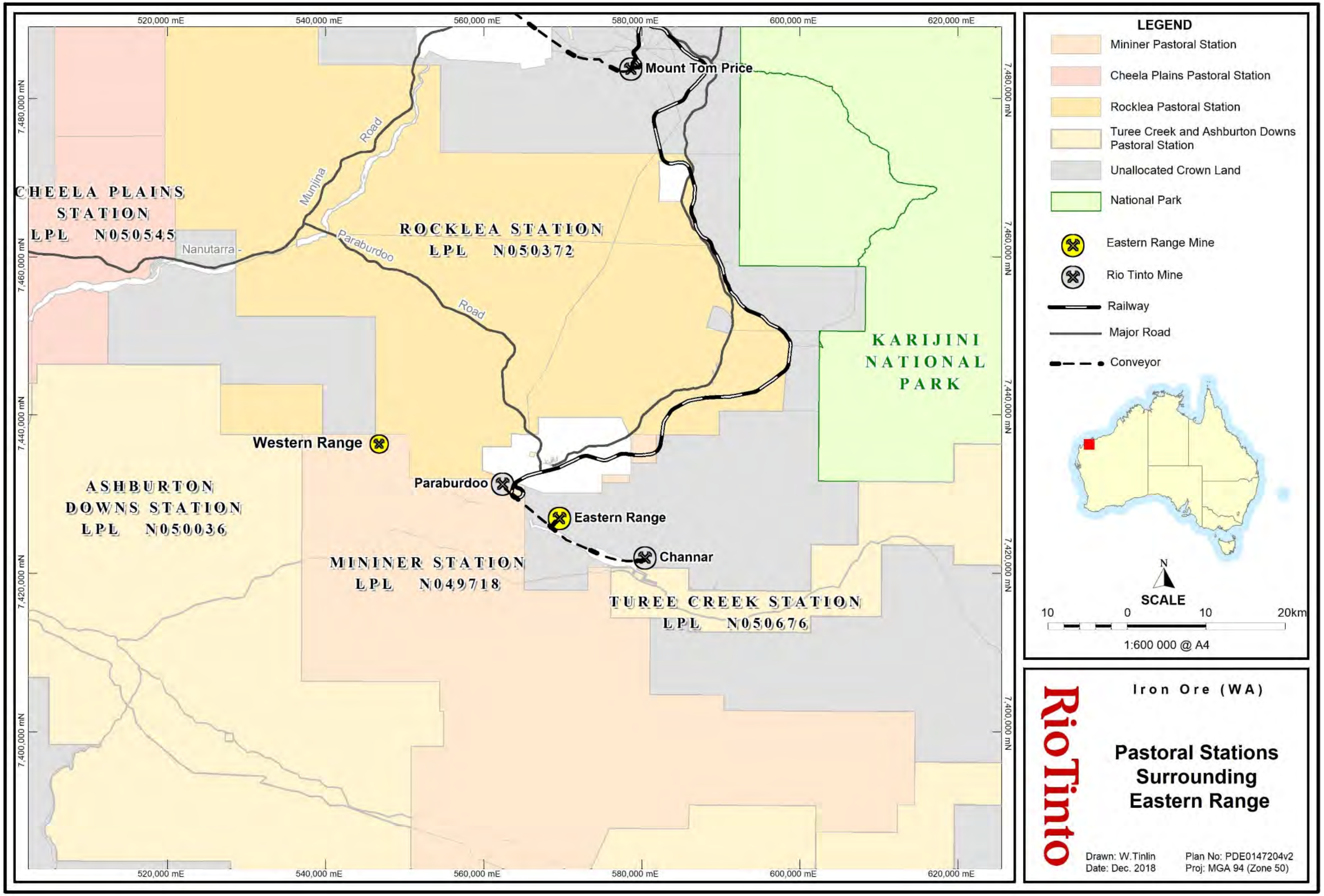

Figure 5: Pastoral leases in proximity to Eastern Range

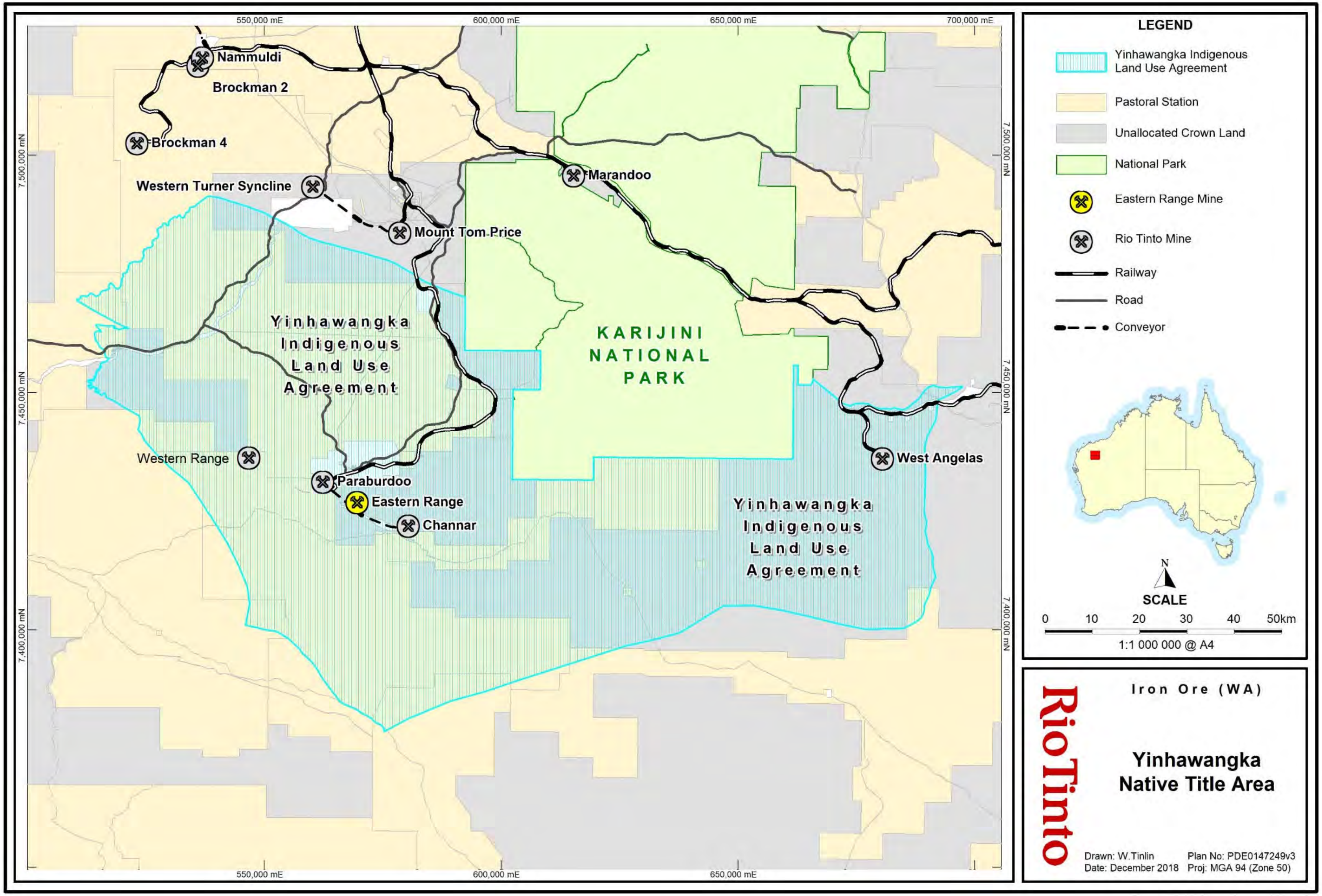

Figure 6: Yinhawangka Native Title area

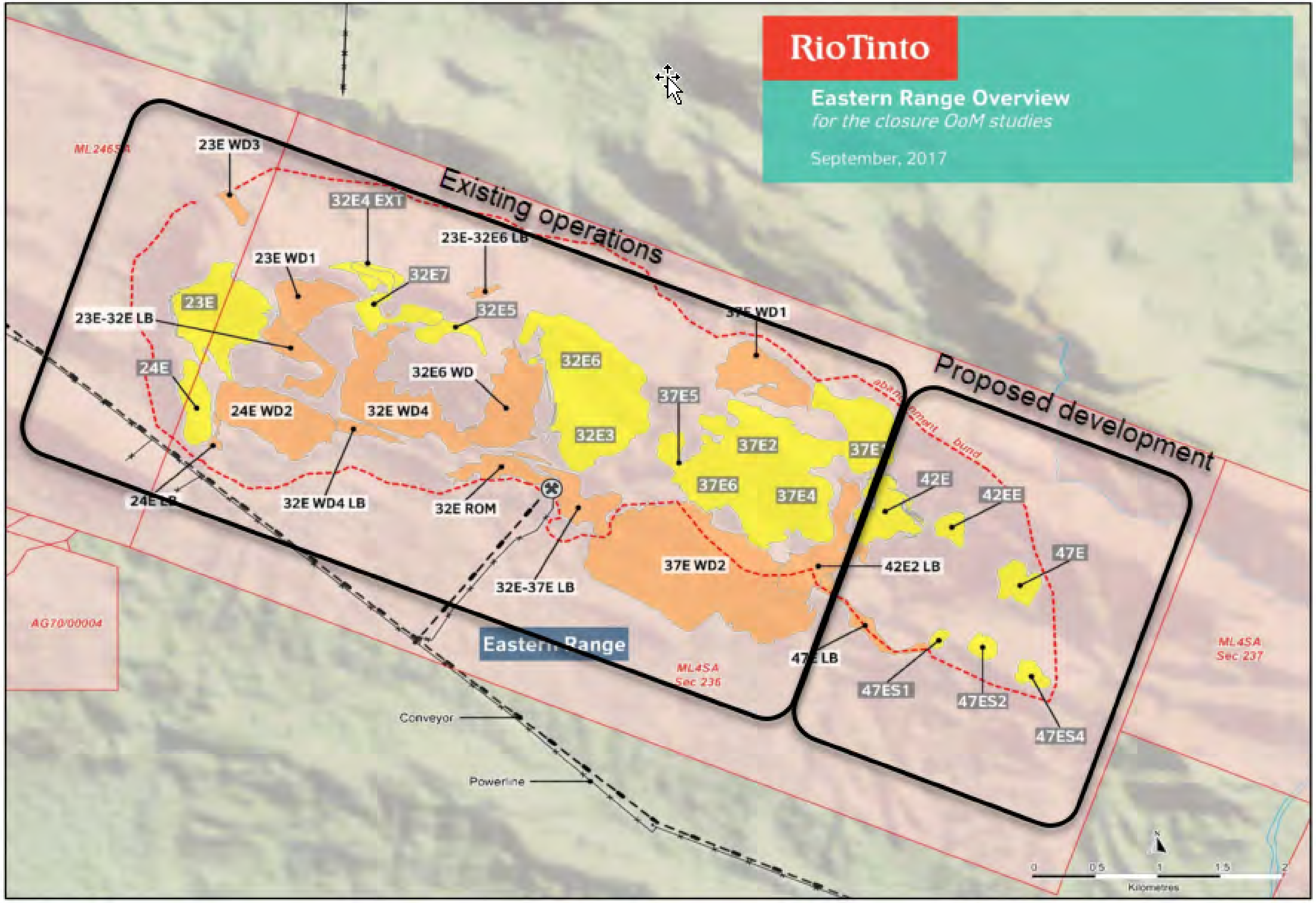

Figure 7: Eastern Range mine layout

Table 1: November 2016 LoM mining schedule at Eastern Range

Deposit	Pit name	Start (year)	Complete (year)	Description	Ground level of pit m RL	Max depth of pit m	Max depth of pit m RL	BWT or AWT	Water table level (RL)	Hazard classification	Pit perimeter kms
23E	23E	<2010	2021	Active	650	250	400	AWT	390	Non-hazardous	4
	23E_S3	<2010	2017	Exhausted	650	140	510	AWT	390	Non-hazardous	
24E	24E	<2010	2017	Exhausted	520	80	440	AWT	345	Non-hazardous	2
32E	32E	2020	2020	Proposed	600	130	470	AWT	370	Non-hazardous	8
	32E3	2012	2017	Exhausted	600	140	460	AWT	370	Non-hazardous	
	32E3_extn	2020	2020	Proposed	600	70	530	AWT	370	Non-hazardous	
	32E4_extn	2019	2019	Active	630	35	595	AWT	370	Non-hazardous	
	32E5	2018	2019	Active	680	80	600	AWT	370	Non-hazardous	
	32E6	2020	2023	Active	635	175	460	AWT	370	Non-hazardous	
	32E7	2019	2020	Active	660	120	540	AWT	370	Non-hazardous	
37E	37E1	2020	2023	Active	700	160	540	AWT	No validated water hits in all holes for 37E deposit. <440	Non-hazardous	6.5
	37E2	2019	2020	Active	600	40	560	AWT	<440	Non-hazardous	
	37E4	2019	2022	Active	640	200	440	AWT	<440	Non-hazardous	
	37E5	2012	2018	Active	570	50	520	AWT	<440	Non-hazardous	
	37E6	2014	2019	Active	640	150	490	AWT	<440	Non-hazardous	
42E	42E	<2010	2017	Exhausted	670	190	480	AWT	No validated water hits in all holes for 42E deposit. <480	Non-hazardous	2.5
	42EE	2021	2024	Proposed	645	155	490	AWT	<480	Non-hazardous	1.5
47E	47E	2021	2024	Proposed	600	90	510	AWT	No validated water hits in all holes for 47E deposit. <480	Non-hazardous	1.6
	47E_S1	2021	2022	Proposed	535	35	500	AWT	<480	Non-hazardous	0.6
	47E_S2	2021	2022	Proposed	535	45	490	AWT	<480	Non-hazardous	1.1
	47E_S4	2021	2023	Proposed	540	30	510	AWT	<480	Non-hazardous	0.9

Table 2: Eastern Range waste landform inventory

Deposit	Landform name	Type	Material classification	Notes	Status	Ex-pit or in-pit?
23E	23E_WD1	Waste dump	Inert waste	N/A	Rehabilitated	Ex-pit
	23E_32E_LB	Landbridge	Inert waste	N/A	Active	In-pit, externally draining, rehabilitation required
	23E_32E6 LB	Landbridge	Inert waste	N/A	Active	Ex-pit
	23E_WD3	Waste dump	Inert waste	Not in 2016 closure plan. Historical external dump tipped off NW ridge.	Active	Ex-pit
24E	24E_LB	Landbridge	Inert waste	N/A	Active	Ex-pit
	24E_WD2	Waste dump	Inert waste	N/A	Active	Ex-pit
32E	32E_37E_LB	Landbridge	Inert waste	N/A	Active	Ex-pit
	32E6_WD	Waste dump	Inert waste	Rehabilitation of top lift previously commenced.	Active	Ex-pit
	32E_ROM	Stockpile	Product	N/A	Active	Ex-pit. Any residual material at closure will be rehabilitated as per waste dump requirements.
	32E_WD4	Waste dump	Inert waste	N/A	Proposed	Ex-pit
	32E3_BF	Waste dump	Inert waste	Backfill dump previously flagged for PAF to be used as short haul for 32E6 mining and to create new stockpile area close to crusher.	Proposed	In-pit, internally draining, no rehabilitation required. Top surface will be ripped and seeded due to being backfilled to pit crest level.
	32E_WD4_LB	Landbridge	Inert waste	N/A	Active	Ex-pit
37E	37E_WD1	Waste dump	Inert waste	N/A	Active	Ex-pit
	37E_WD2	Waste dump	Inert waste	Will receive 42E waste.	Active	Ex-pit
	37E6_BF	Waste dump	Inert waste	No rehabilitation required.	Proposed	In-pit, internally draining, no rehabilitation required.
	37E_LB	Landbridge	Inert waste	N/A	Active	Ex-pit. Merges with 37E_WD2 waste dump.
	37E1_BF	Waste dump	Inert waste	Backfill of 37E1 stage pit area to provide alternate waste dump during construction of 37E_WD1.		In-pit, externally draining. Rehabilitation of northern edge where

Deposit	Landform name	Type	Material classification	Notes	Status	Ex-pit or in-pit?
						ramp is externally draining required.
42E	42E2_LB	Landbridge	Inert waste	Site will be filling the valley between these two structures during operations.	Active	Ex-pit
	42EE_LB	Landbridge	Inert waste	Valley fill landbridge which will be removed as much as practical in the final landform.	Proposed	Ex-pit
	42E_WD1	Waste dump	Inert waste	Not in 2016 closure plan. Historical dump tipped off ridge between 42E and 37E1. Will be dumped over and potentially partially reclaimed as part of 37E1 mining, with residual outer slope requiring rehabilitation at closure.	Active	Ex-pit
47E	47E_LB	Waste dump	Inert waste	Not in 2016 closure plan. Proposed, not yet constructed. Cross valley fill section to be removed at closure.	Proposed	Ex-pit

IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

5. Legal obligations

A closure obligations register for Eastern Range is presented as Appendix A of this document. It identifies legislation, standards and guidelines that either apply to Eastern Range specifically, or may be relevant to closure of mine sites generally. The register also contains details of legal obligations and commitments from the following instruments:

- *Iron Ore (Hamersley Range) Agreement Act 1968* (Paraburdoo) (Paraburdoo Agreement) which is the Third Schedule of the *Iron Ore (Hamersley Range) Agreement Act 1963* (Hamersley Range State Agreement);
- mineral leases issued under the *Mining Act 1978* pursuant to approval under the *Iron Ore (Hamersley Range) Agreement Act 1963*;
- Section 16 and 18 approvals granted under the *Aboriginal Heritage Act 1972*;
- Native Vegetation Clearing Permits (NCVP) issued under Section 51 of the EP Act;
- Part V of the EP Act licence L5275/1972/12; and
- commitments made during the environmental assessment process under s38 of the EP Act.

The majority of Rio Tinto iron ore mines in the Pilbara are subject to a Ministerial Statement under Part IV of the EP Act which specifies environmental conditions. Eastern Range was referred to the Environmental Protection Authority (EPA) in March 1998 and received a ‘Not Assessed – Public Advice Given’ assessment, hence the mine is not subject to a Ministerial Statement. The clearing of native vegetation is governed by Native Vegetation Clearing Permit CPS 4032/4 granted under Section 51 of the EP Act. This permit outlines conditions relevant to rehabilitation of disturbances, which apply during operations and at closure. Subject to Ministerial approval of the proposed new deposits at Eastern Range under Part IV of the EP Act, the register will be updated to include any relevant obligations from a Ministerial Statement.

At this stage it is assumed that the Health, Safety, Environmental and Quality Management System process utilised during operations will continue to be employed to govern closure implementation and the post-closure monitoring period prior to relinquishment. In the PFS a detailed legal review will be completed to ensure that the legal obligations and commitments contained within Appendix A are current.

STAKEHOLDER ENGAGEMENT

6. Stakeholder engagement

6.1 Stakeholder identification

Stakeholder consultation is vital to ensuring closure outcomes meet stakeholder expectations and is an important risk mitigation process. Rio Tinto has established processes for consultation with stakeholders, which are embedded in both the Rio Tinto Closure Standard (2015) and the Community and Social Performance Standard (2015). These standards are aligned with principles from the Australian and New Zealand Minerals and Energy Council and the Minerals Council of Australia (ANZMEC/MCA, 2000). Consultation commences at appropriate times from the early stages of exploration planning and will continue until the final relinquishment of the site.

The 2016 closure plan for Eastern Range identified key stakeholders relevant to the operation and included a record of consultation undertaken to date in relation to closure of the operation. For the OoM study it was necessary to expand consideration to all stakeholders with an interest in the closure of Eastern Range and develop a detailed stakeholder engagement strategy aligned with project progression. A workshop was held to identify all stakeholders, as listed in Table 3. Specific contact information for each stakeholder is maintained via a register held within the Company's Foundation Document Management System (FDMS).

Table 3: Eastern Range closure stakeholders

Stakeholder	Contact position(s) within stakeholder group
State departments/regulators	
Department of Jobs, Tourism, Science and Innovation	Director General, GM Project Facilitation, Executive Director, Senior Project Officer
Department of Mines, Industry Regulation and Safety - Resource Environment Compliance Division	Manager, North, Team Leader - Operations, Environment, Environment Officer
Department of Mines, Industry Regulation and Safety – Safety Division	District Inspector Paraburdoo
Department of Mines, Industry Regulation and Safety - Explosives and Dangerous Goods Division	Manager Explosives and Dangerous Goods, Special Inspector
Department of Mines, Industry Regulation and Safety	Manager Tenure, Mining Registrar
Department of Water and Environmental Regulation – EPA Services Branch	Executive Director Assessment, Manager Assessment Mining North, Manager Compliance and Reporting (Compliance)
Department of Water and Environmental Regulation – Water Branch	Regional Manager Pilbara, Regional Manager Northwest
Department of Water and Environmental Regulation – Contaminates Sites Branch	Contaminated Sites Officer
Department of Water and Environmental Regulation – Environmental Regulation Branch	Manager - Resources North, Environmental Officer – Pilbara

Stakeholder	Contact position(s) within stakeholder group
Department of Biodiversity, Conservation and Attractions	Area Manager North
Department of Primary Industries and Regional Development	Executive Director Strategy and Evaluation
Department of Health	Director
Department of Planning, Lands and Heritage	Registrar of Aboriginal Sites
Department of Planning, Lands and Heritage	Director General, Assistant Manager, Acting Manager Contaminated Sites
Government regional agencies	
WA Police - Pilbara	District Superintendent
WA Country Health Service	Regional Director
Department of Housing (Housing Authority)	Regional Manager Pilbara
Main Roads	Manager Pilbara region
Western Power/Horizon	Manager Pilbara Network
Pilbara Development Commission	CEO
Federal government	
Department of the Environment and Energy	Assistant Secretary
Civil Aviation Safety Authority	Aerodrome inspector
Joint ventures	
Baosteel	Project Manager
Shires	
Shire of Ashburton	Acting CEO, Executive Manager Planning
Indigenous groups / Traditional Owners	
Yinhawangka Aboriginal Corporation	CEO, Implementation Officer, Yinhawangka representatives (multiple)
Yinhawangka Native Title Representation	Yamatji Marlpa Aboriginal Corporation
Yinhawangka Enterprises Ltd (YEL)	Economic Development Manager
Yinhawangka (support)	Phil Haydock, anthropologist supporting engagement
Pastoralists	
Mininer Station	Station Owners
Turee Creek Station	Station Owners
Ashburton Downs	Station Owner
Local businesses and groups	

Stakeholder	Contact position(s) within stakeholder group
North Regional TAFE	Director Training Services
Karingal Neighbourhood Centre	Manager
Pilbara Inland Chamber of Commerce and Industry	Treasurer
Sodexo	Operations Manager Inland
Paraburdoo Medical Centre	General Manager - Operations
Paraburdoo residents	Shire of Ashburton Councillor
Paraburdoo Men's Shed	President
Internal	
Rio Tinto employees and contractors	Multiple
Other	
Chamber of Minerals and Energy	Multiple
Trade Unions	As required
Media	As required
Contractors	As required
Customers	As required

6.2 Stakeholder engagement strategy

Following stakeholder identification and mapping, an engagement strategy was developed to guide engagement throughout the study stages. This strategy focused on the OoM and PFS stages and provides a high level overview for the FS. It outlines key messages for each individual stakeholder as the basis of engagement and includes an indicative number of engagements for each stakeholder group, as detailed in Table 4. It will be revised during the PFS and FS stages according to stakeholder feedback and study findings.

6.3 Engagement to date

A communications register for Eastern Range is maintained; a copy as of January 2019 is included as Appendix B. This register is used to ensure stakeholder feedback is tracked and monitored to ensure that appropriate actions are taken to address these issues in a timely manner.

Specific consultation regarding closure was undertaken with the following external stakeholders during the OoM study:

- Yinhawangka Traditional Owners, including Yinhawangka Aboriginal Corporation representatives;
- the Department of Jobs, Tourism, Science and Innovation (JTSI);
- the Department of Mines, Industry Regulation and Safety (DMIRS);
- the Department of Water and Environmental Regulation (DWER) (including representatives from the EPA Services Branch, Water Branch and the Contaminated Sites Branch); and
- the Shire of Ashburton.

Table 4: Engagement Strategy messaging from OoM to PFS

Stakeholder	**Order of Magnitude**		**Pre-Feasibility**		**Feasibility**	
	Key messages/ focus of engagement	**Number of interactions completed**	**Key messages/ focus of engagement**	**Indicative number of interactions**	**Key messages/ focus of engagement**	**Indicative number of interactions**
Department of Jobs, Tourism, Science and Innovation	Seek to agree an engagement strategy i.e. how often we should engage as planning progresses and with whom within the department. Indicative timing for closure. Future developments planned in the near term i.e. Western Range. Seeking understanding of process for expected transfer of land tenure. Fate of non-fixed and fixed infrastructure and input on this. Feedback on conceptual closure plans for both sites.	2 including a site visit	Order of Magnitude messaging to a greater level of detail plus: Agreement on process for relinquishment. Requirements for asset transfer (if any) are understood by both parties and plans are underway to put agreements in place. Final closure plan requirements/ expectations and approval process. Completion criteria refinement.	2+ (including potential site visit)	Pre-feasibility messaging to a greater level of detail plus: Final landscape imagery. Final closure plan submission. Feedback on closure plan is sought to facilitate its approval. Agreements are in place for asset transfer as required. Process for land transfer is agreed and understood by relevant parties. Timing for closure activities commencement.	2+ (including potential site visit)
Department of Mines, Industry Regulation and Safety	Seek to agree an engagement strategy i.e. how often we should engage as planning progresses and with whom within the department. Feedback on conceptual closure plans for both sites. Indicative timing for closure. Planning process undertaken for closure.	2 including a site visit.	Order of Magnitude messaging to a greater level of detail plus: Agreement on process for relinquishment. Fate of non-fixed and fixed assets (once this has been discussed with DSD). Refinement to completion criteria.	2+ (including site visit)	Pre-feasibility messaging to a greater level of detail plus: Final landscape imagery. Completion criteria are formally agreed and incorporated into the final closure plan. Feedback on closure plan is sought to facilitate its approval.	2+ (including at least one site visit)

Stakeholder	Order of Magnitude		Pre-Feasibility		Feasibility	
	Key messages/ focus of engagement	**Number of interactions completed**	**Key messages/ focus of engagement**	**Indicative number of interactions**	**Key messages/ focus of engagement**	**Indicative number of interactions**
	Refinement of completion criteria. General closure strategies for the various landforms (domains). Closure strategies for complex landforms. Management of PAF material. Safety considerations for closure – requirements in post closure landscape (i.e. abandonment bunding) and during implementation). Environmental considerations in rehabilitation (if any- such as changes to designs to avoid impact to priority areas, or remediation of impacts from operations where possible, inclusion of priority species in seed mixes).		Monitoring strategy. Detailed strategies for complex landforms. Final closure plan requirements/ expectations and approval process.		Timing for closure activities commencement.	
Department of Water and Environmental Regulation (EPA Services Branch)	Seek to agree an engagement strategy i.e. how often we should engage as planning progresses and with whom within the department. Feedback on conceptual closure plans for both sites. Indicative timing for closure. Planning process undertaken for	2	Order of Magnitude messaging to a greater level of detail plus: Fate of non-fixed and fixed infrastructure (once this has been discussed with Department of Jobs, Tourism, Science and Innovation). Refinement to completion criteria. Monitoring strategy.	2+ (including site visit)	Pre-feasibility messaging to a greater level of detail plus: Final landscape imagery. Completion criteria are formally agreed and incorporated into the final closure plan. Feedback on closure plan is sought to facilitate its approval.	2+ (including site visit)

Stakeholder	Order of Magnitude		Pre-Feasibility		Feasibility	
	Key messages/ focus of engagement	**Number of interactions completed**	**Key messages/ focus of engagement**	**Indicative number of interactions**	**Key messages/ focus of engagement**	**Indicative number of interactions**
	closure. Refinement of completion criteria. General closure strategies for the various landforms (domains). Closure strategies for complex landforms. Management of PAF material. Environmental considerations in rehabilitation (if any- such as changes to designs to avoid impact to priority areas, or remediation of impacts from operations where possible, inclusion of priority species in seed mixes).		Detailed strategies for complex landforms. Final closure plan expectations/requirements.		Timing for closure activities commencement.	
Department of Water and Environmental Regulation (Contaminated Sites Branch)	Indicative timing for closure. Planning process undertaken for closure. Contaminated sites investigation process and Preliminary Sampling Plan overview.	1	Order of Magnitude messaging to a greater level of detail.	1	Order of Magnitude messaging to a greater level of detail. Agree contaminates sites classification for the site post closure.	1
Department of Water and Environmental Regulation	Seek to agree an engagement strategy. Indicative timing for closure. Intention in relation to bores supplying the sites.	1	Order of Magnitude messaging to a greater level of detail plus: Input and guidance on rainfall scenarios and landform design.	1	Pre-feasibility messaging to a greater level of detail plus: Final landscape imagery.	1

Stakeholder	Order of Magnitude		Pre-Feasibility		Feasibility	
	Key messages/ focus of engagement	**Number of interactions completed**	**Key messages/ focus of engagement**	**Indicative number of interactions**	**Key messages/ focus of engagement**	**Indicative number of interactions**
(Water Branch)	Water related issues specific to each site if any (e.g. surface water pools at Eastern Range). Water flows from surface features. Drainage considerations. Input on appropriate design considerations.		Overview of water management in closure design.			
Yinhawangka Aboriginal Corporation	Indicative timing for closure. Future developments planned in the near term i.e. Western Range. Planning process undertaken for closure. Completion criteria proposed. General closure strategies for the various landforms (domains). Safety considerations in landform design. Management of cultural heritage during closure. Seeking feedback on areas where access or visual amenity aspects are particularly important. Seeking feedback on bush tucker or other flora species to be considered in	9 including a site visit and dedicated day long workshop.	Order of Magnitude messaging to a greater level of detail plus: Reconfirming the groups' expectations with regards to closure. Fate of non-fixed and fixed assets. Demonstration of how post-closure access is being considered in landform planning. Progressive rehabilitation opportunities. Input into the final closure plan – what is important to be included/addressed?	2 (including potential on-country site visit and survey work)	Pre-feasibility messaging to a greater level of detail plus: Final landscape imagery. Access routes planned. Discussion of how visual amenity has been considered. Progressive rehabilitation opportunities. Timing for closure activities commencement.	2+ (including on country site visit and survey work)

Stakeholder	Order of Magnitude		Pre-Feasibility		Feasibility	
	Key messages/ focus of engagement	Number of interactions completed	Key messages/ focus of engagement	Indicative number of interactions	Key messages/ focus of engagement	Indicative number of interactions
	rehabilitation seed mixes. Seeking understanding of their expectations with regards to closure. Overview of opportunities likely to be presented by closure including demolition, rehabilitation earthworks, monitoring and support services. Closure of these operations is expected to have minimal impact on the workforce and Paraburdoo town as Rio Tinto deposits in the region continue and future ones commence, but some contraction may be anticipated.					
Shire of Ashburton	Indicative timing for closure. Future developments planned in the near term i.e. Western Range. Planning process undertaken for closure. General closure strategies for the various landforms (domains). Safety considerations in landform design. Closure of these operations is expected to have minimal impact on the	1	Order of Magnitude messaging to a greater level of detail plus: Workforce demand projections for future deposits in the region. Closure workforce projections. Overview of workforce strategies being investigated for Eastern Range employees. Mutual discussions regarding strategies for management of impacts on Paraburdoo Town as a	2+	Pre-feasibility messaging to a greater level of detail.	2+

Stakeholder	Order of Magnitude		Pre-Feasibility		Feasibility	
	Key messages/ focus of engagement	Number of interactions completed	Key messages/ focus of engagement	Indicative number of interactions	Key messages/ focus of engagement	Indicative number of interactions
	workforce and Paraburdoo town as Rio Tinto deposits in the region continue and future ones commence, but some contraction is anticipated. Commit to engage as the studies progress and share proposed workforce strategies as they are developed.		result of closure.			
Other stakeholders	Indicative timing for closure. Future developments planned in the near term i.e. Western Range. Planning process undertaken for closure. General closure strategies for the various landforms (domains). Safety considerations in landform design. Other- refine to suit stakeholder group and purpose of consultation. This will include where alternative closure land use options need to be investigated. Closure of these operations is expected to have minimal impact on the workforce and Paraburdoo town as Rio Tinto deposits in the region continue and future ones commence, but some contraction is anticipated.	0	Order of Magnitude messaging to a greater level of detail. Additional messaging to be developed as required.	As required depending on stakeholder group priority and requirements	Pre-feasibility messaging to a greater level of detail. Additional messaging to be developed as required.	As required depending on stakeholder group priority and requirements

POST-MINING LAND USE AND CLOSURE OBJECTIVES

7. Post-mining land use

7.1 Land use

The Yinhawangka people hold Native Title over the land on which Eastern Range is located (Figure 6). Aside from mining activity and associated infrastructure, the Greater Paraburdoo area is largely undeveloped. Since European settlement, land uses in the region have included cattle grazing, exploration and mining, and conservation reserves. The area has been subject to mining since the commencement of the Paraburdoo mine in 1963. Pastoral activity in the region has historically been limited to grazing of cattle on the Rocklea, Mininer, Ashburton Downs and Turee Creek Stations[6]. There are no other mines currently operating in the immediate vicinity of Greater Paraburdoo.

7.2 Proposed post-mining land use

Options for post closure land use are considered limited due to the sparse regional population and the dominance of mining and therefore the default scenario normally adopted is either to return the area to a native ecosystem that is safe, stable and non-polluting or if pastoralism occurred in the area prior to mining, this may be considered.

Operations at Eastern Range are carried out under the *Iron Ore (Hamersley Range) Agreement Act 1968* (Paraburdoo), (Paraburdoo Agreement) which is the Third Schedule of the *Iron Ore (Hamersley Range) Agreement Act 1963* (Hamersley Range State Agreement). This Act requires the Company to only undertake activities that are authorised and consistent with the purpose of the State Agreement and to remediate all disturbances. Therefore it is the intent that the land at Eastern Range will be rehabilitated to a native ecosystem that is safe, stable and non-polluting. This land use would likely fall predominantly under the Australian Land Use and Management (ALUM) classification of 1.3.4 Rehabilitation[7], although this will be confirmed with relevant stakeholders as planning progresses, including the Department of Planning, Lands and Heritage who would administer this land post relinquishment. Pastoralism is not considered an appropriate post-mining land use at this stage, due to a large proportion of the terrain at the site being deemed unsuitable. The mine site is not intersected by any current pastoral leases (Figure 5).

The proposed post-mining land use assumes that the site will be rehabilitated to create a safe, stable and non-polluting landscape vegetated with native vegetation of local provenance, to maximise environmental and cultural heritage outcomes and ensure the site minimises adverse impacts on the current surrounding land use. The post-mining land use will be confirmed prior to closure, during final planning phases and in consultation with relevant stakeholders.

8. Closure objectives

8.1 Rio Tinto vision for closure in the Pilbara

Rio Tinto's general vision for closure is to:

- relinquish its mining leases to the Western Australian State Government;

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[6] Rocklea Station is owned and managed by Rio Tinto while the other three are privately owned and operated. Turee Creek Station is considered a primary stakeholder in Channar closure rather than Eastern Range specifically as it is partially located within the mining footprint of Channar, however consultation will still occur in relation to Eastern Range as relevant.

[7] 2016 ALUM codes available at http://www.agriculture.gov.au/abares/aclump/Documents/ALUMv8.pdf

- preserve, protect and manage the cultural heritage values of the area in cooperation with the Traditional Owners and other stakeholders;
- develop and implement strategies for closure which consider the implications on local communities;
- achieve completion criteria which have been developed with stakeholders and agreed with Western Australian State Government;
- develop landforms that are safe and stable and compatible with the surrounding environment and post-mining land use;
- achieve environmental outcomes that are compatible with the surrounding environment;
- implement a workforce strategy which addresses the impacts of closure on employees and contractors; and
- achieve successful closure in a cost effective manner.

8.2 Eastern Range closure objectives

The ultimate goal of mine closure at Eastern Range is to relinquish the site to the Western Australian State Government. This goal will be achieved once the State Government and community agree that the condition of the site is compatible with an agreed post-mining land use. Closure objectives reflect the aspects of the closure plan that government and relevant community stakeholders agree are key to evaluating the site condition. They do not represent the full range of issues that need to be addressed upon closure; rather they represent the key objectives against which the ability to relinquish will be assessed. The site specific closure objectives proposed for the Eastern Range mine are detailed in Table 5. They have been subject to minor revision since the last (2016) closure plan. During consultation, Yinhawangka representatives requested the addition of an objective which provides for Traditional Owner outcomes. This has been drafted as included in Table 5 and was provided to the group for consideration. It is expected to be confirmed in the PFS study closure plan.

Table 5: Eastern Range closure objectives

Number	Objective
1	Cultural heritage values have been preserved where possible.
2	Public health and safety hazards have been appropriately managed.
3	Contamination risks have been appropriately managed.
4	Final landform is stable and considers hydrological factors.
5	Vegetation on rehabilitated land is self-sustaining and compatible with the post-mining use.
6	Infrastructure has been appropriately managed.

COMPLETION CRITERIA

9. Completion criteria

Completion criteria are the indicators used to assess whether closure objectives have been met and to facilitate relinquishment of mining tenure. Indicative completion criteria (Table 6) have been developed in consideration of the predicted closure outcomes. Measurement processes and the associated supporting data (evidence and / or metrics) are also described in Table 6.

These criteria have had minor refinement since the 2016 closure plan for Eastern Range. The DMP/EPA Closure Guidelines require closure completion criteria to be refined over time, becoming more specific and detailed. Ongoing assessment of rehabilitation performance based on monitoring data will support this refinement during the PFS. The criteria are also expected to be refined to a domain level, with varying criteria set depending on the type of disturbance present across the site.

Table 6: Indicative completion criteria

Objective	Indicative completion criteria	Verification process/method	Evidence
Cultural heritage values have been preserved where possible.	1) Safe access to sites of cultural significance is implemented in consultation with key stakeholders. 2) Key heritage sites have not been impacted by closure implementation where possible. 3) Closure strategies have been developed in consultation with Traditional Owner representatives. 4) The final landform has been subject to visual impact assessment.	• Designated access pathways have been identified and communicated. • Abandonment bund restriction areas have been communicated. • Heritage survey, ethnographic survey and/or site inspection confirms heritage sites of significance have not been impacted. • Stakeholder consultation. • Visual impact assessment.	• Maps of designated access pathways. • Maps of abandonment bund locations and restriction areas. • Heritage and ethnographic survey report. • Consultation register. • Visual impact assessment report.
Public health and safety hazards have been managed.	1) Safety and health risks have been identified. 2) Measures to mitigate the identified public safety and human health hazards have been agreed with key stakeholders and have been implemented. 3) Transfer of any residual liabilities is agreed with stakeholders.	• Risk assessment conducted and mitigation actions implemented. • Relevant stakeholders have been engaged on risk mitigation measures to be employed. • Independent audit(s)/review to confirm that hazard mitigation measures have been implemented. • Process for transfer of residual safety liabilities is documented.	• Risk assessment report. • Audit report to confirm effectiveness of controls. • Records of stakeholder engagement. • Liability transfer agreement/s.

Objective	Indicative completion criteria	Verification process/method	Evidence
Contamination risks have been appropriately managed.	1) Requirements under the Contaminated Sites Act 2003 (WA) have been met for the identification, recording, management, remediation and transfer of any contaminated sites as appropriate.	• The site has been appropriately assessed for the presence of suspected or known contaminated sites. • Suspected or known contaminated sites have been appropriately reported under the Contaminated Sites Act 2003. • Appropriate management measures to address contamination have been implemented. • Process for transfer of residual liabilities is documented.	• Contaminated sites investigation report/s. • Reports submitted to the Department of Water and Environmental Regulation (if required). • Liability transfer agreement/s (if required).
Final landform[8] is stable and considers hydrological factors.	1) Final landforms have been rehabilitated to design specifications derived from local climatic conditions and physical characterisation of the mineral waste types within them. 2) There are no erosion features present that compromise landform integrity, and if present, erosion features are stable. 3) The final landform was designed and constructed with consideration given to its stability during intense rainfall and large flood events. 4) Final landforms are outside predicted zones of instability of pits.	• Rehabilitation monitoring program including quantitative evaluation of behaviour of rills and gullies (if required) over time. • Analysis of aerial imagery to provide qualitative analysis of landform stability. • Post-closure landform review to confirm that risks have been appropriately managed. • Mineral waste physical characterisation.	• Rehabilitation monitoring results. • Post closure landform evaluation report. • Survey data assessment. • Characterisation data and batter selector tool.

[8] 'Landform' includes all post mining constructed features: waste dumps, waste fines storage facilities, abandonment bunds and pits.

Objective	Indicative completion criteria	Verification process/method	Evidence
Vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use.	1) Seed used in rehabilitation works is of local provenance[9]. 2) Native plants within rehabilitated areas are observed to flower and/or fruit. 3) Recruitment of native perennial plants is observed. 4) Species richness[10] of native perennial plants within rehabilitated areas is not less than reference sites. 5) Any weed species recorded within rehabilitation areas are present within the local area.	• Seed management procedures. • Rehabilitation monitoring/site inspections. • Analysis of historical monitoring data.	• Rehabilitation seed list. • Seed database. • Rehabilitation monitoring reports.
Infrastructure has been appropriately managed.	1) Legal agreement to transfer residual liability completed (if required). 2) Where transfer of liability is not established, infrastructure has been decommissioned and removed.	• Appropriate agreements and transfer processes in place and communicated for any infrastructure remaining post closure. • Decommissioning	• Agreements in place with party assuming liability for infrastructure. • Close out report. • Visual inspection.

[9] Note: Some seed used in rehabilitation predates accurate recording of collection area. Note 2: Local for Eastern Range based on the NVCP conditions is defined as from within a 200 km radius within the same IBRA subregion of the area cleared.

[10] Richness is defined as the number of different species in the defined area.

COLLECTION AND ANALYSIS OF CLOSURE DATA

The closure knowledge base (Appendix C) is a collection of baseline studies, models and interpretations, which are used to inform the closure planning process presented in this closure plan. The knowledge may be specific to the site or generally applicable to the Pilbara region and includes information on the performance of closure-related trials completed at other Pilbara mining operations (when appropriate). A summary from these reports is included in this section and the relevant reports will be included in the final Eastern Range closure plan.

10. Climate

Climate, particularly rainfall, rainfall intensity, cyclone frequency and evaporation influence closure planning aspects such as landform design and revegetation success.

The climate associated with Eastern Range is arid to semi-arid, with highly variable annual rainfall totals ranging from 190mm to 650mm, with a mean of 325mm. The closest official Bureau of Meteorology weather recording station is at Paraburdoo Airport (station 007185) which has recorded various climatic information since 1974. In addition to the BOM weather station, Rio Tinto maintains automatic weather stations at both Paraburdoo and Channar.

10.1 Climate and significant weather events

The climate in the area can be characterised as arid tropical with two distinct seasons, hot wet summers and cooler dry winters. Mean daily maxima temperatures range from 40°C in summer to 24°C in winter (Figure 8).

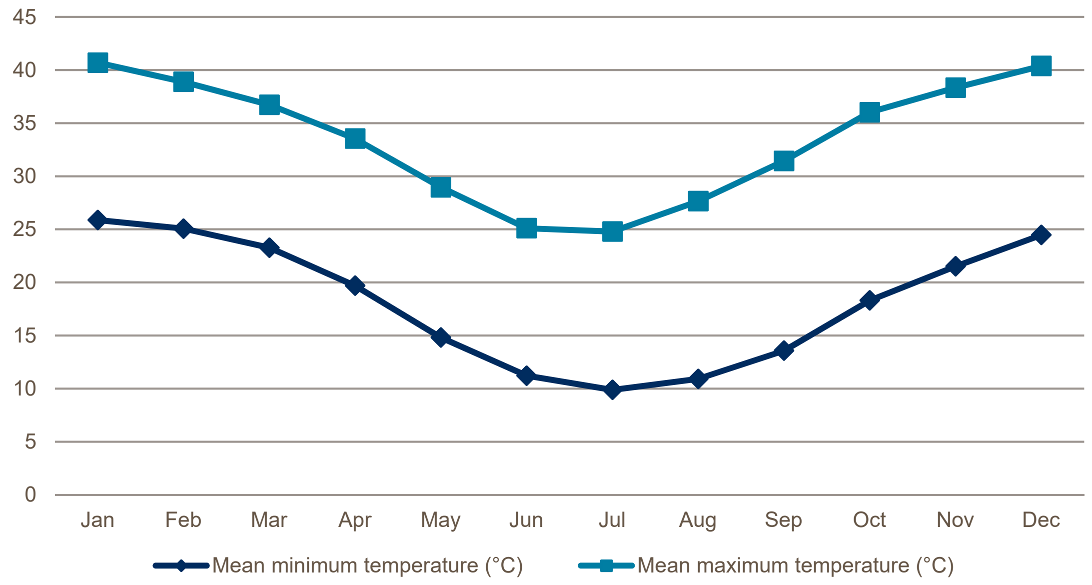

Figure 8: Mean monthly temperatures (degrees Celsius), Paraburdoo Airport 1996-2016[11]

Tropical cyclones are a feature of the region, typically being observed during the late summer between January and March. On average, five tropical cyclones are expected off the coast of the Pilbara each year, with two expected to make landfall. Precipitation is driven by summer cyclonic activity, with the months of January, February and March having the highest average rainfall (Figure 9). Annual rainfall is also highly variable, as evidenced by historical data from 1974 to 2016 (Figure 10).

[11] Bureau of Meteorology, Paraburdoo Airport dataset, Accessed: 08 September 2016.

Evaporation rates in the region greatly exceed rainfall. Annual average potential evaporation rates estimated from the available data at the three nearby weather stations, is 1835mm/yr, which is typical for the Pilbara region.

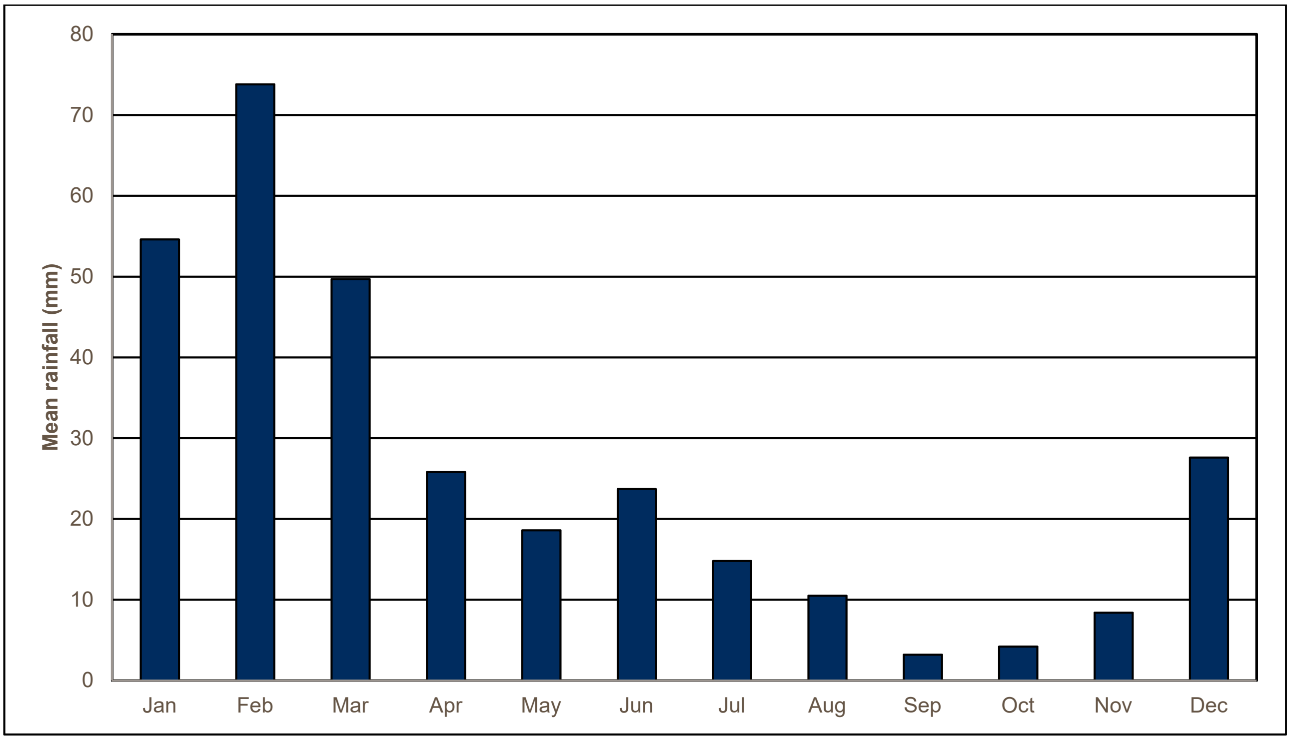

Figure 9: Mean monthly rainfall, Paraburdoo Airport 1974 – 2016.

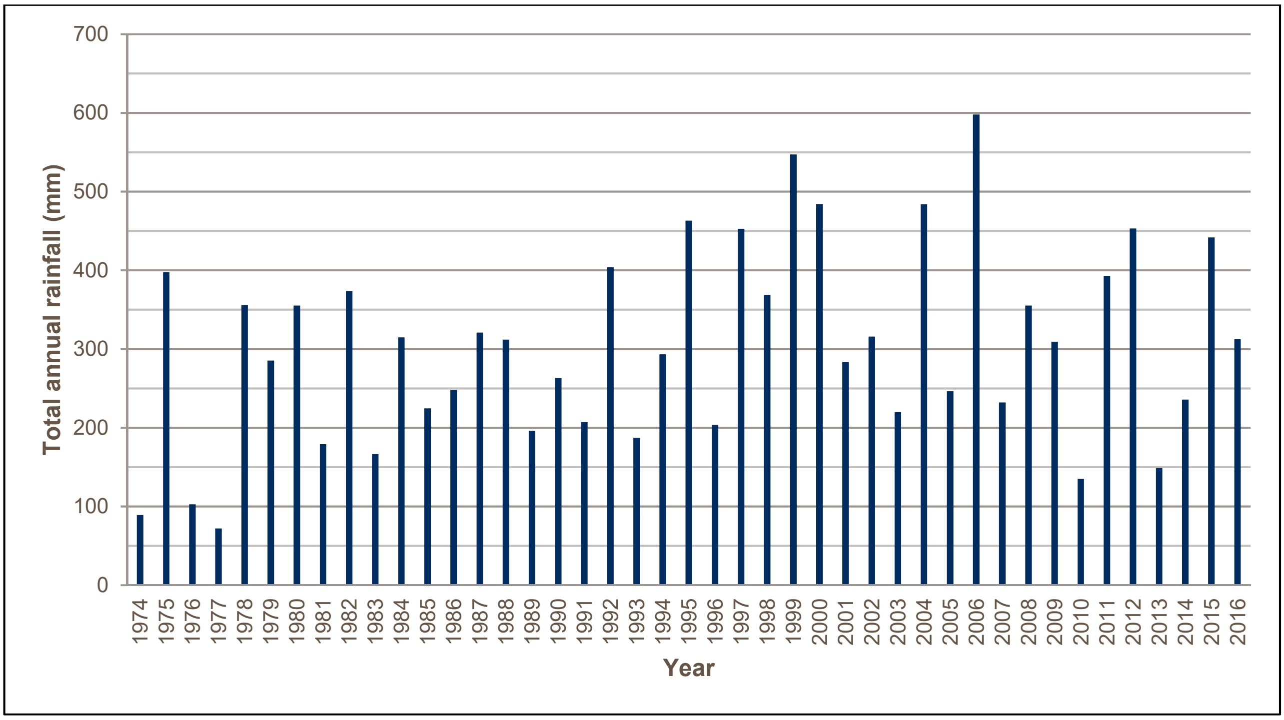

Figure 10: Historical annual rainfall (1974-2016) at Paraburdoo airport.

10.2 Climate and landform stability

The intense but periodic rainfall experienced in the Pilbara makes rainfall the key climatic factor that influences surface stability. Rainfall erosivity (measured in megajoule millimetre per hectare per hour per year - MJ.mm/ha/hr/yr) is the term used to describe the erosive force of rain. For Pilbara sites, long-term annual erosivity values range from ~1,000-1,600 MJ.mm/ha/hr/yr. Rainfall in the Pilbara is typically more erosive than Perth's rainfall, even though it only receives on average half the rainfall that Perth receives on an annual basis. For comparison, average annual erosivity values for Perth are ~1000 MJ.mm/ha/hr/yr from an average of 780 mm of rain a year.

Rainfall erosivity is highly variable for each rainfall event as demonstrated in studies of Pilbara rainfall and erosivity. For example at Tom Price, erosivity for the period 1998 to 2009 ranged from 212 – 6,349 MJ.mm/ha/hr/yr. The most erosive year recorded to date was in 2007 at Channar, where 421mm fell during February (704mm fell over the whole year). This singular rain period embodied 11,994 MJ.mm/ha/hr/yr of erosive force, or 89 per cent of the entire erosivity of rain for that year. Given the pattern of intense and infrequent rainfall events in the Pilbara, it can be expected that only a few events every year (~1-3 events) will generate the majority of runoff and erosion of that occurs each year.

The studies showed a rapid decline in erosion or sediment yield occurs when annual rain decreases below about 300mm per year. However, when annual rainfall increases above 300mm, vegetation growth increases and is increasingly effective in controlling soil erosion. Hence, there is a point of maximum erosion potential at an annual rainfall value of ~200-400 mm such that surface cover (vegetation) is low due to lack of rain and ineffective for controlling erosion, yet rainfall erosivity is sufficiently high to cause erosion, as observed in the Pilbara. Outcomes from these studies have informed development of Rio Tinto's Iron Ore (WA) Landform Design Guidelines for achieving stable waste dumps.

10.3 Climate and vegetation growth

Water is generally the limiting factor for plant growth in the Pilbara's arid environment. As a consequence of the hot temperatures, high evaporative demand and infrequent and irregular rainfall, much of the vegetation displays xeromorphic adaptations. These adaptations include the ability to regulate water loss from leaves, extract water from very dry soils and matching of reproductive strategies with wetter periods. Many species are ephemeral and persist in soil seed banks in between wetter periods.

The adaptive capacity of Pilbara species implies a degree of resilience to changes in hydrological regimes. However, the impacts to Pilbara vegetation as a consequence of climate change are not clear. Changes in vegetation density and water use will alter the amount of runoff that occurs after a rainfall event, which in turn will alter creek flows and groundwater recharge.

10.4 Climate change

The understanding of how climate will change in the future in the Pilbara is guided by the outcomes of climate modelling commissioned by Rio Tinto and various Australian government agencies. The main climate drivers for the Pilbara are the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) ocean currents. However the impact of climate change, the change in water availability and influence on ecosystems in the Pilbara is still unclear. From the modelling completed to date, it is understood that the region will experience the following climate trends:

- a shift in the historical tropical cyclone season, with an earlier start and potentially later finish;
- a decrease in the number of tropical cyclones, however they are likely to become more intense and reach further south;
- continuation of the highly variable multi-decadal scale rainfall trends;
- projected annual rainfall reductions range from 1 to 24 percent by mid-century, and 9 to 24 percent by the end of the century;

- a significant warming trend, influencing maximum temperatures, with the largest changes during the January to March period; and
- on average, maximum temperatures are expected to increase by 2.1 to 3.2˚C by mid-century and by a total range of 3.8 to 4.6˚C by the end of the century. For minimum temperatures the corresponding averaged increases are 1.9 to 2.4˚C (mid-century) and 4.1 to 4.6˚C by the end of this century.

If realised as modelled, these changes are likely to make successful rehabilitation in the Pilbara more challenging. Current landform designs are undertaken with inbuilt conservancy which allows for increased erosion factors; however reduced average rainfall will impact the ability to establish vegetation cover.

11. Land

11.1 Biogeographic overview

Eastern Range lies within the Pilbara Craton, a bioregion defined by the Interim Biogeographic Regionalisation for Australia (IBRA). The Pilbara bioregion is divided into four subregions: Chichester, Fortescue Plains, Hamersley and Roebourne Plains. The Eastern Range area is located in the Hamersley subregion which is described as a "mountainous area of Proterozoic sedimentary ranges and plateaus, dissected by gorges with low Mulga (Acacia aneura) woodland over bunch grasses on fine textured soils in valley floors, and Snappy Gum (Eucalyptus leucophloia) over Triodia brizoides on the skeletal sandy soils of the ranges".

The area surrounding Eastern Range is categorised as Hamersley Ranges which is described as very undulating, rugged ranges and rounded hills, hummock grasslands and scattered trees, dissected by intermittent watercourses with high peaks and gorges being significant features. The landform consists of steep hills and a roughly east-west trending range with elevations ranging from approximately 400m Australian Height Datum (AHD) to approximately 880m AHD.

11.2 Geological setting

The Eastern Range deposits are situated on elevated topography and are AWT, with most Brockman Formation iron ore located less than 100 metres from the surface. The deposits are structurally complex, being cut by numerous faults, some of which have been intruded by dolerites. Local small scale folding is common within large-scale gentle folding. Structurally, the Eastern Range deposits are located on the south-dipping southern limb of the Bellary Dome.

The deposit comprises four sub-deposits: 23 - 24 East, 32 East and 37- 42 East and proposed future mining at 47E deposit. Apart from 23 - 24 East, which has a low to moderate phosphorous microplaty hematite-martite mineralisation, the Eastern Range deposits generally consist of moderate to high phosphorous Brockman type martite-goethite mineralisation.

11.3 Mineral waste characteristics and inventory

Developing a comprehensive understanding of the types and volumes of materials that will remain at the completion of mining at Eastern Range is critical for the effective design, construction and rehabilitation of the mining landforms. Rio Tinto has a well-developed process for the collection and analysis of this information from early exploration works and continues through the life of the mine. Long term material behaviour can also be predicted through characterisation of representative waste types and correlation to similar waste materials present at other sites.

An overview of 23E, 32E and 42E deposit geology is shown in Figure 11 to Figure 14. The mineral waste generated at Eastern Range is categorised with respect to the geological origins of the material, namely:

- Dolerite (high erodibility);
- Joffre Member (low erodibility);

- Whaleback Shale (medium erodibility)
- Dales Gorge (low erodibility);
- Hydrated Zone (low erodibility);
- Footwall Zone (low erodibility);
- Mt McRae Shale (medium erodibility); and
- Mt Sylvia Formation (to be confirmed).

Physical characteristics of mineral waste material at a deposit level is summarised in Table 9 to Table 13. Materials are assessed and classified into one of three levels of erodibility – low, medium or high. The majority of waste at Eastern Range is classified as low erodibility. Potential waste types at Eastern Range have been assessed using a combination of site-specific geophysical test work and extrapolation of block model data with equivalent material at similar sites. This information is used to inform the landform design and management strategies during operations and closure, as documented in Rio Tinto's Iron Ore (WA) Landform Design Guidelines that specify appropriate design parameters to achieve stable waste dumps for various material types. The information presented is based on current best available data and further investigation is required in the PFS to confirm landform characterisation. Volumes of waste types are based on current mining models and will be subject to change as mine models are updated.

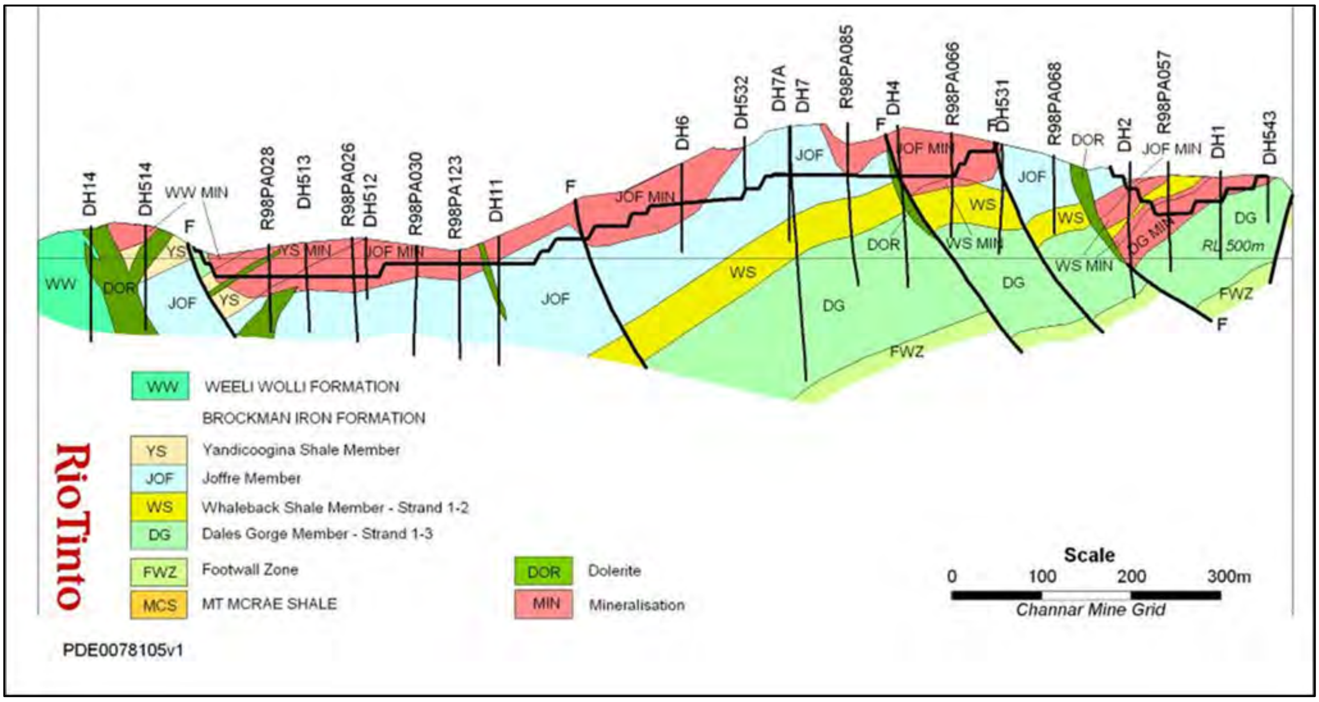

Figure 11: Typical geological cross section from 23E deposit showing mineralisation in pink (looking west)

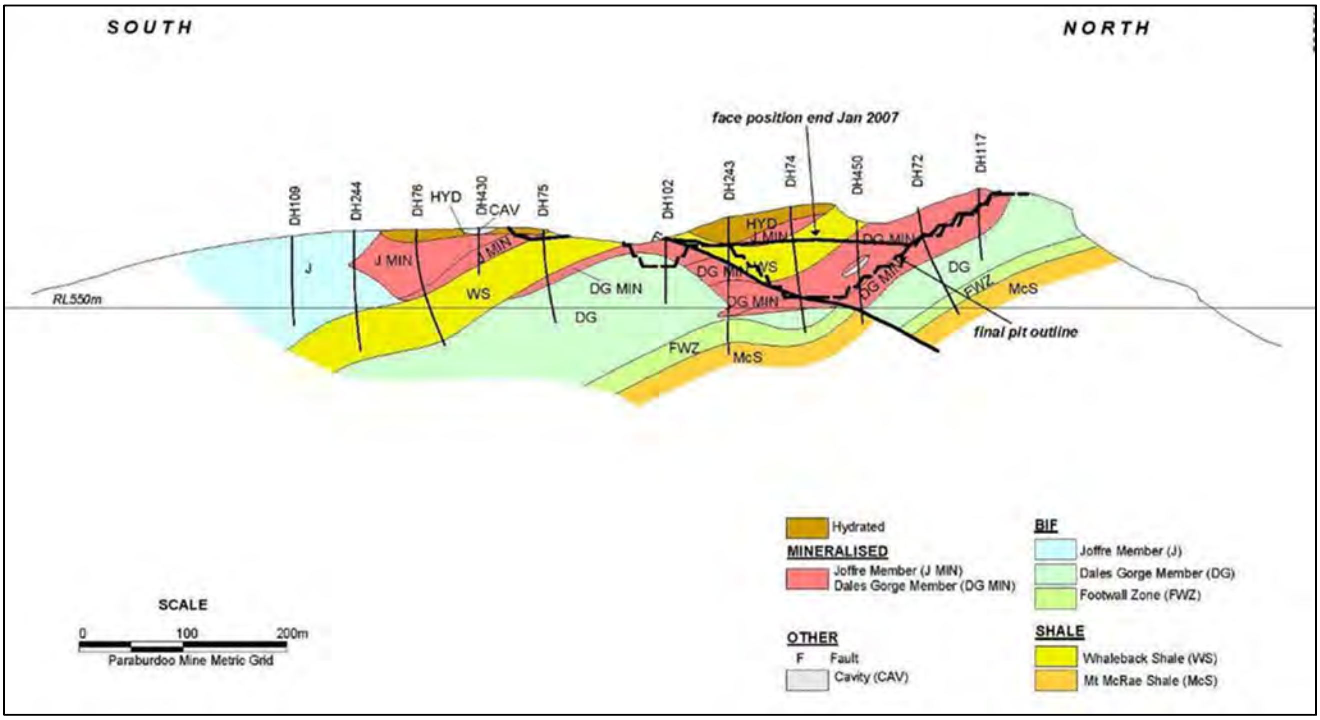

Figure 12: Typical geological cross section from 32E deposit showing mineralisation in pink (looking west)

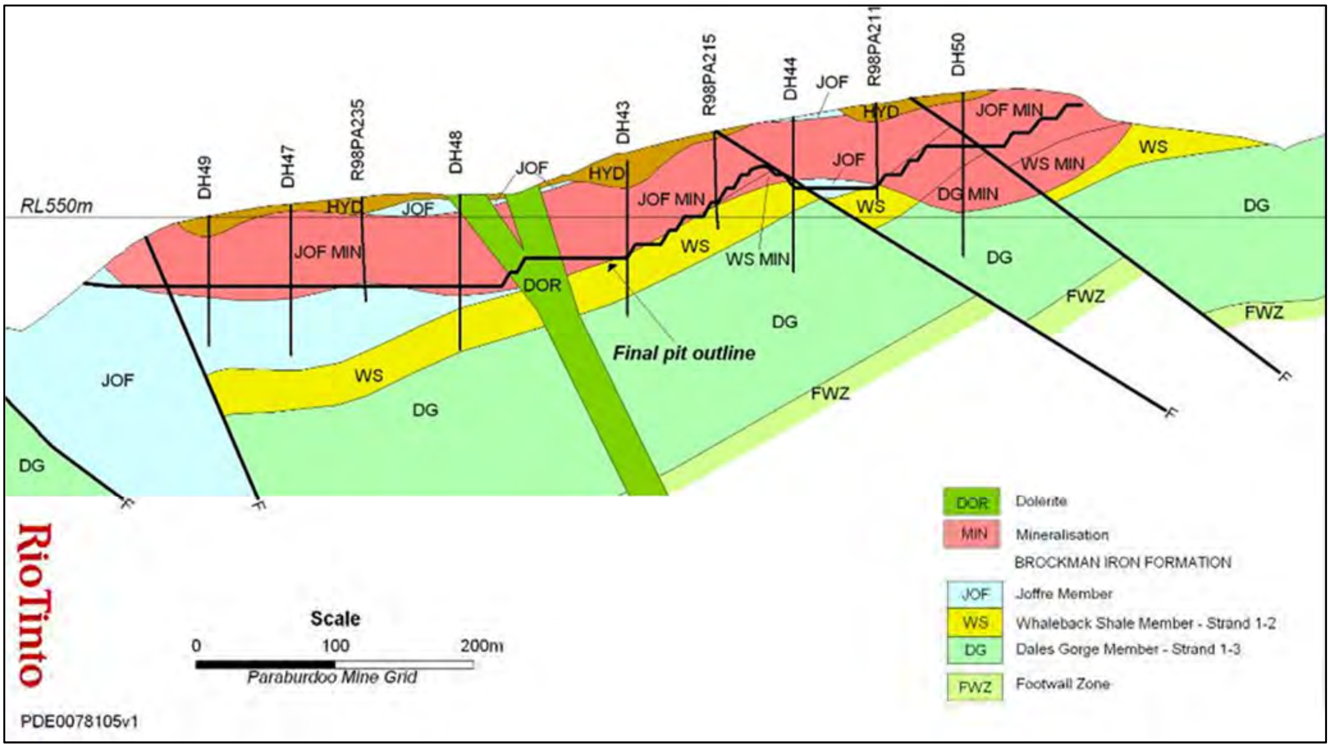

Figure 13: Typical geological cross section from 42E deposit showing mineralisation in pink (looking west)

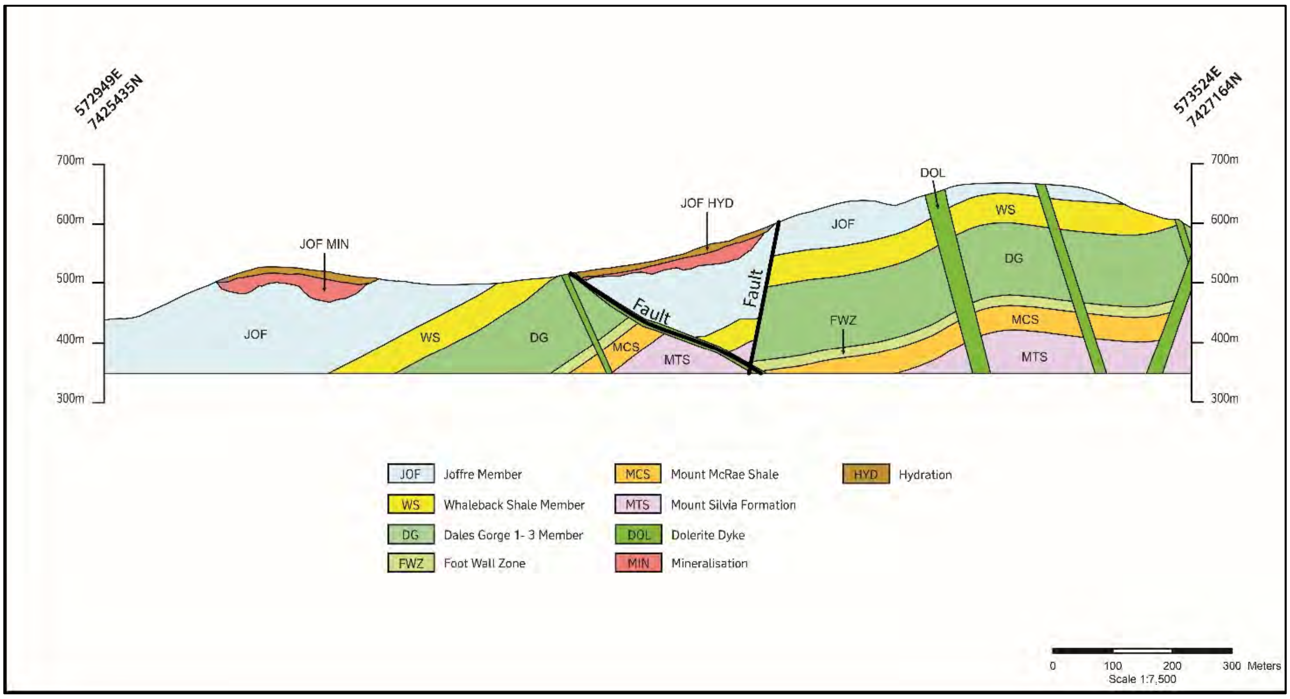

Figure 14: Typical geological cross section from 47E deposit showing mineralisation in pink (looking west)

Table 7: Materials summary of waste at 23E and 24E

Material	**Yet to be mined (prior to end of mine life)**		**Total material (block model based)**	
	Volume (m^3)	**Tonnes**	**Volume (m^3)**	**Tonnes**
Material with potential AMD risk (PAF)	N/A	N/A	N/A	N/A
Material with fibre risks	N/A	N/A	N/A	N/A
Inert mineral waste - low erodibility	7,019,568	17,759,508	35,068,946	88,724,433
Inert mineral waste- medium erodibility	1,577	3,990	4,553,612	11,520,638
Inert mineral waste - high erodibility	1,550,149	3,921,878	6,865,174	17,368,889
Total waste material expected	8,571,295	21,685,376	46,487,731	117,613,960

Table 8: Materials summary of waste at 32E

Material	Yet to be mined (prior to end of mine life)		Total material (block model based)	
	Volume (m^3)	Tonnes	Volume (m^3)	Tonnes
Material with potential AMD risk (PAF)	N/A	N/A	N/A	N/A
Material with fibre risks	N/A	N/A	N/A	N/A
Inert mineral waste - low erodibility	19,950,690	50,475,246	24,714,159	62,526,823
Inert mineral waste- medium erodibility	3,912,094	9,897,597	10,922,274	27,633,354
Inert mineral waste - high erodibility	0	-	0	-
Total waste material expected	23,862,784	60,372,843	35,636,434	90,160,177

Table 9: Materials summary of waste at 37E

Material	Yet to be mined (prior to end of mine life)		Total material (block model based)	
	Volume (m^3)	Tonnes	Volume (m^3)	Tonnes
Material with potential AMD risk (PAF)	N/A	N/A	N/A	N/A
Material with fibre risks	N/A	N/A	N/A	N/A
Inert mineral waste - low erodibility	15,445,890	39,078,103	39,999,107	101,197,740
Inert mineral waste- medium erodibility	452,512	1,144,856	7,617,141	19,271,368
Inert mineral waste - high erodibility	1,129,144	2,856,734	3,184,132	8,055,855
Total waste material expected	17,027,547	43,079,693	50,800,381	128,524,963

Table 10: Materials summary of waste at 42E

Material	Yet to be mined (prior to end of mine life)		Total material (block model based)		42EE only total material (subject to approvals)	
	Volume	Tonnes	Volume	Tonnes	Volume	Tonnes
Material with potential AMD risk (PAF)	N/A	N/A	N/A	N/A		
Material with fibre risks	N/A	N/A	N/A	N/A		
Inert mineral waste - low erodibility	792,955	2,040,102	3,123,758	6,539,969	1,015,508	2,305,760
Inert mineral waste- medium erodibility	-	-	344,250	805,673		-
Inert mineral waste - high erodibility	-	-	359,347	820,236	8,347	15,107
Total waste material expected	792,955	2,040,102	3,827,355	8,165,878	1,023,855	2,320,867

Table 11: Materials summary of waste at 47E (subject to approvals)

Material	Yet to be mined, subject to approvals (prior to end of mine		Total material (block model based)[12]	
	Volume (m^3)	Tonnes	Volume (m^3)	Tonnes
Material with potential AMD risk (PAF)	N/A	N/A	N/A	N/A
Material with fibre risks	N/A	N/A	N/A	N/A
Inert mineral waste - low erodibility	1,153,477	2,997,193	1,153,477	2,997,193
Inert mineral waste- medium erodibility	-	-	-	-
Inert mineral waste - high erodibility	-	-	-	-
Total waste material expected	1,153,477	2,997,193	1,153,477	2,997,193

11.4 Geochemical characterisation

Rio Tinto has undertaken an extensive program of geochemical testing over several years to understand the potential for acid and/or metalliferous drainage (AMD) to occur as a result of exposing various waste rock types common to mining operations in the Pilbara. The geochemical characterisation process aims to assess sulfur content as an indicator of acid generation potential, and to undertake static (acid base accounting

[12] Yet to be mined and total are the same as 47E is a future deposit.

[ABA]) and, if appropriate, kinetic testing of materials. This information is applied to the geological block model and subsequent mining model, to ensure materials posing potential geochemical risks are identified prior to mining and managed appropriately. This work is in accordance with the Rio Tinto Iron Ore (WA) Mineral Waste Management Plan for Undeveloped Resources and Studies and the Rio Tinto Iron Ore (WA) Spontaneous Combustion and Acid Rock Drainage (SCARD) Management Plan.

The most significant geochemical risk in Pilbara iron ore deposits is associated with sulfides, such as pyrite (FeS2), which can form sulfuric acid when exposed to oxygen and water. Black Mount McRae Shale (MCS) is the rock type most commonly associated with AMD in the Pilbara, however pyrite can also occur within other stratigraphies, including black shale in the Mount Sylvia Formation (MTS) as well as in the Wittenoom Formation (WF). Sulfate minerals such as alunite and jarosite can also pose a geochemical risk, albeit the risk of this elevated-sulfur material is lower due to self-limiting chemical processes.

The measured acid neutralising capacity (ANC) of material, along with the maximum potential acidity (MPA) of that material (which is calculated from measured total sulfur content and the likely sulfur forms present), can be used to calculate the ANC/MPA ratio; this ratio is frequently used as a means of assessing the risk of acid generation from mine waste materials. This ratio is also known as the Neutralisation Potential Ratio (NPR). In general, an ANC/MPA ratio (or NPR) of 2 or more signifies there is a high probability that the material will remain circum-neutral in pH. The use of total sulfur to estimate the MPA is a conservative approach which assumes measured sulfur content occurs as pyrite (rather than the sulfate minerals such as alunite and jarosite).

Black shale is not expected to be exposed during mining based on the current pit shells at Eastern Range. It does underlie the orebody in the 32E6 pit, however the pit has been redesigned to avoid intersection. The data in Table 12 is compiled from a subset of MCS, MTS and WF samples from the Greater Paraburdoo area, where there has typically been a bias toward elevated-sulfur samples; the ANC/MPA ratios represent the samples tested, where the average sulfur value is notably higher than what may be expected to present during mining (i.e. for oxidised MCS and MTS).

Static ABA tests have been completed on a total of 302 samples from the Greater Paraburdoo area (including Western Range, Paraburdoo, Channar and Eastern Range), while short-term liquid extract tests have been completed on 306 samples (Table 13). In addition, comprehensive kinetic tests have been undertaken on analogous material deemed to pose a significant geochemical risk. Based on ABA test work, a value of 0.1% total sulfur concentration has been adopted as the boundary value to denote potentially acid forming (PAF) material from inert/non-acid forming (NAF) material.

Table 12: Summary of static ABA testing for Greater Paraburdoo area rock types associated with black shale

			Median			Average		
Rock type	**Number of ABA samples[1]**	**Likely sulfur forms**	**S (%) content of all ABA samples**	**ANC (kgH_2SO_4/t) of all ABA samples**	**NPR[2]**	**S (%) content of all ABA samples**	**ANC (kgH_2SO_4/t) of all ABA samples**	**NPR**
MCS (ox)	47	Sulfates	0.01	2.6	5.3	0.44	12.3	83
MCS (cold and hot BS)	111	Sulfates and Sulfides	0.47	5.0	0.3	2.50	16.1	7
MTS (ox)	6	Sulfates	0.01	4.5	21	0.17	4.2	23
MTS (cold BS)	15	Sulfates and Sulfides	0.45	11.2	1	1.24	67.4	10
WF (cold BS)	8	Sulfates and Sulfides	0.05	21.0	16	0.38	18.5	17

[1] Samples which have been tested for acid neutralising capacity (ANC) are considered “ABA samples”.
[2] Neutralisation Potential Ratio (NPR) median/average value is calculated from individual ABA samples within indicated rock type.

Table 13: Summary of static ABA and short-term liquid extract tests completed on Greater Paraburdoo area samples

Waste material type	Number of samples with ABA data	Number of samples that have liquid extract data
Tailings	19	7
Detritals (CAL)*	7	0
Detritals (DET)*	0	7
Dolerite (DOR)	22	21
Weeli Wolli Formation (WW)	10	16
Yandicoogina Shale Member (YS)	4	11
Joffre Member (JOF)	11	38
Whaleback Shale Member (WS)	7	22
Dales Gorge Member (DG)	12	45
Footwall Zone (FWZ)	12	11
MCS (oxidised)	48	38
MCS (black)	111	29
MTS (oxidised)	6	7
MTS (black)	15	7
Wittenoom Formation (WF)*	11	9
West Angelas Member (ANG)*	0	1
Marra Mamba Iron Formation (MM)*	2	32
Fortescue Group (FOR)*	5	5
Total	**302**	**306**
Note: * Waste types not present at Eastern Range deposits. Geochemical testing complete for all Greater Paraburdoo operations waste types and therefore have been included in table.		

The presence of elevated-sulfur material is indicated by drillhole data within the Eastern Range Project area. Elevated-sulfur material refers to material that is not sulfidic, but has a sulfur content greater than 0.1% and may contain the potentially acid forming sulfate mineral alunite. The assessment of this material is inherently conservative because of the assumption that all sulfur is present as alunite ($KAl_3(SO_4)_2(OH)_6$), where sulfur is likely also derived from other non-acid forming minerals such as gypsum ($CaSO_4$). The acidity potential of elevated-sulfur waste rock expected to be mined from Eastern Range was found to be negligible compared to the neutralising capacity of co-disposed waste rock.

On-going geochemical test work is required to validate this assessment; further test work will be completed during operations as per the Iron Ore (WA) Mineral Waste Management Plan and the Iron Ore (WA) Spontaneous Combustion and ARD (SCARD) Management Plan for Operations, respectively. The aim of this test work is to assess the potential for neutral mine drainage, and also to confirm that potential low levels of acid release from elevated-sulfur waste rock will be effectively buffered by the inherent neutralising capacity of the expected surrounding inert waste rock.

An update to the Eastern Range AMD risk assessment was undertaken in 2018, with a focus on 32E, 42EE and 47E areas. Based on all Eastern Range drillhole samples assayed for sulfur (98,900), approximately 2% have sulfur content greater than 0.1%. When the proposed final pit shells are considered, 2% of all in-pit samples have sulfur content greater than 0.1% (less than 0.5% have sulfur content greater than 0.3%).
In general, mining within the current pit shell designs at Eastern Range is considered low risk in terms of developing AMD. A summary of the waste drillhole sample analysis competed for the site is provided in Table 14, which takes into account an assessment of the calculated ANC/MPA ratios based on waste material drillhole samples located within the current pit shell designs.

In the November 2016 LoM, a cumulative total of 9,000m^3 of PAF material (black MCS) was expected to be removed from the approved pits in 32E, all coming from the 32E6 pit and designated for encapsulation in the 32E3 pit. This was reported in the previous 2016 closure plan for the site. Investigations during 2017-2018 indicated that it is possible to redesign this pit to avoid intercepting PAF material and therefore negate the requirement for management of PAF material at the site. The pit redesign will be reflected in future iterations of the LoM and the 2018 AMD risk assessment reflects this change.

Table 14: AMD risk ratings – summary of waste drill hole samples from Eastern Range deposits.

		Total area waste samples		In-pit samples		
Mining area	**Approx. number of samples assayed for S**	**% with S>0.1%**	**% with S>0.3%**	**% with S>0.1%**	**% with S>0.3%**	**Geochemical risk**
23E and 24E	14,400	2%	1%	2%	1%	Low
32E	5,600	2%	1%	6%	0.5%	Low
37E and 42E	16,500	5%	3%	2%	0.5%	Low
42EE and 47E	1,800	3%	1%	2%	0%	Low

More than 98,900 drillhole samples from Eastern Range have been analysed for the major chemical element suite of Al, Ca, Fe, K, Mg, Mn, Na, P, S and Ti, as well as As, Ba, Co, Cr, Cu, Mo, Ni, Pb, Sn, Sr, V, Zn and Zr. The extent of enrichment of a sample can be reported as the Global Abundance Index (GAI), which relates the actual concentration with average crustal abundance. A GAI value of zero indicates the element is present at a concentration similar to, or less than, the average crustal abundance, and a GAI value of 6 indicates approximately a 100-fold enrichment above the average crustal abundance. The main purpose of the GAI is to provide an indication of elemental enrichment that may be of environmental importance. As a general rule, a GAI of 3 or greater signifies enrichment that warrants further examination, while a GAI of 1 or 2 indicates the element may be elevated. The average concentrations from drillhole samples were also contrasted with Ecological Investigation Levels (EILs) and Health Investigation Levels (HILs) provided in the Contaminated Sites Management Series Assessment Levels for Soil, Sediment and Water as well as US EPA Ecological Soil Screening Levels (Eco-SSLs).

As part of the supplemental ABA test work, select samples from Greater Paraburdoo have also been analysed for Ag, B, Be, Cd, F, Hg, Mo, N, Sb, Se, Th and U, while liquid extracts have been analysed for the following parameters: pH, electrical conductivity (EC), Ag, Al, As, B, Ba, Ca, Cd, Cl, Co, Cr, Cu, F, Fe, HCO3, Hg, K, Mg, Mn, Mo, Na, Ni, NO3, Pb, Sb, Se, SO4, U and Zn.

The following elements have been identified as being enriched or commonly elevated in Eastern Range rock types: As, Cl, Fe, Co, Cr, Cu, Mn, Ni, Pb, S, Sb, Se, Sn, V and Zn. Leach testing on low-sulfur drillhole samples generally resulted in leachates with most trace elements (including nitrate) measured at concentrations that were close to or below the limits of detection.

11.5 Fibrous minerals

Rio Tinto's Fibrous Minerals Management Plan provides guidance for the management of fibrous minerals encountered during mine production. Fibrous minerals present a health hazard if they are of a respirable size (approximately 6 microns) and become airborne and inhaled. Based on current knowledge naturally occurring fibrous minerals have not been encountered to date and are not predicted to be exposed at Eastern Range.

11.6 Geotechnical stability of pit walls

Rio Tinto plans to backfill some pit voids to varying levels via in-pit dumping of mineral waste material at Eastern Range; however open voids will still remain after closure. These will not be reshaped or rehabilitated and the remaining pit walls will be retained in the same configuration as when mining ceases. It is recognised that there will be some degree of geotechnical instability, and that walls will have the potential to collapse in some areas, thereby posing a risk to personnel accessing the post closure landscape such as for post closure monitoring. Geotechnical stability is influenced by:

- hydrogeological changes;
- weathering and slaking of certain soft rocks;
- debris flows;
- filling in of benches (catch capacity);
- surface drainage (ditches) and surface water controls;
- stress relief or relaxation;
- seismicity; and
- shear strength changes of pit wall materials (including intact materials, fractures and structures).

Preliminary zones of geotechnical instability also referred to as potentially unstable pit edge zones have been identified around the pits within the scope of this closure plan, as detailed in Section 19.4. Further geotechnical evaluation will be undertaken in PFS and may result in a reduction of the current polygons identified.

As well as pit voids, another factor relevant to geotechnical stability is the historic positioning of winzes, which are vertical or horizontal shafts used for bulk sampling purposes. These pose a collapse risk if intercepted. Two of these features are present at Eastern Range as shown in Figure 15 and will be considered in mine planning design and closure monitoring programs.

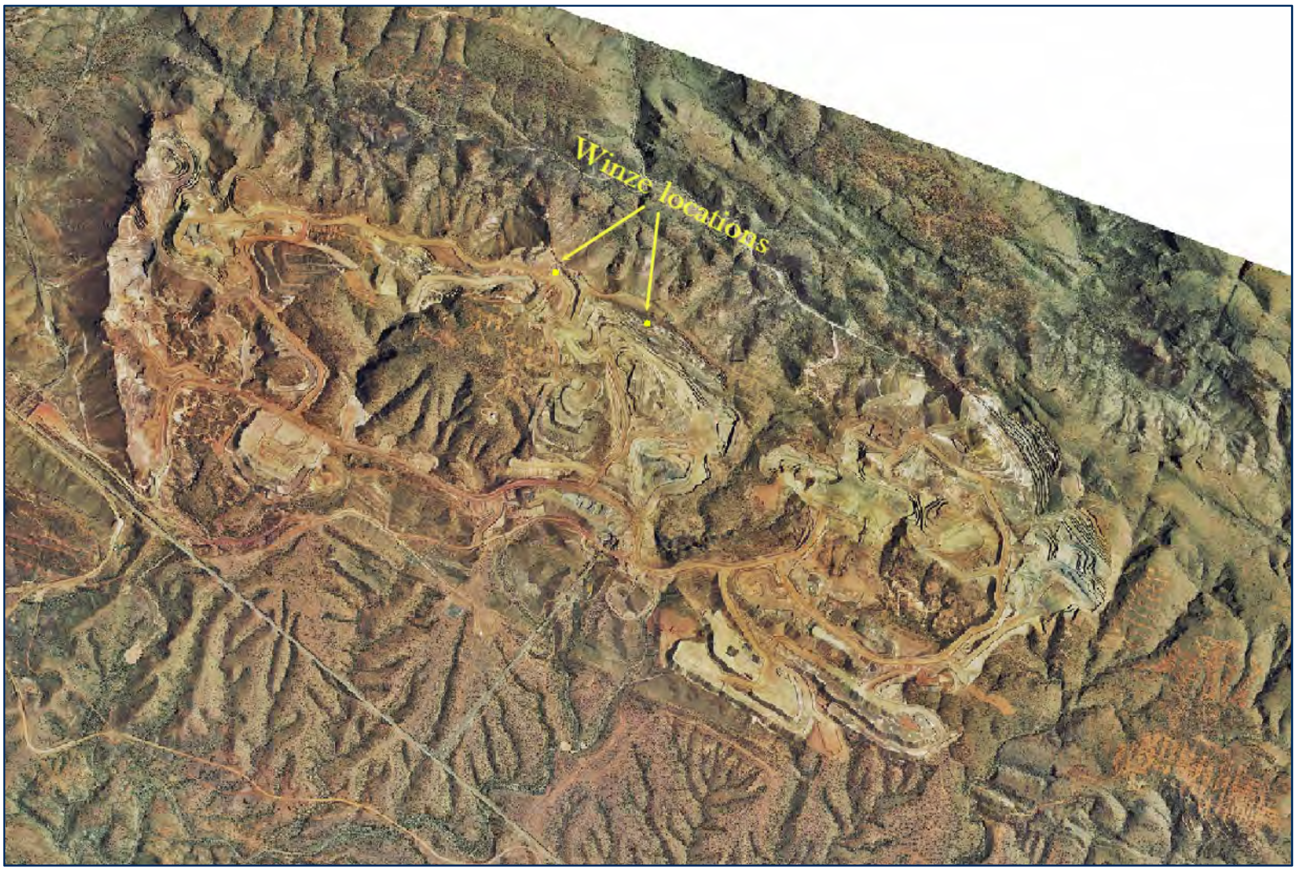

Figure 15: Winze locations at Eastern Range

11.7 Local soils

Application of topsoil is recognised as an important factor in achieving high quality rehabilitation results. Characterisation of soils provides an indication of soil properties and their potential impacts on vegetation establishment, growth and landform stability; although it is important to recognise that soil physical properties are expected to be altered as a result of mining processes. Appropriate characterisation can also help ensure soils with adverse properties are avoided in landform design.

Testing of Eastern Range soils was undertaken in 2017[13]. Two samples were collected from each of the five reference sites[14] established during that year; one at 0-5cm depth and one at 10-20cm depth. The physical and chemical properties of these soil samples are provided in Table 15. The soils at Eastern Range are dominated by sands and are classified as loamy sands or sandy loams. Soil pH ranged from alkaline to moderately acidic, non-saline and non-sodic. Both organic carbon and nutrient levels vary according to landscape position: they are typically very low in the higher portions of the landscape that account for most of the disturbance footprint, but are present in higher levels in low-lying areas and drainage lines as erosive processes deposit these nutrients to low lying areas.

Subsoil has physical properties suitable for plant growth and generally has chemical properties amenable to plant growth, although it does lack the nutrient content, organic matter and soil seed bank of topsoil.

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[13] Eastern Range specific testing was requested by the Department of Mines, Industry Regulation and Safety in their review of the 2016 Eastern Range Closure Plan.

[14] Eastern Range 2017 reference sites include 5 hill locations and 1 plains location.

Table 15: Comparison between local soils and typical Pilbara soil parameters[15]

Properties		Pilbara soils	Paraburdoo topsoil	Eastern Range topsoil
Physical	Soil texture (<2mm soil fraction)	Sand to clay loam	Loamy sand	Loamy sand to sandy loam
	Coarse material content (%)	0 - 93.0	65.2	4.9 - 26
Chemical	Soil pH	5.3 – 9.5	6.8	4.6 – 9.3
	Salinity (dS/m)	0.007 – 0.233	0.08	0.01 – 0.08
	Organic carbon (%)	0.07 – 3.74	0.37	0.07 – 0.76
	Macro-nutrient status	-	Low	Low
	Micro-nutrient status	-	Low to moderate	Untested
	Effective cation exchange capacity (mq/100g)	1.9 – 16.8	1.16	0.2 - 18
	Exchangeable sodium percentage (%)	0.21 – 6.39	4.31	<0.02 – 0.13

11.8 Soil inventory

The Eastern Range landscape is dominated by hills and rocky ridges, which have extensive areas without soil cover and those soils that do occur are shallow and skeletal. Rocks of this topography weather very slowly, and any soil which does form tends to be transported into the surrounding valleys and plains as a result of the sparse vegetation cover and erosion force of heavy rains derived from thunderstorms and cyclones. The soils on slopes, although having had more time to develop than the soils of the adjacent ridges, are still influenced by the parent rock and may be shallow and stony sands or loams. These soils are generally unfavourable for plant growth due to low moisture holding capacity and poor nutrient status. Subsoil is intended to provide a growth medium when topsoil has been exhausted, although as noted in Section 11.7, it generally lacks the nutrients and organic matter present in topsoil, as well as not containing a seed bank.

Recovery and storage of soil is managed in accordance with the Rio Tinto's Soil Resource Management Work Practice and stockpile area locations are recorded in spatial software, as outlined in Figure 16. Where practical, a minimum of 200mm of topsoil and 600mm of subsoil is collected when new areas are disturbed. The recovery of soils on slopes and ridge lines is impeded at sites like Eastern Range due to the topography which either results in scarce topsoil being present to begin with i.e. less than 200mm or it does not allow safe access for machinery, and so often less topsoil than the prescribed 200mm depth is recoverable in these areas.

The current soil reconciliation at Eastern Range for the life of mine reconciliation which includes planned future disturbance is detailed in Table 16. There is expected to be a shortfall of almost 78 percent; however this reconciliation is based on all areas requiring rehabilitation receiving 200mm of topsoil or subsoil. In recent years rehabilitation undertaken by Rio Tinto has been trialling the application of reduced topsoil volumes i.e. 100mm and also no application of topsoil. Areas such as 84E5 waste dump at the adjacent Channar mine, which received no topsoil, are performing well in terms of growth and structure. In the PFS, a

[15] Note that the typical ranges apply to topsoil and not subsoil.

domain by domain review will be completed to ascertain how soil resources are best utilised in rehabilitation. A hierarchy will guide this process, giving preference to waste dumps and high disturbance areas receiving topsoil and low disturbance areas such as tracks receiving no topsoil or instead receiving subsoil or alternative growth media if available.

Table 16: Life of mine soil reconciliation for Eastern Range[16]

Parameter	Data
Predicted LoM topsoil stockpile volume (m3)	145,817
Predicted LoM subsoil stockpile volumes (m3)	147,376
Total predicted LoM Soil Stockpiled (m3)[17]	293,193
Predicted LoM area minus pit voids (ha)	665
Predicted area to be rehabilitated with soil (ha)[18]	665
Predicted soil volume required for 200mm cover (m3)	1,329,492
Predicted LoM soil deficit (m3)	1,036,299
Predicted LoM soil available as a %	22%
Predicted volume deficit %	78%

Figure 16: Soil storage locations at Eastern Range

[16] The LoM footprint requires confirmation in the PFS.

[17] Remaining LoM recovery has been calculated assuming a 30 percent recovery rate based on current recovery rates due to topography at the site.

[18] This reconciliation assumes all areas will receive soil however this will be reviewed during the PFS.

11.9 Alternative growth media

Since 2010, Rio Tinto has commissioned studies into the use of mine waste materials including subsoil, mineral waste and tailings as alternative rehabilitation growth mediums. The studies reviewed the characteristics of these materials from select Pilbara mining operations to identify material combinations that may be suitable as a topsoil substitute or as a supplement in cases where topsoil available is insufficient for rehabilitation requirements. Alternative growth media has been utilised in recent rehabilitation at other nearby Rio Tinto mines including on the MMW4 waste dump at Tom Price during 2017. In addition to this, rehabilitation of the 84E5 waste dump at Channar in 2011, the MME waste dump at Tom Price during 2018 and the CH94E8 waste dump bottom lift at Channar in 2019 was completed using no topsoil and the Tom Price landfill was completed in 2017 using subsoil. The performance of these landforms over time will help inform the approach taken at Eastern Range.

Assessment of Eastern Range samples (banded iron formation (BIF) waste and hydrated waste) indicated these materials are suitable to moderately suitable as an alternative growth media. Tested materials were within the acceptable range parameters for salinity, sodicity, pH, permeability and coarse fragment content. Moderately suitable materials had acceptable chemical properties but physical properties that may limit plant establishment and growth (fine material susceptible to erosion and high or low permeability impacting on water infiltration and storage).

During 2018, the potential presence of significant additional volumes of material that could be used as alternative growth media was identified across Greater Paraburdoo. Materials at Channar were tested and confirmed their suitability as an alternative growth medium. Similar material was identified at Eastern Range. Further sampling of the material at Eastern Range will occur as this presents in mining and suitable material will be added to subsoil stockpiles and included in future reconciliations.

12. Water

12.1 Surface water

The Eastern Range mine site is situated on the southern edge of the Hamersley Basin along the north-west/south-east trending Paraburdoo Ridge. The majority of Eastern Range is located in the Turee Creek catchment with a small proportion residing in the Seven Mile Creek catchment to the north (Figure 17). The Turee Creek sub catchment is 6,910 km^2. The Seven Mile Creek sub-catchment is 2,575 km^2. Mining operations disturb less than 0.5% of these catchments.

The upper headwaters of the Turee Creek originate from two major branches located within Karijini National Park; Turee Creek and Turee Creek East. Turee Creek navigates a 90 degree bend westwards over 25 km at the southern foothills of the Channar Range towards Eastern Range. At the junction of Stony Creek and Turee Creek the channel transitions a 90 degree bend to travel southwards to merge with the Ashburton River some 50 km downstream.

The upper Seven Mile Creek catchment is drained from Tom Price to Paraburdoo by Bellary Creek, where it merges with Tableland Creek immediately downstream of the Paraburdoo Airport. Pirraburdu Creek drains through the western portion of Paraburdoo mine and joins with Seven Mile Creek south west of the mine site. Seven Mile Creek discharges into the Ashburton River at Deolan Pool located 58 km downstream of Paraburdoo mine site.

No significant creek systems or drainage systems are located in the Eastern Range mine area; however, there are several unnamed minor tributaries and minor creeks which flow into the area. Throughout the elevated range numerous incised gullies flow in a southerly direction, with the upper northern portions generally steeper and deeper cut than the southern portions. Regional stream flow is generally east to west;

however, Turee Creek typically flows to the south near Eastern Range. Minor creeks and gullies of note in the local area are detailed in Table 17.

Table 17: Minor creeks associated with Eastern Range

Minor creek	Description
24 East gully	The flow path commences in the north western upper reaches of Eastern Range tenure adjacent to the 23E deposit and flows south combining with the 32 East gully and through the sealed haul road via a bank of culverts, then south westerly and joins Turee Creek approximately 30 km downstream. Python Pool (23EPB1) is located within this gully system (approximately 567076E, 7427545N).
32 East gully	The flow path commences in the north western upper reaches of Eastern Range tenure separating the 23E-24E deposits from the 32E deposits and flows south westerly combining with the 24 East gully and through the sealed haul road via a bank of culverts and joins Turee Creek approximately 30 km downstream.
32-37 East gullies	The flow paths commence mid tenure within the upper reaches and flow in a southerly direction through the sealed haul road via a bank of culverts, then flowing south westerly through significant meanders to combine with the 24 East and 32 East gully flow paths joining Turee Creek approximately 30 km downstream. A series of rock pools (MOC pools) are located within this gully system.
42 East gullies	The flow paths commence north eastern upper reaches of Eastern Range tenure adjacent to the 42 East and 47 East deposits and flow in a southerly direction through the sealed haul road via two banks of culverts, then flowing south easterly towards the confluence of Stony Creek and Turee Creek downstream of Neerambah and Mud(dy) Springs approximately 6 km downstream. A series of rock pools are located within this gully system.
Geode Creek	Geode Creek flows in a south easterly direction to Howie's Hole, passing through a narrow gorge (approximately 20 m wide) before traversing the western perimeter of Channar via numerous braids towards Neerambah, Mud(dy) Springs and Maguire Pool within the "Rights Reserved" heritage region at the Mininer and Turee Station tenure boundary.
Stony Creek	Stony Creek main channel flows parallel and to the West of Geode Creek, through Afghan Springs (Dogger's Gorge Spring), and Dogger's Gorge before joining Geode Creek. Upstream of Neerambah and Mud(dy) Springs this catchment is approximately 81 km^2.

The surface hydrology characteristics in the Greater Paraburdoo region are determined primarily by climatic conditions. All streams in the area are ephemeral and are dry for most of the year, only flowing after significant and intense rainfall events. There are three areas at Eastern Range which host surface water pools of heritage and environmental significance, namely at 24E, 32-37E and 42E (Figure 18). Studies on the pools show that based on depth to groundwater (as shown in the conceptualisation in Figure 19) and chloride and isotope analysis, there is no groundwater flow to these pool systems i.e. they are sustained by incident rainfall and surface water flows from the upper catchment. The pools are described as follows:

- **24E pool (Python Pool)** - Drainage to the pools is from the north. Mining activities have reduced the natural surface water catchment and sedimentation has been recorded in these pools.
- **32E - 37E pools (MOC Pools)** - Drainage to the pools is from the north. Part of the catchment area has been cut off by mining activities to the north west and north east and sedimentation has been recorded in

these pools. The 32E_37E landbridge is situated just to the south and has a culvert to enable flushing to the south. This landbridge will be removed at closure.

- **42E pools (ERP Pools) -** Drainage to the pools is from the north. Catchment areas have been reduced to the north-west by mining activities. The 42EE landbridge will further reduce the catchment area of the gorge system hosting the pools and the 47E landbridge will impede southward flows from the gorge system during operations until they are removed at closure.

The condition of these pools will continue to be managed and monitored throughout the life of mine and into closure.

Surface water reporting to the pits is from incident rainfall or runoff from small local catchments. Ponded water is likely to dissipate via infiltration and evaporation. Pits and landbridges may reduce local catchment runoff however there is also the potential for surface water runoff from pit catchments to enter the natural environment or contribute to local runoff along haul roads following significant rainfall events.

12.2 Groundwater

Mining at Eastern Range is AWT with the water table well below the final depth of mine pits (refer to Table 1) and therefore no dewatering of the groundwater is required to enable mining. Groundwater is located within fractured rock (dolomite and banded iron formation) and the overlying unconsolidated surficial sedimentary aquifers (i.e. valley fill comprising alluvium and colluvium). Sedimentary aquifers are located along localised drainage lines such as Stony Creek, and also in the broad alluvial in-filled palaeovalleys (up to 100m deep) such as Turee Creek Valley. Fractured rock aquifers of significance outside of the orebody deposits include the dolomitic units of the WF and the Wyloo Group (WYL).

Groundwater recharge in the area occurs via the vertical infiltration of rainfall that occurs during intense rainfall events when evaporation is low. Recharge will be enhanced in zones of high permeability such as outcrops of mineralised and fractured bedrock and also along minor drainage lines where increase surface water runoff occurs. Regional groundwater flows in a south west direction from the Paraburdoo Range down toward Turee Creek. The catchment created by the mine void will result in localised ponding at the base of the mine voids following heavy rainfall, which will dissipate via infiltration and evaporation shortly after the event.

Water for the operation is supplied by the Turee Creek borefield, which is located south east of the operation. The borefield was commissioned in 1996 to supply water to the Paraburdoo fines processing plant, the Eastern Range operation and the Channar operation. Water abstracted from this borefield is used primarily for dust suppression for earthworks and construction purposes, mineral ore processing and other mining purposes at Eastern Range. The borefield will continue to operate after the closure of Eastern Range to supply the Greater Paraburdoo operations and is included in the scope of the Paraburdoo Closure Plan. This borefield is overlapped by the Paraburdoo Gold Wellfield as shown in Figure 17 which was third party operated and has been decommissioned.

The Turee Creek borefield aquifer is hosted within a sequence of alluvial, colluvial and chemical sediments, located central to the Turee Creek palaeovalley and extends into the underlying fractured and weathered basement rocks of the Wyloo Group. The depth to water is between 2 and 14 meters below ground level (mbgl) in the shallow aquifer and between 10 and 60 mbgl in the deep aquifer. Groundwater flow is east to west.

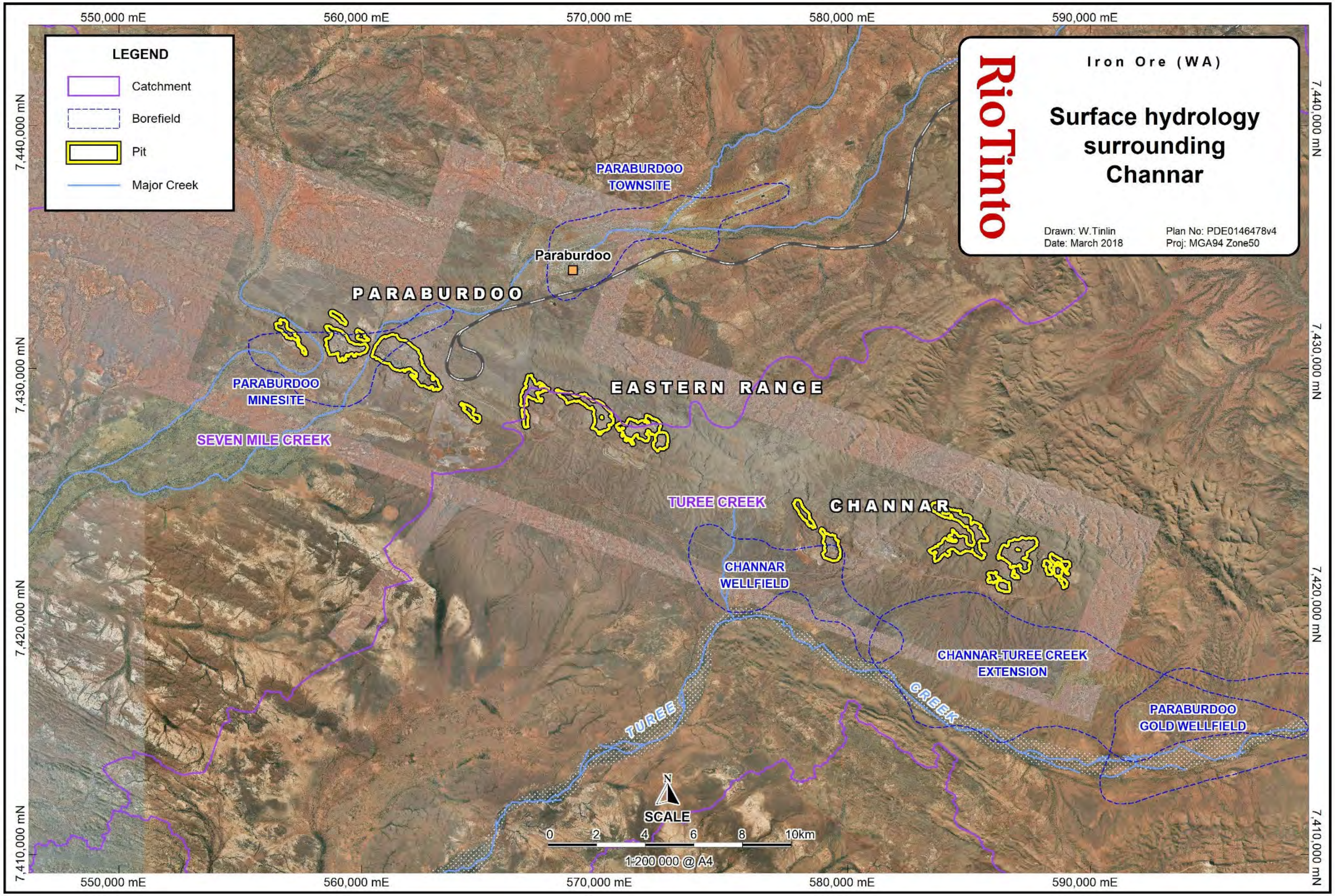


Figure 17: Surface hydrology and borefields surrounding Eastern Range

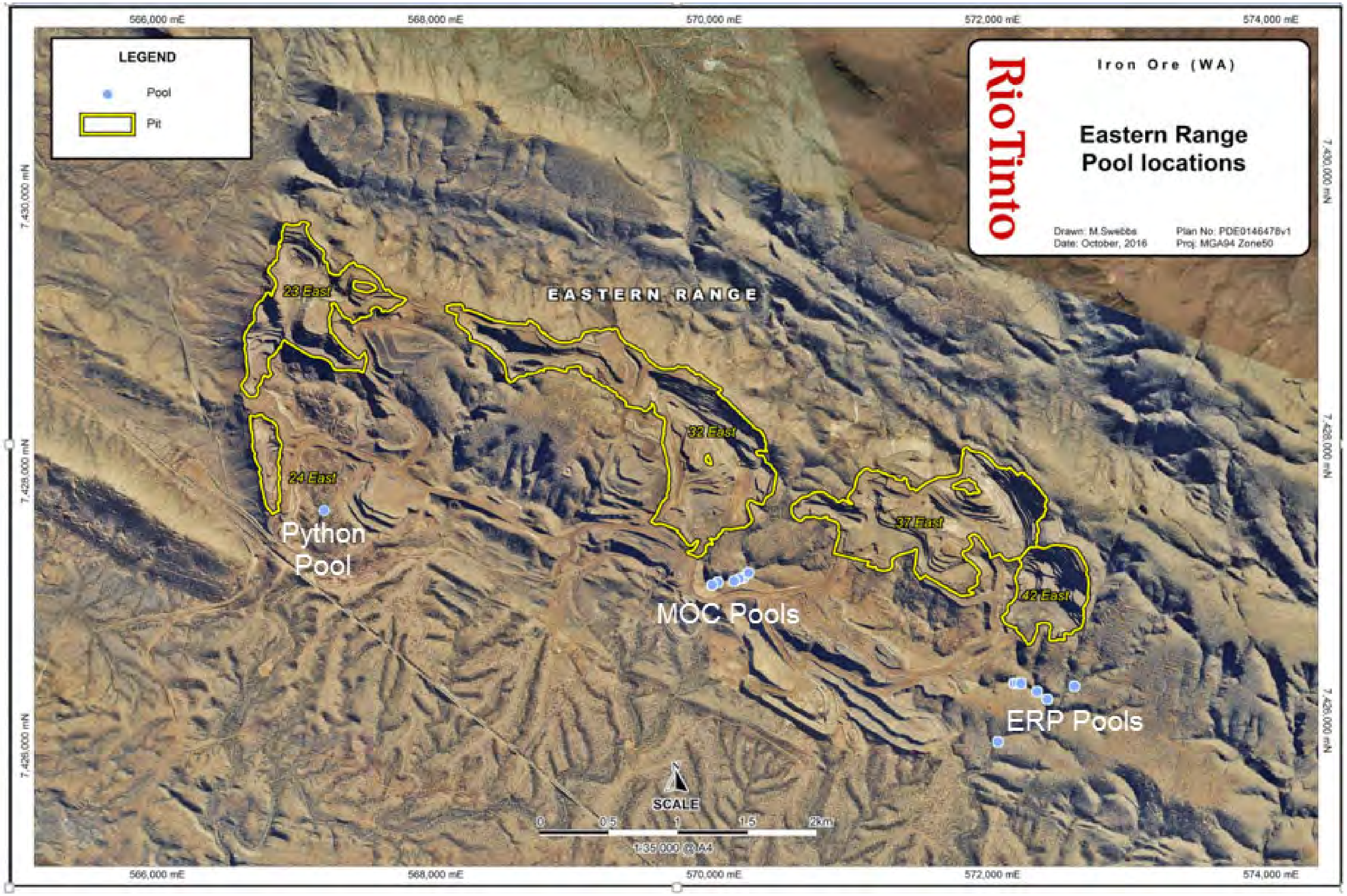


Figure 18: Eastern Range pool locations

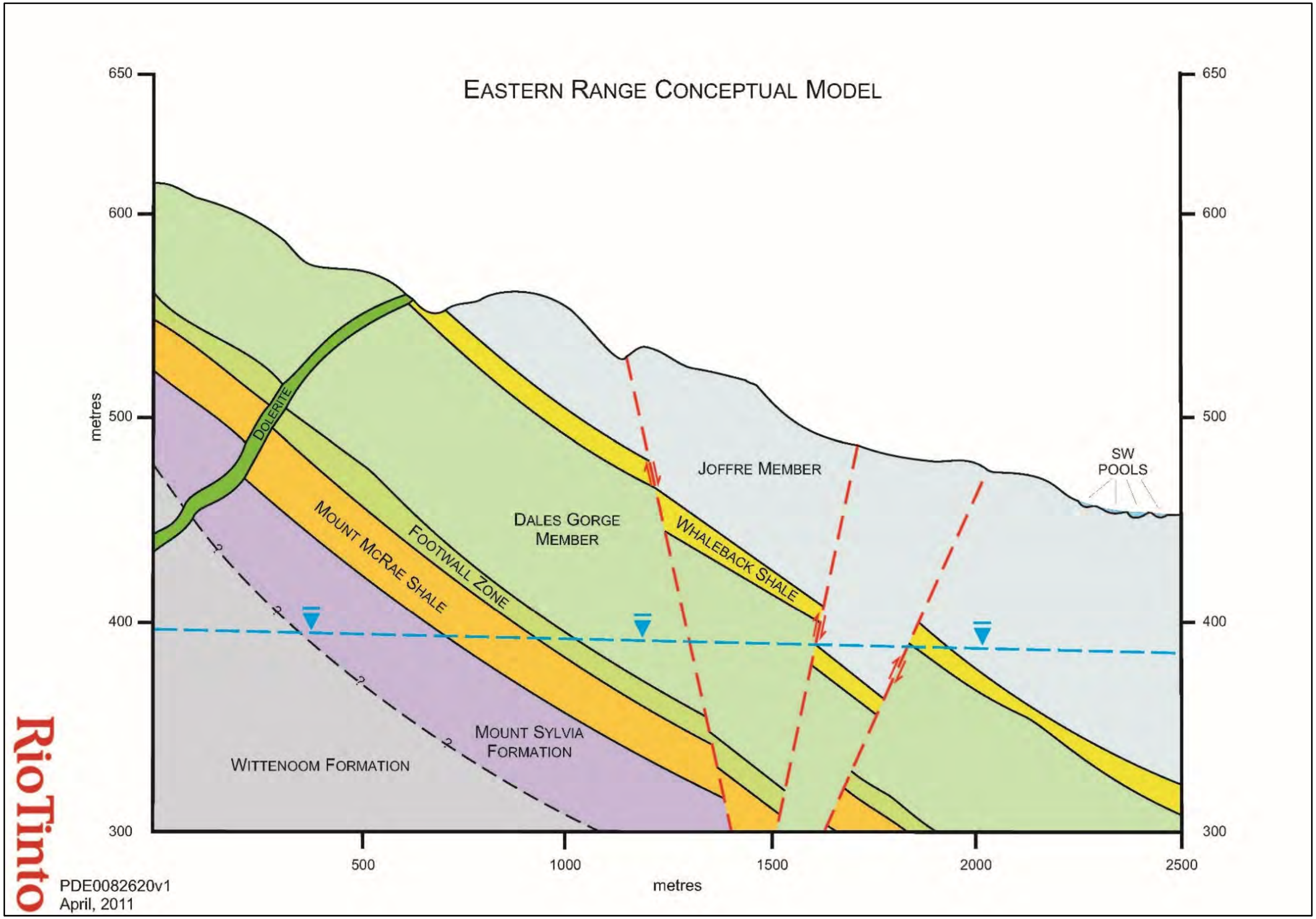


Figure 19: Eastern Range conceptual model

13. Biodiversity

13.1 Terrestrial habitat

Extensive biological surveys have been undertaken at Eastern Range to date, as shown in Figure 20. Six broad habitat types were mapped at Eastern Range prior to mining, all of which are expected to be represented in undisturbed areas after closure. These habitats include gorge, breakaway, hill crest, hill slope, stony plain and drainage line (Figure 21). Characteristics of these habitat types are provided in Table 18.

Gorge habitats present in the survey area are considered important on a local scale due to the significant microhabitats they provide, such as caves and water pools. Gorges, particularly those containing rock pools, have been recognised as high value habitat for species including the following Commonwealth Matters of National Environmental Significance (MNES) under the Environment Protection and Biodiversity Act 1999 (EPBC Act); Northern Quoll (Dasyurus hallucatus), Pilbara Leaf-nosed Bat (Rhinonicteris aurantia), Ghost Bat (Macroderma gigas) and Pilbara Olive Python (Liasis olivaceus barroni).

Table 18: Description of pre-mining habitats identified at Eastern Range

Type	Basic description
Gorge	Deep, often rocky gorges, sometimes with semi-permanent freshwater pools. Scattered Eucalypts over Acacia shrubland over sparse to scattered hummock or tussock grassland. Rocky structures providing large opportunities of refuge and foraging for a wide suite of vertebrate fauna species; numerous rock ledges, crevices and caves. Some semi-permanent water pools. Provides significant refugia/shelter sites and greater diversity of prey species. Potential core habitat for MNES such Pilbara Leaf-nose Bat, Ghost Bat, Pilbara Olive Python and Northern Quoll. This habitat creates a diverse array of microhabitats and refugia. The habitat often contains rock shelters in the form of overhangs, cracks, crevices, caves and areas for water to pool during the wet season. Vegetation provides microhabitats in the form of logs, debris and hollows. The characteristics of this habitat are unlikely to be restored or created as part of the rehabilitation activities. This habitat zone will be present in undisturbed areas of the mine.
Breakaway	Breakaway or ridge line, falling away to steep scree slope. Scattered Eucalypts over mixed hummock and tussock grassland. Stony compact soils, low levels of leaf litter, sparse open vegetation; small or shallow caves and crevices, surface water present in some areas. The habitat often contains rock shelters in the form of overhangs, cracks and crevices, although limited cave potential. Potential habitat for the Northern Quoll with microhabitat opportunities which may provide refugia. Vegetation provides microhabitats in the form of logs, debris and hollows. The characteristics of this habitat are unlikely to be restored or created as part of the rehabilitation activities. This habitat zone will be present in undisturbed areas of the mine. This habitat zone will be present in undisturbed areas of the mine.
Hill Crest	Stony hills on high ranges with dissected valleys and gullies. Scattered Eucalypts over sparse Acacia shrubland over hummock or tussock grassland. Stony compact soils, low levels of leaf litter, sparse open vegetation, small overhangs. Low fauna habitat value although will be used for dispersal and foraging. This habitat zone will not be substantially disturbed by mining activities and will be present in undisturbed areas of the mine. The characteristics of this habitat are not compatible with the closure landform and it is unlikely to be restored or rehabilitated as part of the rehabilitation activities.
Hill slope	Low rolling stony hills and valleys. Acacia (some Mulga) shrubland over hummock grassland. Stony compact soils, low levels of leaf litter, sparse open vegetation. Low fauna

Type	Basic description
	habitat value as does not provide significant refugia or shelter. This habitat zone will be present in undisturbed elevated areas of the lease. Characteristics of this habitat may be suitable for rehabilitation planning and could be considered on flat areas.
Stony Plain	Low-lying undulating stony plain. Acacia shrubland over sparse hummock grassland. Stony compact soils, low levels of leaf litter, sparse open vegetation. Low fauna habitat value as does not provide significant refugia or shelter. This habitat type contains limited microhabitats with the dominant Acacia species providing no tree hollows, few logs, limited leaf litter and sparse vegetation. This habitat zone will be present in undisturbed areas of the lease. Characteristics of this habitat may be suitable for rehabilitation planning and could be considered on waste dumps.
Drainage line	Broad valley drainage lines. Eucalyptus victrix (with pockets of E. camaldulensis woodland or Acacia (Mulga) shrubland overstorey with hummock or tussock grassland. Range from soft sandy soils with surface cobbles and pebbles, diversity of microhabitats leaves logs and twigs to rocky structures and sometimes small semi-permanent freshwater pools. Larger drainage lines have moderate fauna habitat value as could be used for foraging however minor drainage lines have low fauna habitat value. These drainage features act as wildlife corridors that help flora and fauna disperse across the landscape. There is a high diversity of microhabitats including logs, debris, tree hollows and soft soils and freshwater pools. This habitat zone will be present in undisturbed areas outside of the mine and within pockets of the mining area.

The physical factors associated with the closure landform provide a starting point to identify which habitat units could best be reinstated across the mine area, given the changes to the land resulting from mining activities, in order to establish native self-sustaining ecosystems. If only a low level of land disturbance has occurred, the land can usually be returned similar to the pre-mining habitat or closest equivalent from the surrounding area. Optimal species selection and habitat reformation of final post-closure landforms will continue throughout mine life (during progressive rehabilitation) and during development of the final closure plan and will be informed by ongoing research activities. Habitat for native fauna will be provided where possible in appropriate rehabilitated areas (such as rock piles, dead vegetation and/ or logs).

There will be some areas associated with the pits that cannot be rehabilitated due to safety and access issues. This usually includes the pit high walls and benches, and areas above the high wall where access is cut off as ore is mined. These areas will have safety bunds placed around them to prevent inadvertent access where possible and will be classified as cleared habitat that is considered to have minimal habitat value.

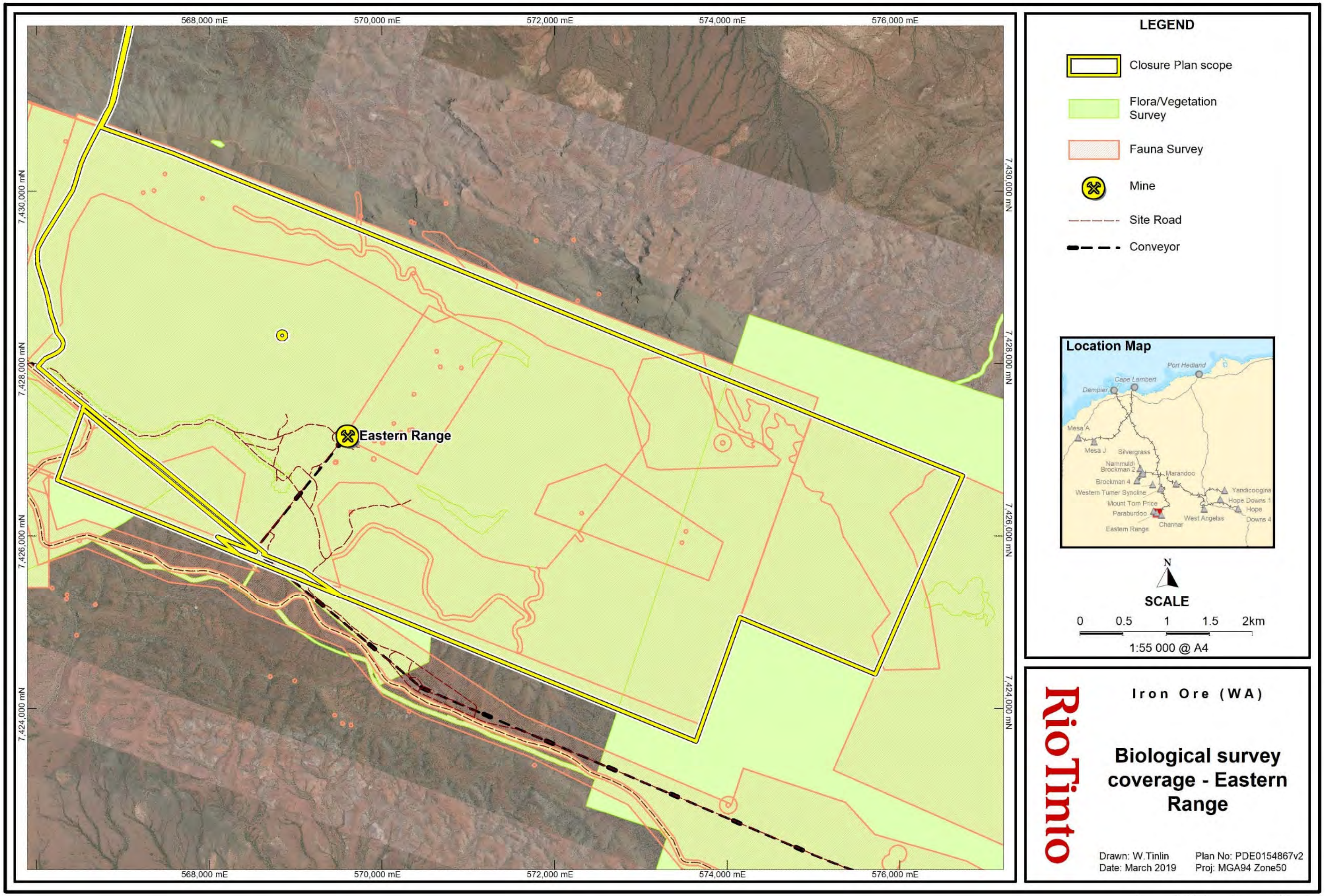


Figure 20: Biological survey coverage at Eastern Range

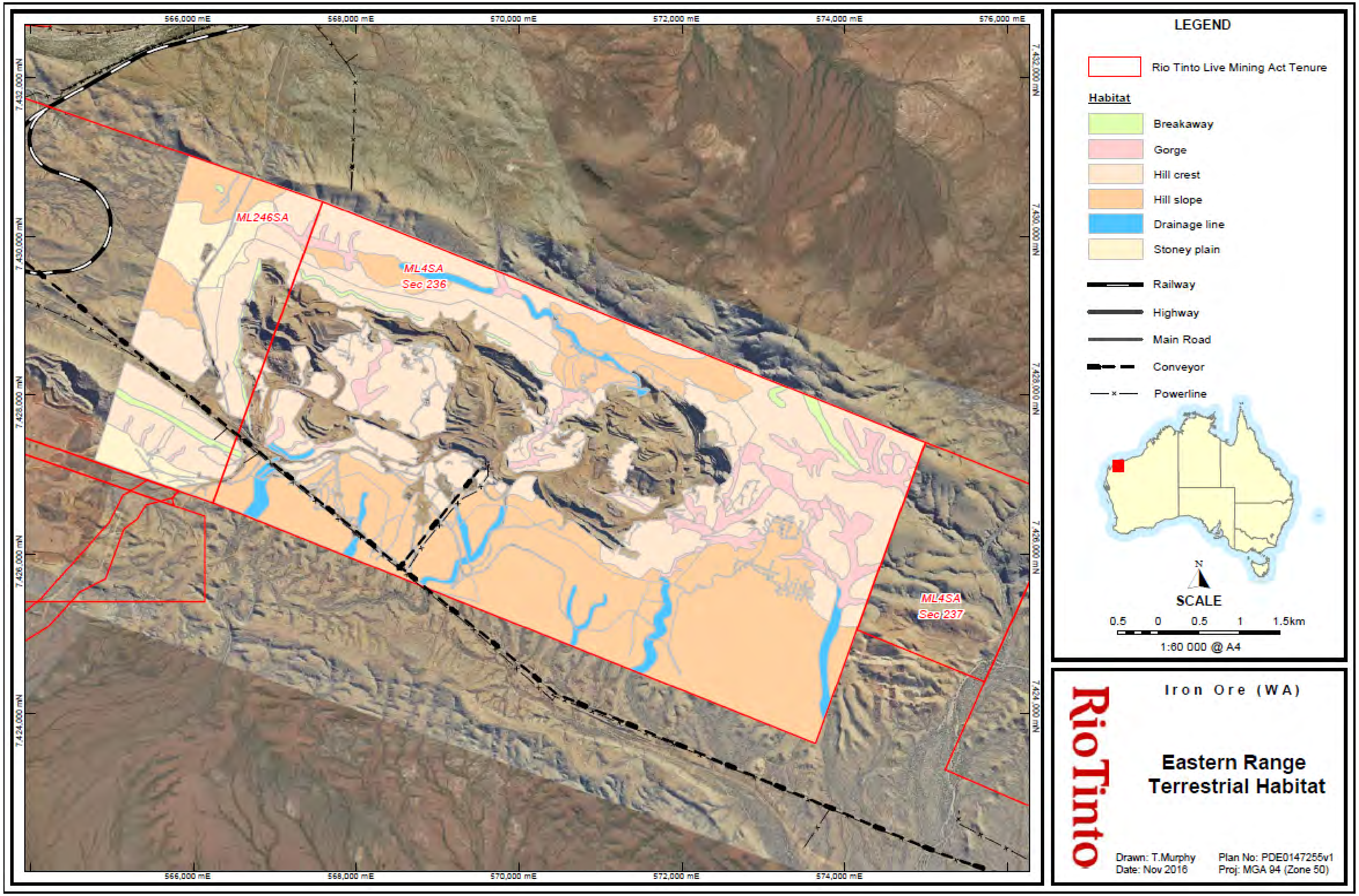


Figure 21: Eastern Range terrestial habitat

13.2 Flora

No vegetation unit recorded at Eastern Range is listed as either a Threatened Ecological Community (TEC) or as a Priority Ecological Community (PEC) under the EPBC Act or the Biodiversity Conservation Act, 2016. The nearest TEC is located 97 km north of the mine area and the nearest PEC 79 km north-east within Karijini National Park. Some vegetation units in drainage lines are of moderate/low significance, while other drainage vegetation units are considered of low significance. The remaining vegetation units at Eastern Range are widely distributed both locally and throughout the Hamersley subregion. Vegetation condition surrounding the direct mining area is displayed in Figure 22. Condition ranges from good to excellent, with the majority in excellent condition, and a number of units having slightly reduced condition (very good-to-excellent range). The predominant disturbance factors affecting the condition of vegetation outside the direct mining area is clearing from general access tracks, exploration tracks and pads and borrow pits.

A total of 214 species of native flora have been recorded at Eastern Range, with Acacia, Eremophila, Senna and Triodia being dominant. Neither of the two threatened flora from the Pilbara region (Thryptomene wittweri and Aluta quadrata) have been recorded at Eastern Range, although Aluta quadrata is found 2.5 kms east of the lease boundary, close to the Channar mine and also in proximity to Paraburdoo and Western Range. Priority flora that have been identified or may occur at Eastern Range are detailed in Table 19 and locations in relation to the mine footprint shown in Figure 23. The Eastern Range footprint is not expected to impact the conservation status of any flora species through changes to abundance, species diversity, geographic distribution and / or productivity of flora at species or ecosystem levels.

Table 19: Conservation significant flora recorded or that may occur at Eastern Range.

Flora taxon	Conservation status WA	Habitat comments
Eremophila sp. Hamersley Range (K. Walker KW 136)	Priority 1	Occurs high in the landscape on hill crests, top of gorges and cliffs, gullies and steep rocky hill slopes.
Hibiscus campanulatus[19]	Priority 1	Base of cliffs, and steep gullies.
Sida sp. Hamersley Range (K. Newbey 10692)	Priority 1	Skeletal red stony soil, ironstone. Shady locations, cliffs, summits. Not recorded to date but may occur at Eastern Range.
Solanum octonum	Priority 2	Occurs on skeletal soils and gritty sands on ridge tops.
Eremophila coacta	Priority 3	Laterite shale soils, Ironstone hills and creeklines. Not recorded to date but may occur at Eastern Range.
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	Priority 3	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains. Not recorded to date but may occur at Eastern Range.
Grevillea saxicola	Priority 3	Occurs on hill and scree slopes.
Nicotiana umbratica	Priority 3	Occurs on shallow soils on rocky outcrops. Not recorded to date but may occur at Eastern Range.
Olearia mucronata	Priority 3	Schistose hills and along drainage lines. Not recorded to date but may occur at Eastern Range.
Pilbara trudgenii	Priority 3	Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces. Recorded on the boundary of the project footprint.
Sida sp. Barlee Range (S. van Leeuwen 1642)	Priority 3	Skeletal red soils pockets on steep slopes.
Eremophila magnifica subsp. magnifica	Priority 4	Occurs on skeletal soils over ironstone. Not recorded to date but may occur at Eastern Range.
Eremophila youngii subsp. lepidota	Priority 4	Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats. Not recorded to date but may occur at Eastern Range.
Ptilotus trichocephalus	Priority 4	Sandy soils and colluvial plains. Not recorded to date but may occur at Eastern Range.
Ptilotus mollis	Priority 4	Stony hills and screes. Recorded at Channar although not recorded to date but may occur at Eastern Range.

[19] Previously known as *Hibiscus sp. Canga* (P.J.H. Hurter & J. Naaykens 11013).

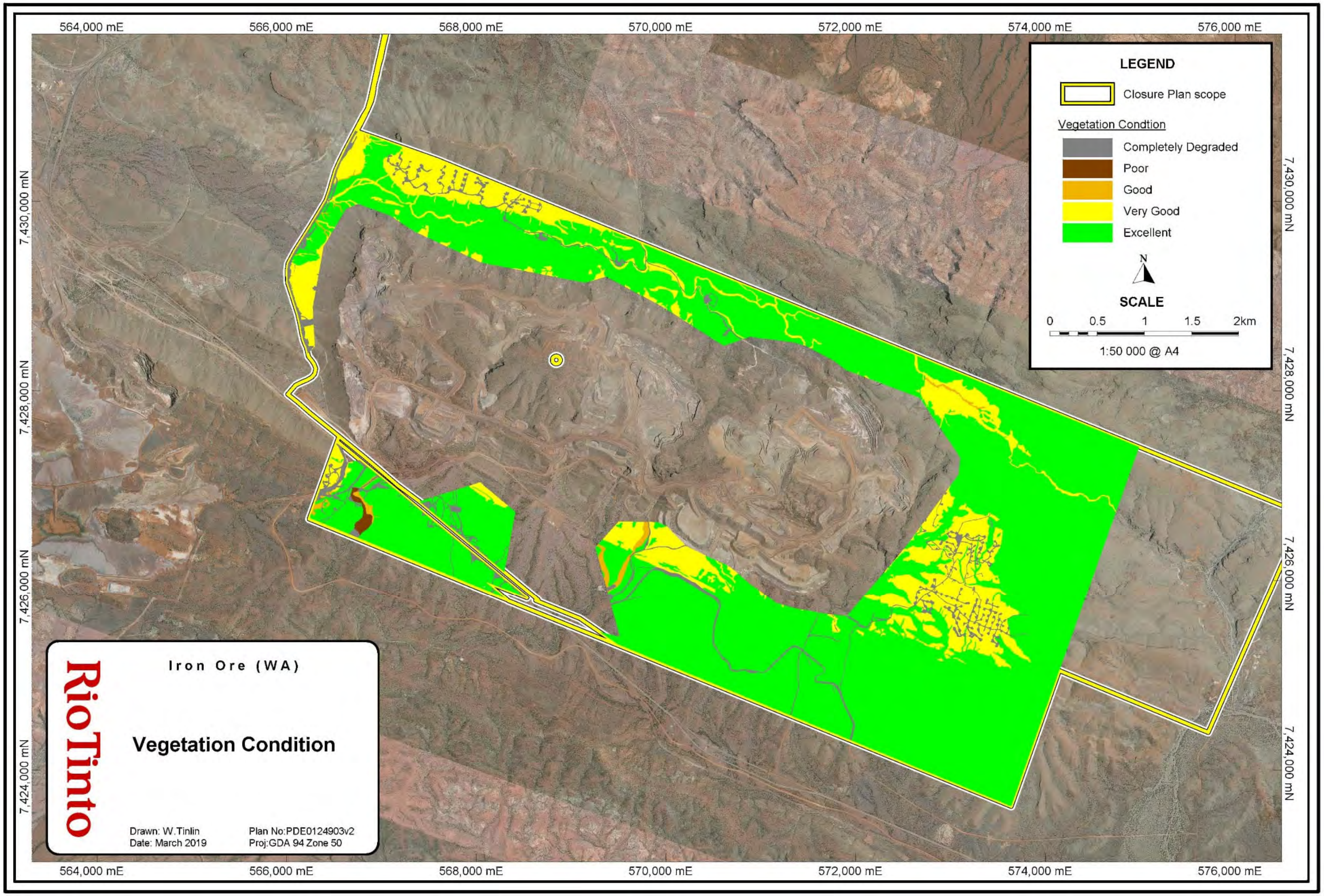


Figure 22: Vegetation condition

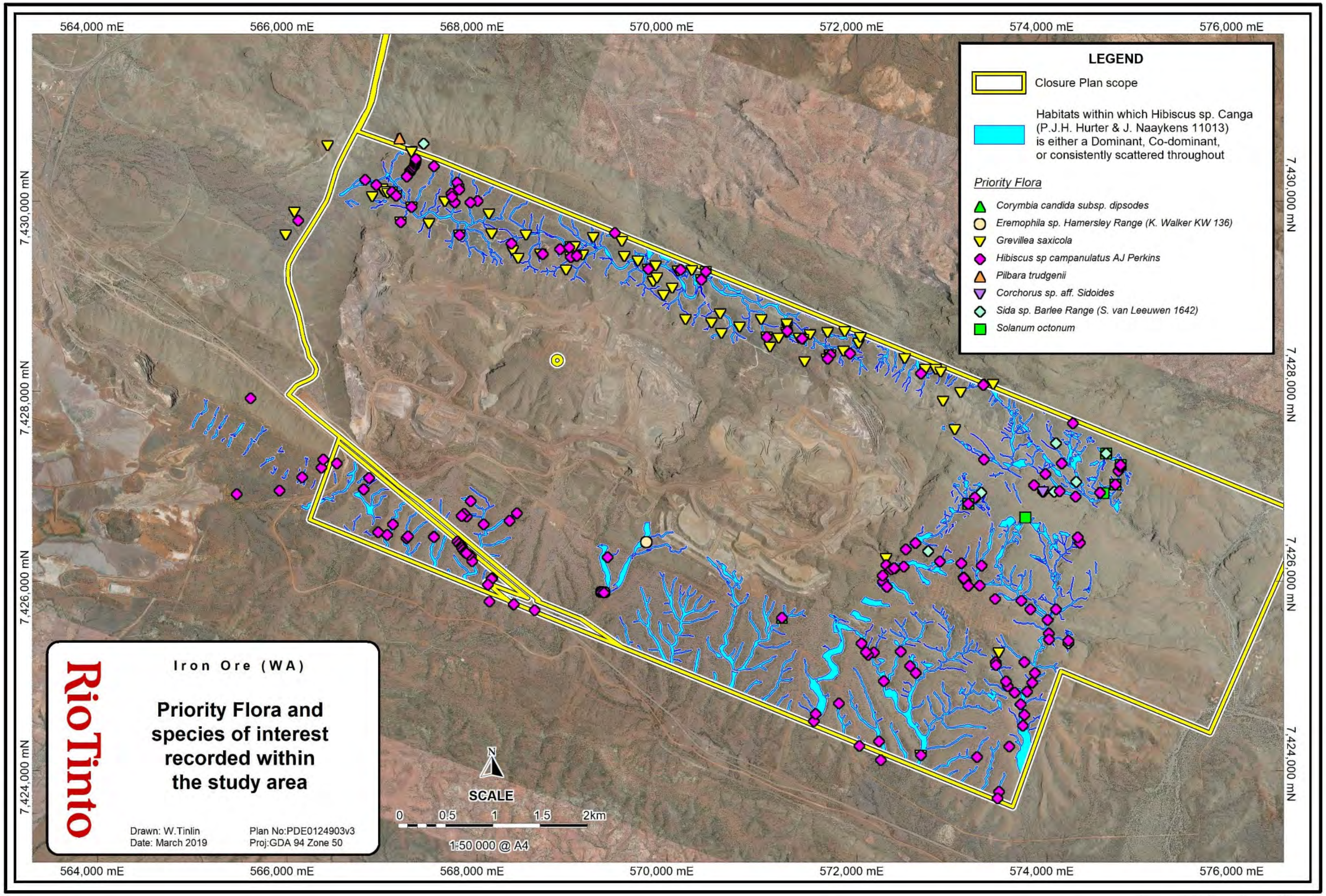


Figure 23: Priority flora recorded within the study area

13.2.1 Seed provenance and selection

Locally collected seed is needed to assist in revegetation and the creation of a self-sustaining ecosystem. Over time the viability of seeds in stockpiled topsoil decreases, and thus the quality of the topsoil deteriorates. In addition, topsoil salvaged prior to disturbance may not contain seeds of all the target species of its new location/habitat. Seed mixes for rehabilitation are of local provenance[20]. Specific seed mixes are selected to provide a range of species appropriate to the desired habitat, taking into consideration landscape position and slope. In areas where erosion risks are identified, seed mixes may be modified to include or increase the portion of species that provide rapid cover. The main focus of rehabilitation programs is to create safe and stable landforms, restore vegetation complexes that include the more common species present in the particular habitat type and to achieve a diverse range of strata. The inclusion of rare and threatened species in rehabilitation programmes is limited by:

- habitat preference (preference for drainage lines, gullies, calcretes or other habitat not suitable or similar to those likely to be present in the rehabilitation landscapes);
- abundance – very few populations or small populations from which to source viable seed;
- difficult taxonomy / unresolved taxonomy issues and thus status of species highly uncertain;
- growth form – e.g. short lived annual species with preference for growth under woodland canopies;
- seed production – some species do not regularly produce seed;
- propagation methods – some species are not able to germinate from seed and cuttings are required which is not a suitable method for broad scale application in an arid environment;
- availability of seed at the time when rehabilitation occurs; and/or
- seed dormancy.

Rio Tinto purchases seeds from commercial seed suppliers, with emphasis on ensuring that there are appropriate local provenance seeds available for rehabilitation of each of its sites. Seeds are stored in one of two purpose-built, climate controlled storage facilities to maximise long term viability.

13.2.2 Invasive flora

Flora surveys have recorded six introduced (weed) species in the Eastern Range area (Table 20). None of these species are listed as Weeds of National Significance or declared plants for the Pilbara region under the Biosecurity and Agriculture Management Act 2007 (WA). The Department of Biodiversity, Conservation and Attractions Weed Species Ranking takes into account the potential distribution, current distribution, ecological impact, invasiveness and feasibility of control to derive a final broad qualitative weed species ranking corresponding to specific management actions. Most weed species recorded from the area have a ranking of high. Weeds are managed during operations in accordance with the Iron Ore (WA) Pilbara Weed Management Strategy, which includes strategies such as periodic spraying and equipment hygiene.

[20] Local is defined as 200 km radius in the same IBRA subregion of the area cleared. Note 2: Some seed used in rehabilitation predates accurate recording of collection areas.

Table 20: Weed species recorded at Eastern Range

Scientific Name	Common Name	Ecological Impact	Invasiveness
Acetosa vesicaria	Ruby Dock	High	Rapid
Aerva javanica	Kapok Bush	High	Rapid
Bidens bipinnata	Cobbler's Pegs	Unknown	Rapid
Cenchrus ciliaris	Buffel Grass	High	Rapid
Cenchrus setiger	Bordwood Grass	High	Rapid
Malvastrum americanum	Spiked Malvastrum	High	Rapid

13.3 Fauna

To date a total of 221 vertebrate fauna species have been recorded within 40 km of the mining area, including:

- 72 reptiles;
- 2 amphibian species;
- 26 native mammals; and
- 121 bird species.

Of these, 25 species are of conservation significance, including one reptile species, 18 bird species and six mammal species. Four species of conservation significance under the Biodiversity Conservation Act 2016 (WA) and the EPBC Act (Federal) may occur, or evidence of their presence has been found, within close proximity to Eastern Range, as detailed in Table 21.

Table 21: Species of conservation significance associated with Eastern Range

Fauna species	Conservation status WA	EPBC Act status	Habitat occurrence
Northern Quoll (Dasyurus hallucatus)	Schedule 2 endangered	Endangered	Dissected rocky escarpments and rocky eucalypt woodland.
Pilbara Leaf-nosed Bat (Rhinonicteris aurantia)	Schedule 3 vulnerable	Vulnerable	Deep warm, humid caves or rock cracks.
Ghost Bat (Macroderma gigas)	Schedule 3 vulnerable	Vulnerable	A wide range from rainforest, monsoon and vine scrub in the tropics to open woodlands and arid areas.
Pilbara Olive Python (Liasis olivaceus barroni)	Schedule 3 vulnerable	Vulnerable	Inhabits gorges, rock pools and riparian zones.

The gorge habitats in the north-east corner of the study area, the two gorge systems in the centre of the current disturbance footprint and the gorge system in the north-western corner of the study area (Figure 21) have been mapped as potentially suitable habitat for these four species, based on the presence of caves, crevices and overhangs within rocky areas.

Despite suitable habitat being present, only one record of tracks (2011) and a single scat (2018) attributed to the Northern Quoll has been recorded in the area to date, despite extensive search effort and the use of motion-sensitive cameras. Eastern Range is located on the very edge of the Northern Quoll known distribution range and the species is considered to only have a moderate likelihood of occurrence at Eastern Range.

The Pilbara leaf-nosed bat is thought to frequent the Eastern Range area, with gorge habitats within the study area being used for foraging and drinking, particularly at the permanent and semi-permanent pools based on call activity. The species requires deep caves offering suitable humidity and stable temperatures, and is restricted in the Pilbara to caves where at least semi-permanent water is present nearby. Two large colonies occur in proximity to nearby Paraburdoo mine rather than Eastern Range; these roosts are referred to as the West Paraburdoo roost and East Paraburdoo roost. The West Paraburdoo site has been confirmed as a maternal roost.

The gorge habitats at Eastern Range are also considered suitable for the Ghost Bat. A small number of Ghost Bat calls have been recorded from a cave entrance in the north-west corner of Eastern Range along with the identification of scats and feeding debris recorded within gorge habitats, although the roost location is not thought to be present in proximity to the mining area.

The north-eastern, north-western, and parts of central gorge habitat which contain water pools are also considered to be suitable for the Pilbara Olive Python, which has previously been recorded in the area.

Five stygofauna species have been found near Eastern Range. However, groundwater systems below Eastern Range have not been disturbed by mining and therefore stygofauna habitat has not been disturbed. No further management considerations for stygofauna are required as part of this closure plan.

Mining activities at Eastern Range are not expected to impact the conservation significance of any species as the landforms types which are preferred habitat for these species will remain post-closure in areas adjacent to current mining activity. Ecosystem restoration activities and reintroduction of fauna are not planned as part of rehabilitation activities; however habitat features such as logs and rocks will be incorporated into rehabilitation where available.

13.4 Feral animals

Seven introduced species have been identified at Eastern Range: house mouse (Mus musculus), dog (Canis lupus familiaris), red fox (Vulpes vulpes), cat (Felis catus), donkey (Equus asinus), horse (Equus caballus) and cow (Bos taurus).

Feral carnivores (e.g. cats, dogs, foxes) can create locally increased predation pressure on native fauna as well as increase competition with native species for resources such as space (territory), water and food, while feral herbivores (e.g. cattle, horses, donkeys) can have a significant impact in rangeland areas, such as the Pilbara. In dry times, grazing pressure reduces the abundance of palatable native species, impacting biodiversity and can create conditions that encourage weeds to grow. Foot traffic impacts the soil conditions, and in combination with over grazing, can encourage erosion. Foot traffic has also been the cause of damage to heritage sites. Overgrazing and damaged soils has a flow-on effect to native fauna species that rely on this vegetation for food and shelter.

14. Progressive rehabilitation

Regular reviews of the mine plan are undertaken to identify disturbed areas of the site where mining activity has been completed. These areas are then reviewed for potential to undertake progressive rehabilitation works. Lessons learnt during these activities, and from subsequent monitoring campaigns, are used to inform and update our standard management practices and provide input into suitability of final closure criteria for the site. Results from the progressive rehabilitation undertaken by Rio Tinto at Eastern Range is summarised in Section 14.1.

To date, approximately 30 hectares (ha) has been rehabilitated at Eastern Range, as summarised in Table 22 and locations shown in Figure 24. The majority of these areas are of low to moderate disturbance except for one waste dump, the 23E waste dump[21], which had the two upper lifts rehabilitated in 2013 as detailed in Figure 25 and Figure 26. This dump received fresh topsoil to a maximum depth of 100mm over the surface, excluding the berms. This dump was also selected for a fertiliser trial (Multicote 8) which was spread on the lower lift.

Table 22: Progressive rehabilitation at Eastern Range

Name/location	Category	Area (ha)	Year of rehabilitation
Borrow pits (various)	Borrow pits	6.44	2004
Light vehicle roads	Road/track	7.094	Prior to 2004, 2018
Construction camp	Camp	2.908	2004
Construction laydown	Laydown	1.927	2004
Conveyor sediment diversion dam	Infrastructure	0.918	2009
23E waste dump	Waste dump	9.637	2013
37E exploration disturbance	Exploration	1.372	2014
TOTAL		**30.296**	**N/A**

14.1 Monitoring of rehabilitation and baseline conditions

Monitoring of rehabilitated and reference sites is scheduled and conducted according to Rio Tinto's Rehabilitation Monitoring Procedure. The objective of the rehabilitation monitoring program is to evaluate development of the rehabilitation, and provide useful feedback for the improvement of rehabilitation techniques, and to help assess progress towards long term rehabilitation goals. Monitoring also provides information which can be used to set realistic and achievable completion criteria. Reference sites, also known as controls or analogues, are located within uncleared native vegetation representative of the local area where the rehabilitation is located.

Five rehabilitation transects (linear monitoring points which are divided into quadrats) have been installed on 23E dump at Eastern Range; two on the upper lift, two on the lower lift and one on the top of the dump and to date these have been monitored in 2013, 2014, 2015 and 2017. The following parameters are being measured:

- perennial native cover;
- spinifex cover;
- grass cover;
- shrub cover;
- estimated litter cover;
- estimated tree cover >2 m (irrelevant for first few years of monitoring);

[21] Note the 2016 closure plan reported this as 13.2 ha which was based on the surface area of the dump rather than the 2D footprint area.

- species richness (total number of species counted in the transect quadrats);
- total perennial density;
- presence of weeds;
- presence of erosion gullies and if present these are measured;
- presence of logs and rocks;
- presence of native ants;
- general fauna sightings;
- presence of scats and other evidence of fauna traffic including tracks, burrows and nests;
- evidence of grazing; and
- evidence of fire.

Monitoring results to date show that target native species are establishing relatively well on the dump (Figure 27). All rehabilitation transects showed an increase in the number of species from 2015 to 2017. A total of 14 of the 19 seeded species were recorded from the rehabilitation transects in 2017; more than the 10 species recorded in 2015. A total of 23 other perennial species that were not in the seed mix were also recorded from the rehabilitation transects, indicating good germination from the topsoil seed bank and an improvement on 2015 results, when only eight non-seeded species were recorded.

Perennial density at the rehabilitation transects increased markedly in the first year after the rehabilitation was completed, but subsequently have showed only a gradual increase, likely reflecting the long periods of below-average rainfall since that time. Three weed species have been recorded in the transects; namely Buffel Grass (Cenchrus ciliaris), Ruby Dock (Rumex vesicarius) and Kapok Bush (Aerva javanica) which will be managed during operations as required.

Erosion monitoring results indicate that erosion is occurring on the slope, with most on the lower transects, but some erosion is also present in the upper two transects. Litter cover in the rehabilitation transects ranged from sparse to moderate and no fauna colonisation has been recorded at this early stage.

Analysis of the fertiliser trial shows that some differences have developed between the two sites, with perennial and spinifex cover appearing to be higher in the two upper transects, which were not fertilised, than in the lower transects which were fertilised. Total perennial density is also significantly higher in the upper transects, reflecting good spinifex establishment. At this stage, it can be concluded that the presence of fertiliser in this instance has not resulted in improved rehabilitation outcomes.

No other areas of rehabilitation are currently monitored at Eastern Range. However other local areas of rehabilitation and control monitoring sites located at Channar and Paraburdoo are monitored.

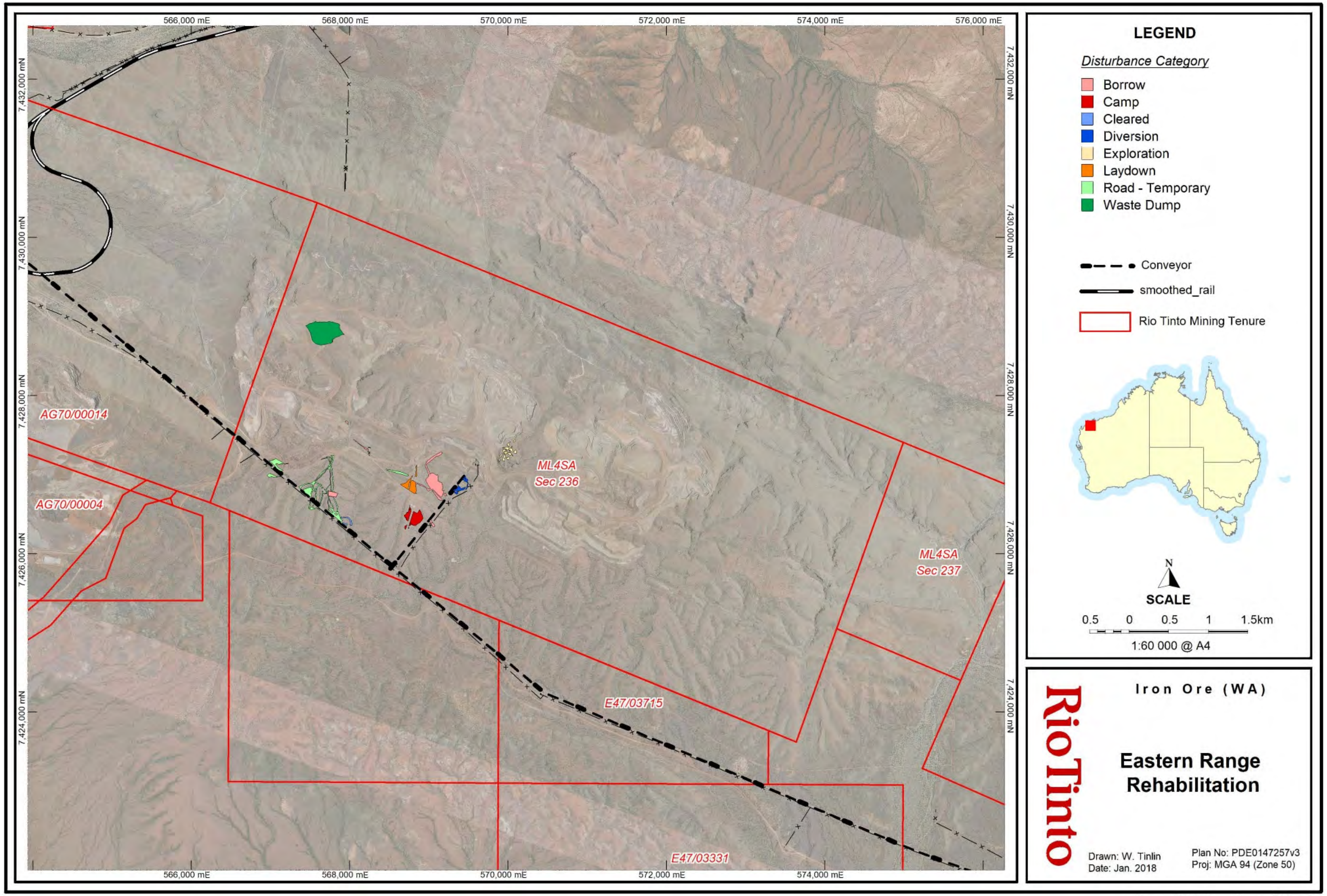


Figure 24: Eastern Range rehabilitation

Figure 25: Final 23E_WD1 landform at completion of rehabilitation in 2013.

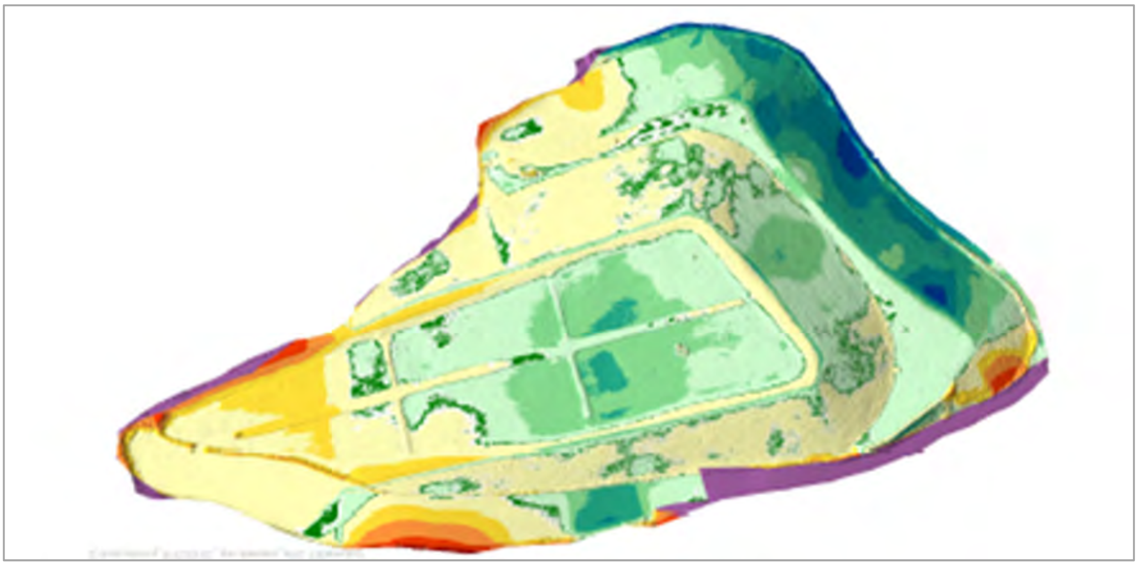
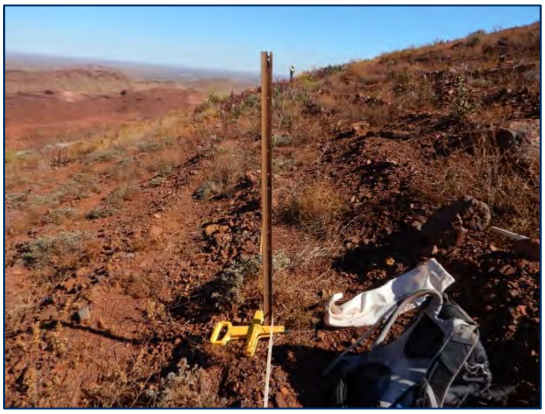


Figure 26: Surface cells on 23E_WD1 for surface water retention


23E Lower T2 (start)


23E Lower T2 (end)


23E Upper T1 (start)


23E Upper T1 (end)


23E Upper T2 (start)


23E Upper T2 (end)


23E Flat T1 (start)


23E Flat T1 (end)

Figure 27: 23E_WD1 rehabilitation monitoring transects start and end, 2017

15. Contaminated sites

Rio Tinto Iron Ore maintains registers for potentially contaminating activities and known or suspected contaminated sites which have been formally reported under s11 of the Contaminated Sites Act, 2003 (WA). The registers are informed by regular review of operations and, where required, preliminary or detailed site investigations (PSI or DSI) undertaken to assess contaminants associated with such activities and their risk of harm to human health, the environment and environmental values. Potentially contaminating activities and land uses as described in the guideline 'Assessment and Management of Contaminated Sites' (DER, 2014), that may be associated with mining activities onsite include, but are not limited to:

- automotive repair workshops (light and heavy machinery);
- substations and transformers;
- fertiliser and explosives storage;
- landfill sites;
- mineral processing, mining, screening and crushing facilities;
- rail transport corridors;
- hydrocarbon storage, handling and dispensing facilities; and
- sewage waste water treatment plants; and
- disturbance of potentially acid forming materials during the course of mining.

As Eastern Range has limited infrastructure, potentially contaminating activities are restricted to a fast fuel facility and temporary workshop, as shown in Figure 28. As part of the Rio Tinto closure study process, these locations and any other areas identified as potentially contaminating activities, will be assessed based on the proposed landuse. Based on this assessment, specific plans will be developed to remediate or manage contaminants, where required, to support the post-closure land use. Potentially acid forming material is not included in this assessment process; rather the risk is assessed as part of the overall mineral waste management for the site.

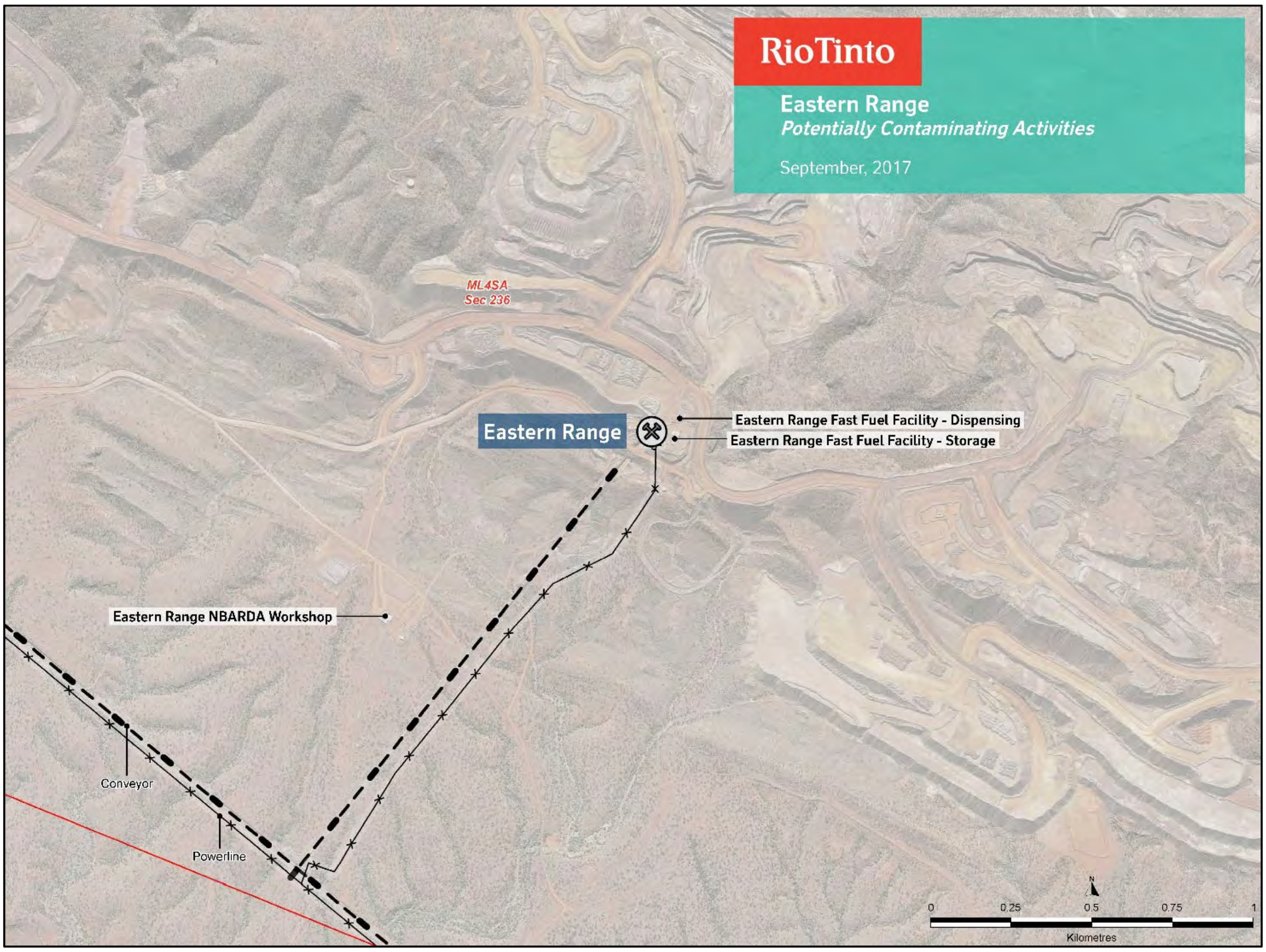


Figure 28: Areas of potential contamination which require investigation

16. Cultural heritage

16.1 Native title

Rio Tinto recognises and respects the significance of Australia's cultural heritage, and in particular the cultural heritage of Aboriginal people who have traditional ownership of, and/or cultural connections to, the land on which we operate. The Yinhawangka People are the traditional custodians of the land identified in this closure plan, holding Native Title over an area approximately 10,150 km^2 across the Shires of Ashburton and Meekatharra, as determined on 18 July 2017. The most recent published Yinhawangka member list indicates there are currently 307 registered Yinhawangka members. Members are geographically dispersed with key locations of residence being Paraburdoo, Tom Price, Wakathuni, Bellary Springs, Onslow, Roebourne, Karratha, Port Hedland and Perth. Yinhawangka People are represented by the Yinhawangka Aboriginal Corporation (YAC) for cultural heritage matters. YAC has established a business arm, registered as Yinhawangka Enterprises Limited (YEL).

On 31 January 2013, Rio Tinto executed a Claim Wide Participation Agreement (PA) and an Indigenous Land Use Agreement (ILUA) with the Yinhawangka People (collectively the Agreements), with the latter being registered with the National Native Title Tribunal on 5 July 2013. The PA sets clear guidelines for processes such as land access, tenure, heritage and environmental approvals, mining benefits payments[22] and reporting and communication requirements. The PA replaced historical agreements including all prior

[22] Within the Greater Paraburdoo Operational footprint, Eastern Range is the only mine from which the Yinhawangka People currently derive financial benefit.

Binding Initial Agreements (BIA) with the Yinhawangka People. The Yinhawangka people are informed of any proposed development and closure through commitments in the PA.

The Yinhawangka People have also opted-in to the Regional Framework Deed (RFD). The RFD establishes a series of mutual commitments between Rio Tinto and the relevant Pilbara Traditional Owner groups 'Opt-In groups' , with the intention of providing a series of non-monetary benefits across seven regional standards including:

- Employment and training;
- Cultural heritage management;
- Business development and contracting;
- Life of mine planning;
- Environmental management;
- Cultural awareness training; and
- Land access.

16.2 Ethnographic and archaeological values

The Eastern Range area has been subject to varying levels of heritage surveys, with survey coverage shown in Figure 29. Rio Tinto takes all reasonable measures to prevent harm to cultural heritage sites, including during works associated with rehabilitation and closure. Where this is not practical, steps are taken to minimise or mitigate impacts and ensure required statutory approvals are obtained. Heritage sites are protected by law under the Aboriginal Heritage Act 1972 (WA) (AHA) and any proposed development affecting the heritage values of these places requires submission of a Section 18 notice under the AHA, in order to obtain ministerial consent to impact a site.

Approximately 50 heritage sites, places and features with cultural value and significance have been identified within the Eastern Range footprint; these include artefacts scatters, rock shelters, water sources, stone features and a culturally modified tree. Twenty heritage sites have been cleared since operations began with the salvaged material stored at the heritage storage facility located at Paraburdoo. Discussions with Yinhawangka representatives commenced during 2018 regarding their preference for future management of these artefacts.

Closure planning considers post closure access requirements to culturally significant sites. Yinhawangka has stressed the importance of water in the landscape as a life-sustaining and cultural resource. In particular the local creeks and water-sources of the Greater Paraburdoo area, including at Eastern Range, are central to the customs, folklore and spiritual beliefs of the community. The Eastern Range waterways and pools have a clear mythological connection with Warlu, the creation snake as well as important associations with camping and ceremonial activities. The location of important heritage sites, and approach to maintaining access to these at closure, is discussed further in Section 19.5.2.

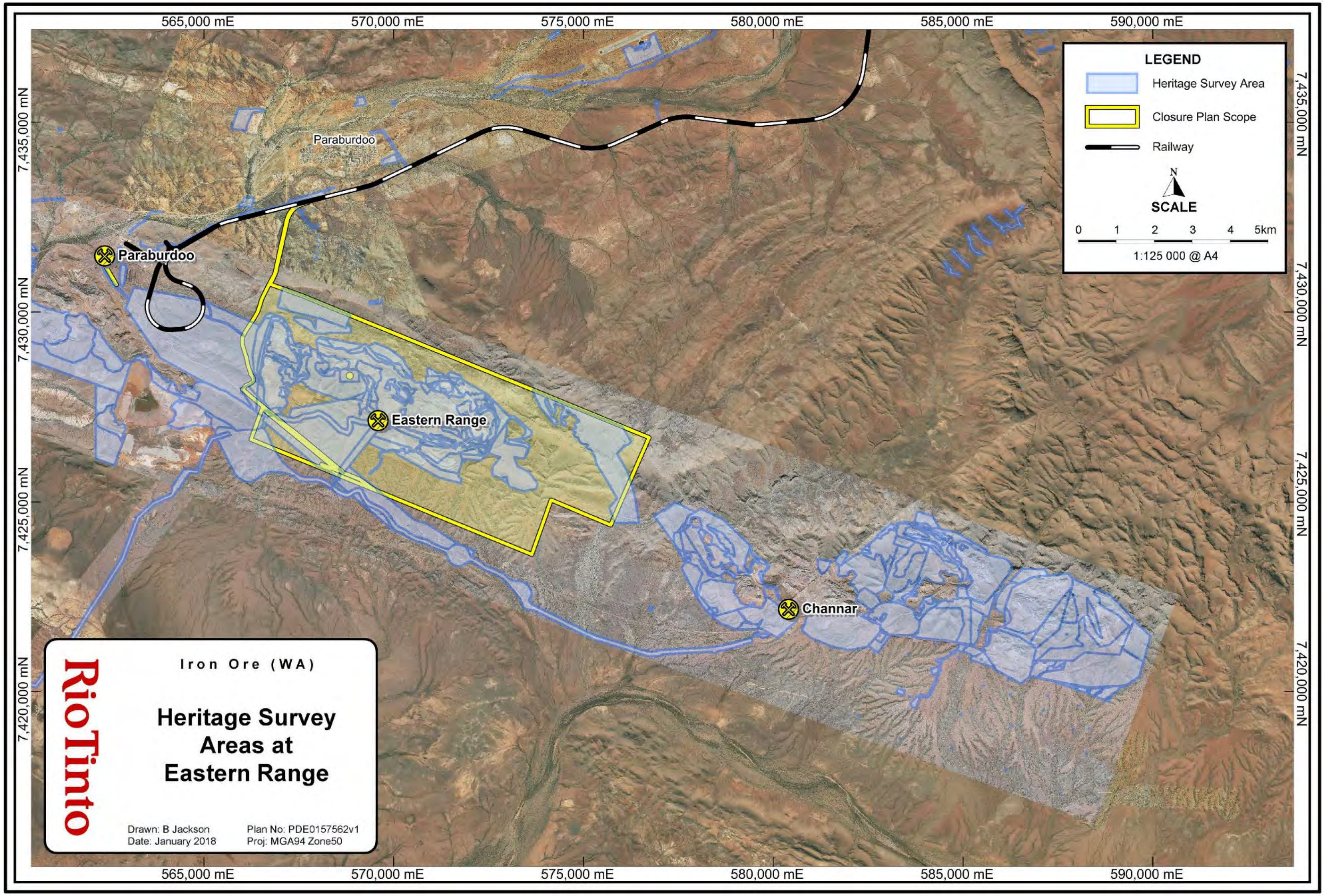


Figure 29: Heritage survey area at Eastern Range

17. Regional community and workforce

Communities that are geographically associated with Eastern Range include:

- the town of Paraburdoo - 8 km north of the site;
- the Bellary Springs Aboriginal Community - located approximately 30 km north of Paraburdoo town (a short distance off the Paraburdoo/Tom Price Road), which had a population of 50 people in 2008; and
- the Wakathuni Aboriginal Community - located approximately 50 km north of Paraburdoo town (a short distance off the Paraburdoo/Tom Price Road), which had a population of 72 in 2008[23].

The 2016 Australian Bureau of Statistics Census recorded a population of 1,380 in the town of Paraburdoo, which is approximately 130 people less than in 2011. The Eastern Range workforce of approximately 228 full time equivalent roles[24] is a combination of both fly-in, fly-out workers and residential workers residing in Paraburdoo. The majority of fly-in, fly-out staff travel from Perth to the Paraburdoo airport, with small numbers also flying from regional centres. They are housed in two fully serviced accommodation facilities, while the residential workforce resides in company and privately owned houses.

At this stage of closure planning, it is anticipated that regional mining activities at Greater Paraburdoo will continue after the closure of Eastern Range and therefore there is expected to be no significant impact to the local or regional community. While the communities associated with Eastern Range are specifically excluded from the scope of the closure plan as they are considered separately, detailed workforce planning, baseline studies and social impact assessments will be undertaken during the PFS to determine potential social impact to these communities as a result of closure of Eastern Range, and this will inform the development of mitigation strategies to limit impacts.

[23] A census was undertaken in 2016 however community information for Bellary Springs and Wakathuni was incorporated in the Paraburdoo and Tom Price datasets.

[24] This number excludes Channar and Paraburdoo roles.

IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

18. Risk evaluation process

During the OoM study a comprehensive closure risk assessment was prepared for Eastern Range. This built on the risk assessment completed during the 2016 conceptual closure plan for the site. Three sessions were held with a range of technical disciplines to confirm risks and associated ratings and identify any new risks. Risk was evaluated on the basis of the maximum reasonable outcome consequence and the likelihood of that consequence occurring. They were evaluated inclusive of current management and commitments, and represent current residual risk. Risks are assessed against the following consequence criteria:

- costs: economic impacts if the risk were to eventuate ranging from low to very high, determined as a percentage of the projected closure cost for the operation;
- health: reversible health effects of little concern (very low) to multiple fatalities (very high);
- personal safety: inconvenient first aid treatments (very low) to multiple fatalities (very high);
- environment: reversible impact (very low) to widespread, long-term impacts (very high), with these risks separated into two categories (during decommissioning/active closure implementation or post closure);
- community trust: mistrust amongst a small section of the wider community (very low) to widespread mistrust with key stakeholders (very high) and also includes potential heritage impacts ranging from reparable damage to a site of low cultural significance (very low) through to irreparable damage to a site of international cultural significance (very high); and
- compliance: non-conformance to internal requirements (very low) to prosecution for breach of regulatory licence(s) (very high).

Risks are separated into threats or opportunities and classified as follows:

- low (Class I): risks that are below the risk acceptance threshold and do not require further management at this stage.
- moderate (Class II): risks that lie on the risk acceptance threshold and require regular review to ensure management remains adequate and fit-for-purpose.
- high (Class III): risks that, based on the current level of knowledge, could exceed the risk acceptance threshold and require proactive management and / or resolution of knowledge gaps.
- critical (Class IV): risks that, based on the current level of knowledge, will exceed the risk acceptance threshold and require immediate attention.

A summary of the threat profile for Eastern Range is presented in Figure 30. This threat profile shows there are currently three Class I, five Class II, eight Class III and three Class IV threats associated with closure of the site. Threats that exceed the risk acceptance threshold comprise:

- closure outcomes do not meet stakeholder(s) / community expectations (Class IV);
- changes during planning and operations leads to increased closure complexity (Class IV);

- closure costs are not effectively provisioned (Class IV);
- AMD generation creates a contaminated site (Class III);
- landforms (excluding mine void areas) erode and / or collapse (Class III);
- vegetation does not meet completion criteria (Class III);
- adverse impact to flora or fauna with conservation status or wider regional impact to high value environment (Class III);
- heritage site condition / cultural value is degraded as a result of implementing the closure plan (Class III);
- mine closure has a significant, long-term detrimental impact on local communities (Class III);
- access to the area post-closure poses a public liability risk (Class III); and
- stakeholder engagement inadequate to meet requirements of the study (Class III).

Actions are assigned to risks that exceeded the risk acceptance threshold (Class III and IV) and therefore require additional control measures to reduce the risk to an acceptable level. Actions are also assigned to address knowledge gaps where it is assessed that further information is required to better understand and/or adequately assess the risk presented by an issue. These actions are summarised in Section 20 and also presented with the risk assessment in Appendix D.

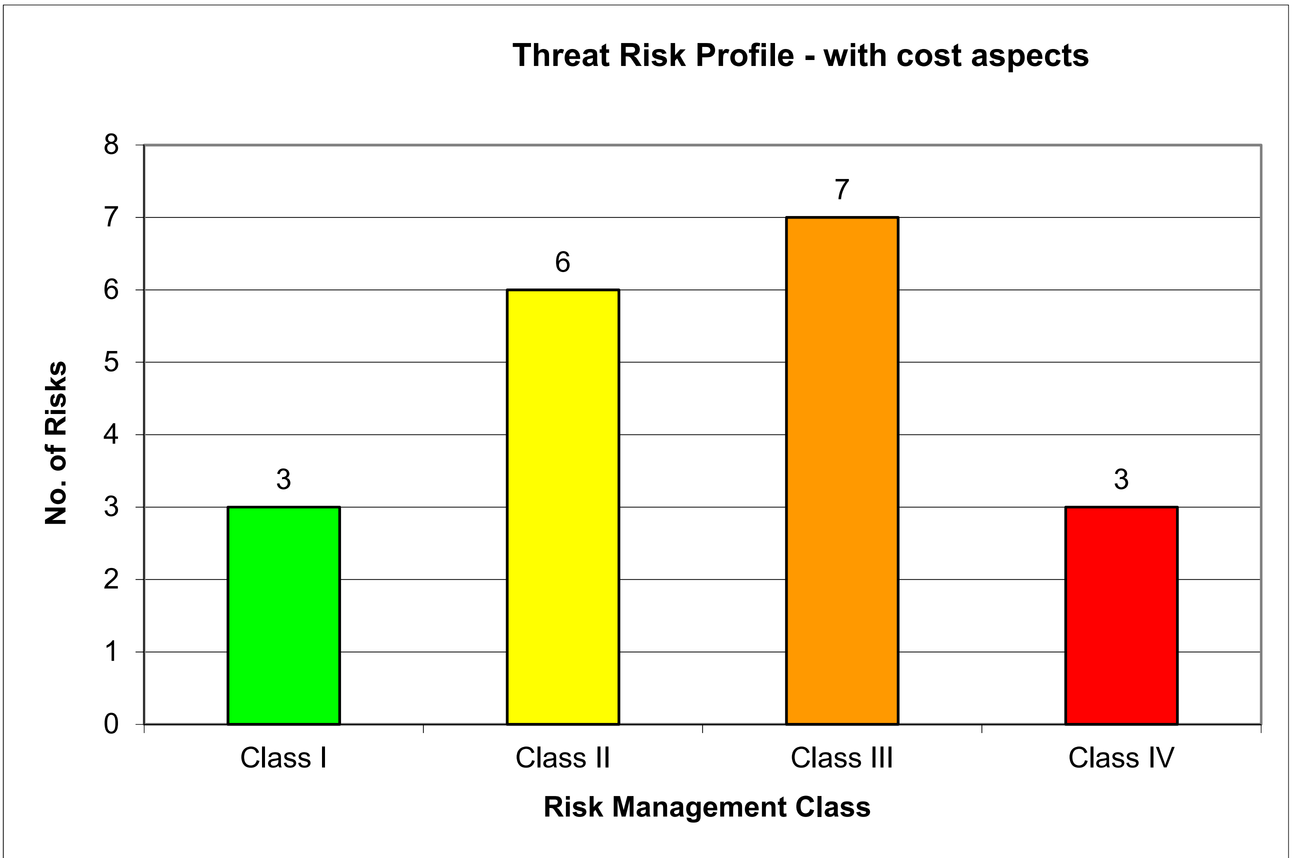


Figure 30: Eastern Range threat risk profile

19. Management of key issues

The DMP/EPA Guidelines for Preparing Mine Closure Plans lists a number of rehabilitation and closure issues that may be relevant for mine sites. An evaluation of the relevance of each of these issues to Eastern Range mine is presented in Table 23. The information in this table is intended to complement that contained in the risk assessment presented as Appendix D.

Table 23: Relevance of potential closure and rehabilitation issues to Eastern Range

Issue	Evaluation of relevance to Eastern Range	Further discussion
AMD	Geochemical studies have identified a low AMD risk for Eastern Range with the exception of 32E deposit. Pit designs which would have intercepted PAF material have been redesigned to avoid intercepting this material (Class III threat).	Section 19.1
Challenges associated with rehabilitation and revegetation	Rehabilitation conducted to date appears to have resulted in good outcomes. However, there are some challenging structures that will require rehabilitation at the end of mine life (Class III threat). The site is expected to have a topsoil shortage at closure (Class III threat).	Section 19.2
Dispersive, sodic and erosive materials	Mineral waste contains a low fraction of material that is classified as highly erodible. Further testing is proposed in the PFS to confirm classifications for historic dumps (Class III threat).	Section 19.3
Fibrous materials	No fibrous material has been or is expected to be intersected. This is not an issue that is considered to require additional management for closure.	Not addressed further in this chapter.
Radioactivity	Not considered a risk for this site.	Not addressed further in this chapter.
Adverse impacts on surface and groundwater quality	Groundwater quality is not expected to be impacted as a result of the closure strategy. Surface water quality may be impacted where rehabilitation of the mining landform results in sedimentation or the mining landform is impeding surface flows; however impacts are being avoided or remediated as much as practical (Class III threat).	Section 19.10
Alteration of the depth to water table of the local aquifer	All mining is AWT and alteration of groundwater depth is not expected.	Not addressed further in this chapter.
Mine pit lakes	All mining is AWT and the formation of pit lakes is not expected.	Not addressed further in this chapter.
Geotechnical instability	Several waste dumps and landbridges intersect zones of instability around pit walls (Class II threat).	Section 19.4
Inadvertent public access	Abandonment bunds will be required to restrict inadvertent public access to potentially unstable pit edge zones. Access for Traditional Owners to the area is required post closure (Class III threat).	Section 19.5

Issue	Evaluation of relevance to Eastern Range	Further discussion
Hazardous materials	Hazardous materials (e.g. hydrocarbons, ammonium nitrate) will be removed prior to, or during, decommissioning to the extent reasonably necessary (Class II threat).	Not addressed further in this chapter.
Hazardous and unsafe facilities	All infrastructure is expected to be salvaged or demolished during decommissioning, or handed to the State in accordance with State Agreement requirements (Class III threat).	Section 19.6
Contaminated sites	There are no reportable contaminated sites. A preliminary sampling and investigation will be undertaken during the PFS to determine if any remediation measures are required (Class II threat).	Not addressed further in this chapter.
Non-target metals and target metal residues in mine wastes	No chemical processing occurs at the site.	Not addressed further in this chapter.
Design and management of surface water structures	Surface water diversions are not planned and this is not considered to be a significant closure issue for the site. Surface water flows and velocities during a variety of flood events have been evaluated during the OoM and will inform surface water design requirements during the PFS.	Section 19.10
Dust emissions	This is not considered to be a significant closure issue for the site due to its remote location. Dust management will continue to be managed during closure implementation in accordance with operational dust control measures and monitoring requirements.	Not addressed further in this chapter
Noise/vibration/air blast	This is not considered to be a significant closure issue for the site given the remote location relative to human receptors. Noise and vibration management will continue to be managed during closure implementation in accordance with operational control measures and monitoring requirements.	Not addressed further in this chapter
Flora and fauna diversity/threatened species	Management is required of priority species (flora and fauna) habitats which are located in close proximity to the mining footprint (Class III threat).	Section 19.7
Visual amenity	This is not considered to be a significant closure issue due to the sites remote location. A visual amenity assessment will be undertaken in the PFS once the final landform is further refined and again post implementation.	Section 19.8
Heritage issues	Management of cultural heritage values will be conducted through processes established under the Indigenous Land Use Agreement and strategies incorporated into Cultural Heritage Management Plans (Class III threat).	Section 19.9

Issue	Evaluation of relevance to Eastern Range	Further discussion
Alteration of the direction of groundwater flow	Alteration of groundwater flows is not expected as all mining is AWT.	Not addressed further in this chapter.
Alteration of the hydrology and flow of surface waters	Alterations to the hydrology and flow of surface waters are expected to be localised. Landbridges have the potential to impound surface water (Class III threat).	Section 19.10

As defined within Section 18, risks associated with stakeholder expectations and stakeholder engagement were also identified during the risk process. Although these are not listed within the DMP/EPA Guidelines for Preparing Mine Closure Plans they are also discussed within this section.

19.1 Acid and / or metalliferous mine drainage

Rio Tinto has developed comprehensive practices for the management of PAF materials to reduce the risk of AMD being generated. This includes the Rio Tinto Iron Ore (WA) Mineral Waste Management Plan for Undeveloped Resources and Studies and the Rio Tinto Iron Ore (WA) Spontaneous Combustion and Acid Rock Drainage (SCARD) Management Plan. The management strategy for PAF material is based upon the following principles:

- identification of the black shale and/or elevated-sulfur material distribution and geochemical characteristics throughout the deposit;
- minimising the exposure and mining of black shale to the extent possible;
- identification and special handling of black shale that must be mined; and
- encapsulation of black shale (and elevated-sulfur material, if applicable) inside inert waste rock dumps to limit water contact and allow the dumps to be revegetated.

The November 2016 mine plan intercepted a minor amount of black MCS (estimate 9,000m3) in the 32E6 pit. Subsequent investigations found that this pit could be redesigned to avoid intercepting black MCS, thereby negating the need for PAF management at Eastern Range. This update to the closure plan takes into account this redesign, and therefore no ongoing PAF management is expected to be required for the site.

The presence of elevated-sulfur material is indicated by drillhole data within the Eastern Range project area. Here, elevated-sulfur material refers to material that is not sulfidic, but has a sulfur content greater than 0.1% and may contain the potentially acid forming sulfate mineral alunite. The assessment of this material is inherently conservative since sulfur is likely also derived from other non-acid forming minerals such as gypsum. The acidity potential of elevated-sulfur waste rock from Eastern Range was found to be negligible compared to the neutralising capacity of co-disposed waste rock.

On-going geochemical test work is required to validate this assessment; test work will be completed during operations as per the Iron Ore (WA) Mineral Waste Management Plan and the Iron Ore (WA) Spontaneous Combustion and ARD (SCARD) Management Plan for Operations, respectively. The aim of this test work is to assess the potential for neutral mine drainage and also to confirm that potential low levels of acid release from elevated-sulfur waste rock will be effectively buffered by the inherent neutralising capacity of the expected surrounding inert waste rock.

19.2 Challenges associated with rehabilitation and revegetation

Rio Tinto's iron ore mining operations in the Pilbara are typically large scale and long life. Multiple pits are mined simultaneously to meet grade and product requirements and waste dumps can be active for long periods. Consequently, long periods of time may elapse between the commencement of mining and the availability of areas for progressive rehabilitation. It is also anticipated that changes to iron ore markets may result in some material currently classified as waste being processed for ore in the future, in order to satisfy State Agreement and joint venture obligations of maximising resource benefits. Rio Tinto considers all of these aspects prior to progressing areas for rehabilitation to ensure that scarce topsoil and seed resources are appropriately utilised.

Opportunities to undertake progressive rehabilitation at Eastern Range are reviewed annually and available areas are incorporated into the rehabilitation plan. As identified in Section 14, just over 30 ha have been rehabilitated at Eastern Range to date.

Prior to rehabilitation being carried out, engineering designs are developed for each landform. These designs are technically reviewed by internal specialists from a range of disciplines and approved prior to implementation. Waste reshaping is then implemented in accordance with the approved design and survey controls and machine guidance systems are also used to ensure strict conformance to the planned landform design is achieved. At the completion of earthworks, areas are cross-ripped on contour and seeded with a native seed mix of local provenance (refer to Section 13.2.1). Seed is purchased from third party suppliers for use in rehabilitation activities. Stringent controls on seed quality, provenance and seed storage are in place and seed pre-treatments are used for some species to maximise the potential of germination under field conditions.

Rehabilitation success across Greater Paraburdoo to date has been variable, with poor rehabilitation outcomes observed in some older areas. However, significant improvements have been made in recent years in waste characterisation and landform design, leading to reduced erosion rates and improved waste dump stability. These refinements have resulted in improved rehabilitation outcomes, both at Eastern Range and other sites.

19.2.1 Rehabilitation complexities at Eastern Range

Eastern Range mining deposits are topographically elevated and therefore can present access and safety challenges to standard rehabilitation techniques. Landbridges in particular are challenging structures. Built to facilitate access between high points in the natural landscape where no alternative means of access is available, they are single faced structures constructed from mineral waste material, built at the angle of repose (~35 to 37 degrees) and in many cases they have access constraints. When assessing whether an individual landbridge should be removed or rehabilitated in-situ when it is no longer required, the following issues are considered:

- landform stability;
- waste material characterisation;
- terrain and safety implications for personnel/equipment;
- access;
- upstream and downstream heritage receptors;
- upstream and downstream environmental receptors;
- upstream ponding potential;
- footprint requirements and constraints;
- upstream catchment;
- flood management strategy;

- potentially unstable pit edge zone intersections;
- practicality;
- legal requirements; and
- cost.

As discussed in Section 22, a detailed assessment has been undertaken during the OoM study to determine the most suitable closure strategy for each individual landform. Further investigation and consultation will be undertaken in the PFS regarding any upside and downside scenarios in order to determine the final strategy for each landform. Design parameter details and schematics are presented in Appendix E with a summary presented in Table 24.

Table 24: Landform final design criteria

Landform	Lift height m	Batter angle degrees	Berm width with backslope m	Backslope degrees	Flat berm width m	Top crest mRL	Bottom toe mRL	Bottom toe m
23E_WD1	20	20	10	11	15	632	581	51
23E_32E_LB	20	20	10	11	15	570	470	100
23E_32E6_LB	20	20	10	11	15	645	610	35
23E_WD3	20	20	10	11	15	TBC	TBC	TBC
24E_LB	20	20	10	11	15	460	420	40
24E_WD2	20	20	10	11	15	480	430	50
32E6_WD	20	20	10	11	15	630	465	165
32E_ROM	20	20	10	11	15	535	450	85
32E_WD4	20	20	10	11	15	580	480	100
32E_WD4_LB	20	20	10	11	15	480	440	40
32E3_BF	In-pit, internally draining. Will be backfilled to pit crest level so top surface area will be ripped and seeded.							
37E_WD1	20	20	10	11	15	595	485	110
37E_WD2	20	20	10	11	15	550	420	130
32E_37E_LB	Cross valley section removed, remaining in-situ areas rehabilitated to same parameters as the remaining landscape.							
37E6_BF	In-pit, internally draining, no rehab required							
37E_LB	20	20	10	11	15	546	515	31
37E1_BF	In-pit, internally draining. Only northern edge where the ramp is located is externally draining so this section will be reshaped and rehabilitated.							
42E2_LB	20	20	10	11	15	560	466	94
42EE_LB	Valley fill removed as practical and safe, remaining in-situ areas rehabilitated to same parameters as the remaining landscape.							
42E_WD1	20	20	10	11	15	635	617	18
47E_LB	Cross valley section removed, remaining in-situ areas rehabilitated to same parameters as the remaining landscape.							

19.2.2 Alternative growth media

As discussed in Section 11.8, there is expected to be a deficit of topsoil and subsoil material at Eastern Range at closure. One strategy to address this topsoil shortage is to use mined waste materials as alternative growth media. The Operations team has proactively identified potential alternative materials at the site. Sampling has been conducted on materials mined at the adjacent Channar mine and deemed them to be a suitable subsoil substitute. As this material presents in mining at Eastern Range it will be similarly tested and stockpiled if deemed suitable.

A trial is also underway at the nearby Tom Price operation on the MMW4 waste dump to validate the suitability of mineral waste material for use as alternative growth media in rehabilitation activities at Rio Tinto operations. Tom Price is also trialling rehabilitation with no use of topsoil, i.e. direct seeding of the dump landform, on the MME waste dump. Rehabilitation using no topsoil has also been implemented at the 84E5 waste dump at Channar in 2011 and the CH94E8 waste dump bottom lift at Channar in 2019. If alternative materials prove viable in rehabilitation success, it is proposed that topsoil application be prioritised to higher risk areas (e.g. large waste dumps and landbridges) and lower risk areas such as laydown or infrastructure areas will receive alternative growth media or no soil material if unavailable. If required, seeding rates may be increased in areas receiving alternative growth media or subsoil material to compensate for the lack of a topsoil seedbank. The application of fertiliser will also be considered for materials that have low nutrient status, although recent evidence suggests the addition of fertiliser is not always beneficial.

19.2.3 Seed availability

Each year a biannual seed collection (autumn and spring) is completed across numerous locations in the Pilbara to ensure there is sufficient seed for rehabilitation projects. This is driven by the level of progressive rehabilitation expected across each site in the short to medium term. This process has recently started to consider the sourcing of additional seed beyond medium term planned rehabilitation to meet longer term seed requirements as sites begin to approach closure. During the OoM study, work was undertaken to forecast the life of mine seed requirements for Eastern Range. This involved:

- a review of legal requirements with regards to seed for Eastern Range;
- a review of the potential for including priority species in seed mixes;
- a review of rehabilitation monitoring reports for the site;
- the development of a recommended seed list;
- a review of seed application rates (kgs/hectare) to account for seed viability and areas which may not receive topsoil;
- a review of seed treatment requirements; and
- a forecast of seed requirements based on this information and planned life of mine disturbance.

In terms of priority flora species, the OoM review concluded that these should not be focused on at this point for several reasons including:

- these plants by nature generally do not produce a significant amount of seed. Seed produced is required to maintain these populations and collecting it could have a detrimental impact;
- their habitat preference (preference for drainage lines, gullies, calcretes or other habitat not suitable or similar to those likely to be present in the rehabilitation landscapes);
- propagation methods – some species are not able to germinate from seed and cuttings are required which is not a suitable method for broad scale application in an arid environment; and
- seed dormancy traits.

Trials have been conducted on three priority flora species to date by Rio Tinto to understand the potential for including these species in rehabilitation. These include *Ptilotus subspinescens*, *Indigofera sp. Bungaroo Creek* and *Aluta quadrata*. To date these efforts have not been successful. *Aluta quadrata* showed some success in growing from cuttings in laboratory conditions however when relocated to the Pilbara, only a single specimen survived. This species does not occur naturally at Eastern Range however further research is planned on the species as part of the Western Range project.

Under the current NVCP CPS 4032/4 for Eastern Range, which was last revised in November 2016, the operation is required to ensure that rehabilitation is undertaken with 'native vegetation that will result in a similar species, composition, structure and density of native vegetation to pre-clearing vegetation types in that area and ensuring only local provenance seeds and propagating material are used'.

The Eastern Range NVCP defines local provenance as 'native vegetation seeds and propagating material from natural sources within 200 km and the same Interim Biogeographic Regionalisation for Australia (IBRA) subregion of the area cleared'. The IBRA zone that Eastern Range falls within is depicted in Figure 31. This has been clipped to a 200km radius of the site as required by the NVCP. The seed provenance zone used by Rio Tinto for the Tom Price and Greater Paraburdoo areas in the absence of a defined local provenance condition is shown in Figure 32. By comparing the two zones it is evident that while the NVCP condition allows for an expansion of the seed collection area to the west and east, the mine operation is located very close to the southern boundary of the IBRA zone and therefore collection from areas south of the site are significantly constricted.

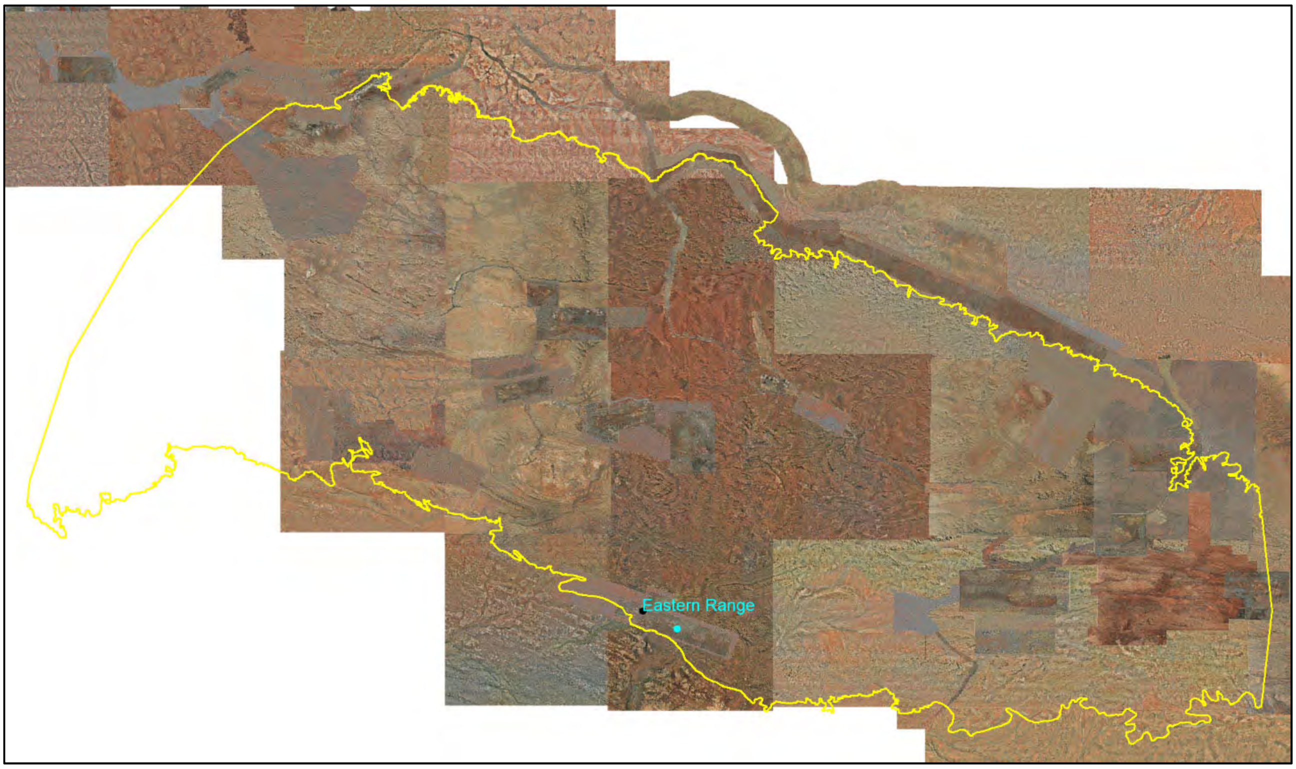


Figure 31: Eastern Range seed collection zone (shown in yellow) based on NVCP conditions

A seed list was subsequently developed which separated species compositions across the three main landscape types expected in the final landform; rocky plains, hill slopes and undulating plains, and the quantities of each seed type was estimated. The quantities provided in Table 25 have been calculated based on the expected final landform disturbance surface area.

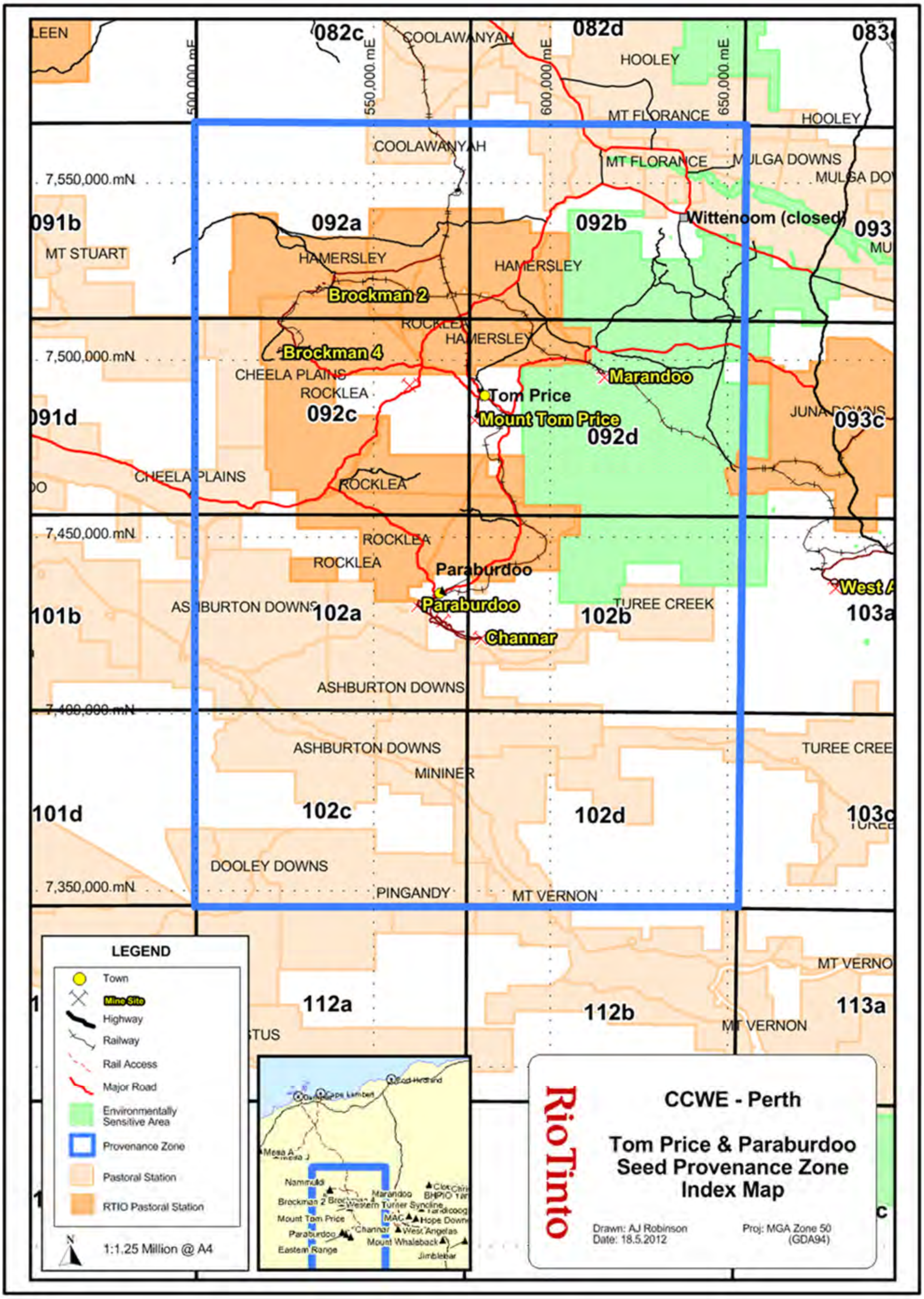


Figure 32: Tom Price and Paraburdoo seed provenance zone in the absence of an IBRA condition

Table 25: Seed forecast to be required to rehabilitate Eastern Range (including future disturbance)

Landform	Seed required (kg)	Seed required including 20% contingency (kg)
Rocky plains	1,048	1258
Hill slopes	3,814	4577
Undulating plains	346	416
Total	**5,209**	**6251**

Some of this required seed has already been procured and is in storage, however the majority is required to be procured. It is estimated that 16 per cent of the seed required is currently in stock. It should be noted that this figure is calculated based on Eastern Range and Channar combined requirements. It does not take into account any progressive rehabilitation which may occur either at these sites or at other sites within the same provenance zone between now and the point of closure for Eastern Range.

During the PFS, this reconciliation will be revised to account for the revised life of mine plan (LoM) disturbance. A targeted seed procurement strategy has commenced to ensure additional seed begins to be sourced and stored in anticipation of closure requirements.

19.3 Dispersive, sodic and erosive materials

The objectives of waste dump and landbridge design is to achieve landforms which are:

- safe;
- stable;
- non-polluting;
- aesthetically compatible with the surrounding landscape;
- vegetated; and
- compatible with the agreed post-mining land use.

Achieving long term stability of waste landforms is considered fundamental to the successful rehabilitation and closure of a site. Stability is largely controlled by the nature of the surface materials, as well as the rehabilitation parameters adopted. Rio Tinto has performed, and continues to undertake, characterisation and landform evolution modelling of mineral waste types encountered at its Pilbara operations to determine erodibility characteristics and based on these develop appropriate rehabilitation design parameters. The design criteria and guidelines are subject to ongoing review, with the most recent update in 2017. These parameters are based on the assumption that an average erosion rate of 5t/ha/year (with a maximum of 10t/ha/year) will be acceptable, and modelling is conducted on the conservative assumption of no vegetation cover being present, which will provide further surface stabilisation.

Eastern Range is dominated by low erodibility wastes, such as Dales Gorge and Joffre BIF and footwall zone material. As a result, the majority of waste dumps and landbridges are considered to have a low erosion risk, however some mineral waste units are expected to be moderately or highly erodible, as outlined in Table 7 through to Table 11. Based on current characterisation knowledge, rehabilitation parameters for the majority of landforms comprise of maximum 20m high lifts, 20 degree batter slopes and 10m berm widths, along with an 11 degree berm backslope. This is aligned to the design criteria defined in Rio Tinto's Landform Design Guidelines.

19.3.1 Management of dispersive, sodic and erosive materials

Management options for highly erodible waste material have been reviewed with respect to the mine sequence, considering frequency of occurrence for highly erodible waste material, availability of pits for in-pit backfill, availability of materials for capping and stockpile requirements for capping. All waste dumps within the scope of this closure plan are expected to have sufficient volumes of low erodibility material to create stable final landforms, however targeted geological assessments will be completed in PFS to confirm this. Once confirmed, designs will be revised as required. At this stage no specific management is proposed for sodic soils based on site specific soil sampling for Eastern Range.

19.4 Geotechnical instability

Mining safety in Western Australia is regulated by DMIRS under the *Mines Safety and Inspection Act 1994*, the *Mines Safety and Inspection Regulations 1995*, and the *Mines Safety and Inspection Amendment Bill 2009*. For the majority of Rio Tinto operations the issue of public safety is mainly related to the potential for the public to inadvertently access pit voids (or areas of potential instability surrounding pits). Open pits are designed to be stable during the life of the mining operations, but may not be stable in the long term as materials weather and erode, leading to instabilities in sections of the pit walls. These instabilities may lead to significant risks to people who access these areas in vehicles or on foot.

A number of pits in the Eastern Range deposits have weaker shale bands and bedding planes within the BIF, in which the northern pit walls have been excavated. These can dip into the pits at angles less than the 25 degrees prescribed by DMIRS for weathered rock mass. These slope sectors will be assessed in further detail during the PFS to finalise appropriate safety abandonment bund placement.

The overall slope angles of the rehabilitated waste dumps and landbridges have been set at 20 degrees. This is aligned to the design criteria defined in Rio Tinto's Landform Design Guidelines. These slope angles are relatively shallow due to erosional considerations and seldom present an inherent stability issue. An assessment was undertaken in the OoM study of all of the waste dumps and six of the landbridges utilising the stability rating and hazard classification framework prescribed by the industry guideline Guidelines for Mine Waste Dump and Stockpile Design[25]. Four of the waste dumps (Figure 33) were rated as a moderate stability hazard and two of the landbridges (Figure 34) were rated as a high stability hazard due to lack of knowledge on foundation conditions and construction and performance factors. These landforms require further investigation in the PFS to improve knowledge to either lower their hazard rating, or to determine if amendments to rehabilitation design criteria are required.

19.4.1 Management of landforms within the potentially unstable pit edge zone

At Eastern Range, 20 pit voids (including pit extensions) will remain after closure. As indicated in Section 11.6, there is no intent to reshape or rehabilitate these in-pit areas, and the remaining pit walls will be retained in the same configuration as when mining ceases. It is recognised that there will be some degree of geotechnical instability, and that walls will have the potential to collapse in some areas. This area is referred to as the potentially unstable pit edge zone (PUPEZ). All rehabilitation designs for waste dumps and landbridges have taken this potentially unstable zone into consideration; however some toes of waste dumps and landbridges to be rehabilitated currently have minor intersections within this PUPEZ, as highlighted in Figure 35 to Figure 37. This will continue to be assessed in the PFS to determine if material from individual landforms requires removal or whether it can be left in-situ.

[25] Hawley and Cunning, 2017. *Guidelines for Mine Waste Dump and Stockpile Design*. CSIRO Publishing.

				Mining Area	ER	ER	ER	ER	ER	ER	ER	ER	ER	ER
				Landform Name	23E_WD1	23E_WD2	24E_WD2	32E_ROM	32E3_Pit_BF	32E_WD4	32E6_WD	37E_WD1	37E_WD2	42E_WD1
Regional Setting	Seismicity	Engineering Geology Index (EGI)	Waste Dump & Stockpile Stability Rating (WSR) WSR = EGI + DPI	0.21g Estrada 2009	1	1	1	1	1	1	1	1	1	1
	Precipitation			271mm BOM Para	6	6	6	6	6	6	6	6	6	6
Foundation Conditions	Foundation Slope			Ave angle	2.5	4	5	4	5	1	2.5	2.5	4	2.5
	Foundation Shape				0.5	1.5	1.5	1.5	2	0	1	1	1.5	1
	Overburden Type				3	3	3	3	4	3	3	3	2	2
	Overburden Thickness				1.5	1.5	2	1.5	2	1.5	1.5	1.5	1	1.5
	Undrained Failure Potential				-2.5	-2.5	0	0	0	-5	-2.5	-2.5	-5	-5
	Foundation Liquifaction Potential				-2.5	0	0	-2.5	0	-2.5	-2.5	-2.5	-2.5	-2.5
	Bedrock				2	2	1	1	2	1	1	1	1	1
	Groundwater				1.5	2	1	1.5	3	1	1.5	1.5	1.5	1.5
Material Quality	Gradation			Ave Snowden report	3	3	3	7	3	3	3	3	3	3
	Intact Strength & Durability				4	4	4	0	4	4	4	4	4	4
	Material Liquifaction Potential				-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
	Chemical Stability				2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Geometry & Mass	Height	Design & Performance Index (DPI)			3	4	4	4	3	3	3	3	3	3
	Slope Angle			rehab 20° = 3	3	3	3	3	3	3	3	3	3	3
	Volume and Mass				1.5	2	1	1.5	1.5	1	1.5	1.5	1	1.5
Stability Analysis	Static Stability				7	7	7	7	7	7	7	7	7	7
	Dynamic Stability				1.5	1.5	1.5	2	3	1.5	1.5	1.5	1.5	1.5
Construction	Construction Method				6	8	8	8	8	8	8	8	8	8
	Loading Rate				7	7	7	7	7	7	7	7	5	7
Performance	Stability Performance				15	15	15	7.5	15	0	15	7.5	7.5	7.5
			Overall Rating (WSR)		61.5	70.5	71.5	61.5	77	42	63	55.5	51	52
			Hazard Class (WHC)		II	II	II	II	II	III	II	III	III	III
			Instability Hazard		LOW	LOW	LOW	LOW	LOW	MOD	LOW	MOD	MOD	MOD

Figure 33: Waste dump stability hazard ratings using the Hawley and Cunning framework.

				Mining Area	ER					
				Landform Name	**23E_32E6_LB**	**32E_WD4_LB**	**24E_LB**	**23E_32E_LB**	**32E_37E_LB**	**42E2_LB**
Regional Setting	Seismicity	Engineering Geology Index (EGI)	Waste Dump & Stockpile Stability Rating (WSR) WSR = EGI + DPI	0.21g Estrada 2009	1	1	1	1	1	1
	Precipitation			271mm BOM Para	6	6	6	6	6	6
Foundation Conditions	Foundation Slope			Ave angle	2.5	4	4	2.5	0	0
	Foundation Shape				1	1	1	1	0.5	0.5
	Overburden Type				3	2	3	3	1	2
	Overburden Thickness				1.5	1.5	1.5	1.5	0.5	1
	Undrained Failure Potential				-2.5	-2.5	-2.5	-2.5	-10	-5
	Foundation Liquifaction Potential				-2.5	-2.5	-2.5	-2.5	-5	-5
	Bedrock				1	1	1	1	1	1
	Groundwater				3	1.5	1.5	1.5	0	0
Material Quality	Gradation			Ave Snowden report	3	5	5	3	4	4
	Intact Strength & Durability				4	4	4	4	4	4
	Material Liquifaction Potential				-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
	Chemical Stability				2.5	2.5	2.5	2.5	2.5	2.5
Geometry & Mass	Height	Design & Performance Index (DPI)			4	2	4	3	3	3
	Slope Angle			rehab 20° = 3	3	3	3	3	3	3
	Volume and Mass				2	1	2	1.5	1.5	1.5
Stability Analysis	Static Stability				7	7	7	7	7	7
	Dynamic Stability				1	1.5	1.5	1	1	1
Construction	Construction Method				6	8	8	8	0	0
	Loading Rate				5	5	5	5	5	5
Performance	Stability Performance				15	15	15	15	0	0
			Overall Rating (WSR)		64	64.5	68.5	63	23.5	30
			Hazard Class (WHC)		II	II	II	II	IV	IV
			Instability Hazard		LOW	LOW	LOW	LOW	HIGH	HIGH

Figure 34: Landbridge stability hazard ratings using the Hawley and Cunning framework.

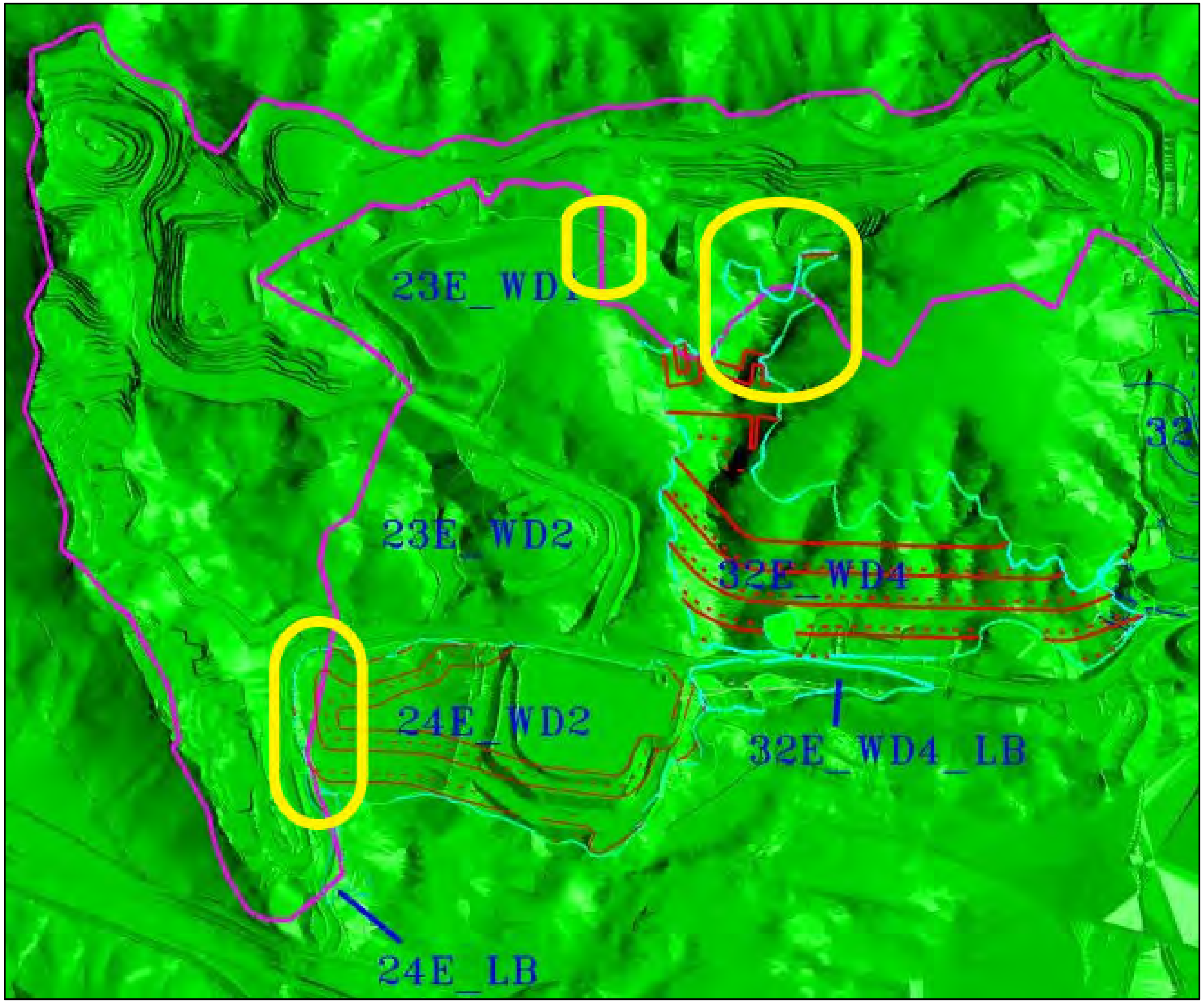


Figure 35: Intersections between the PUPEZ and closure landforms at 23E, 24E and 32E. Purple line is PUPEZ, yellow polygons indicate waste landforms which have intersections with this zone.

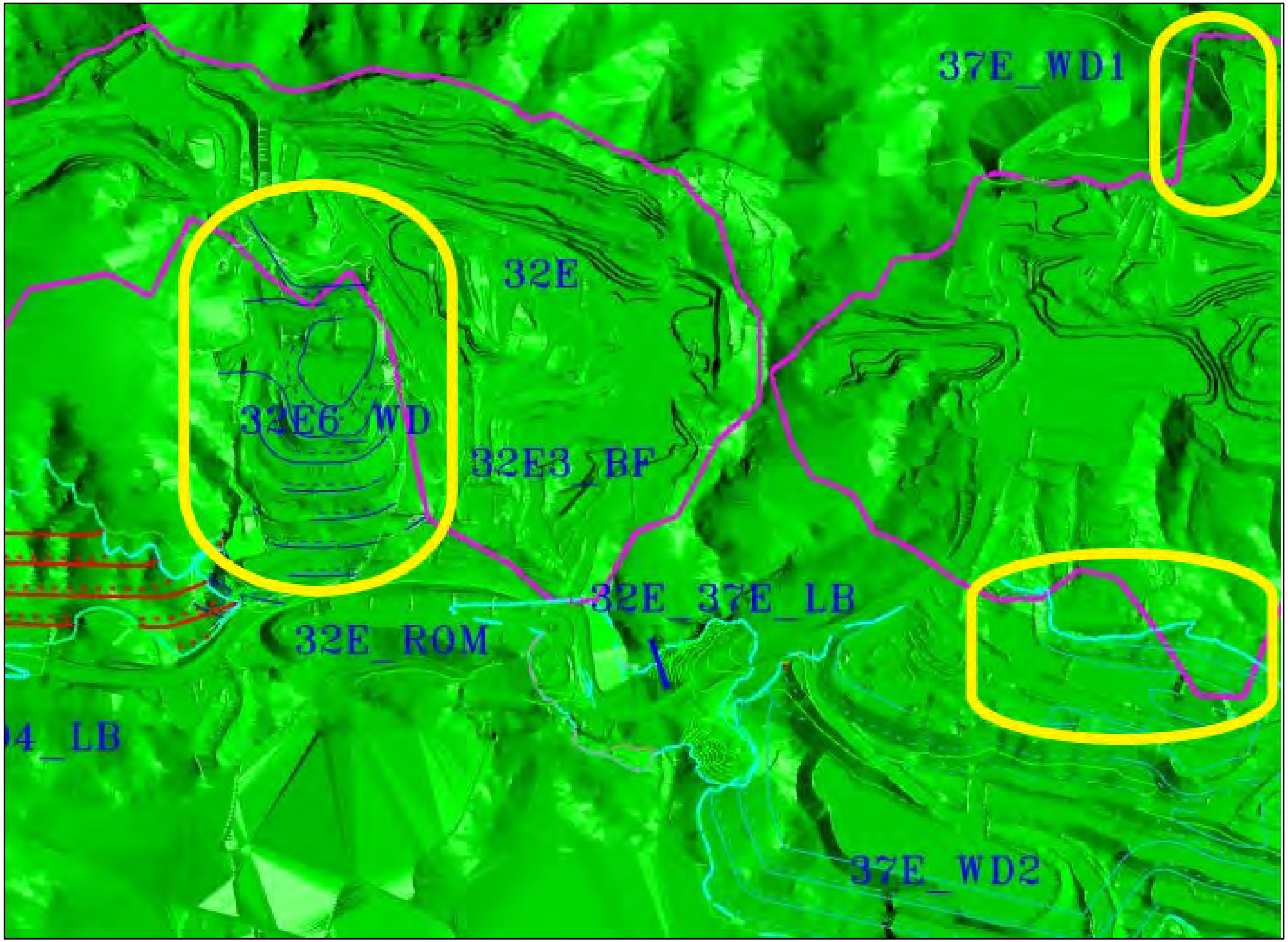


Figure 36: Intersections between the PUPEZ and closure landforms at 32E and 37E. Purple line is PUPEZ, yellow polygons indicate waste landforms which have intersections with this zone.

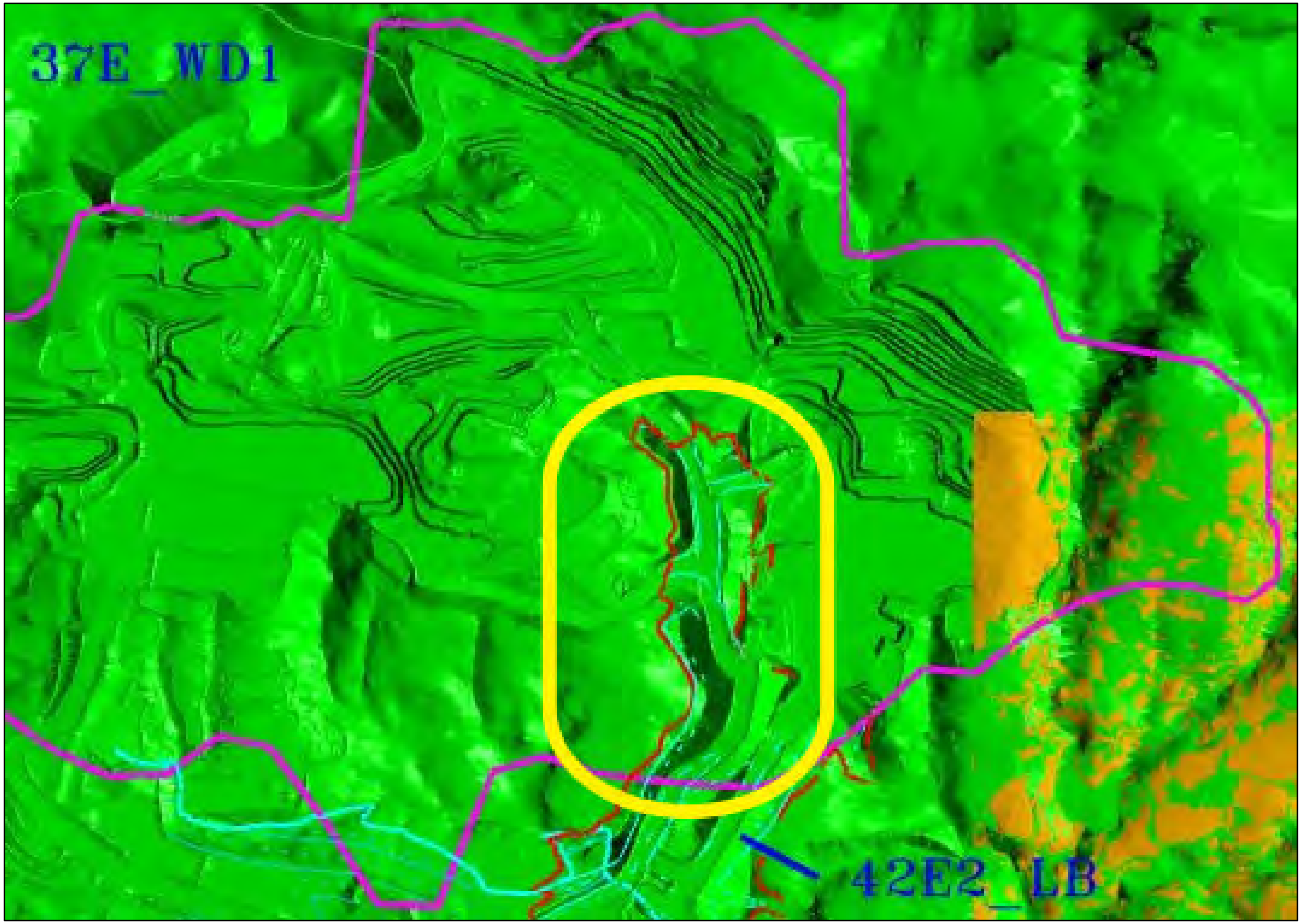


Figure 37: Intersections between the PUPEZ and closure landforms at 37E and 42E. Purple line is PUPEZ, yellow polygons indicate waste landforms which have intersections with this zone.

19.5 Site access

19.5.1 Inadvertent public access and post closure access

Eastern Range is situated in a remote location, on unallocated crown land, with very few public roads in the immediate vicinity. Public access is likely to be limited due to the remoteness of the site and the implementation of measures to actively discourage access. Furthermore, the final landform is not expected to contain any unique features that would attract visitors.

The period immediately following the bulk earthworks rehabilitation phase is expected to require the highest level of maintenance and may require rework of some sections as the landform materials settle and vegetation is established. At the completion of this phase, it is expected that further roads and tracks can be decommissioned and rehabilitated, leaving only those access routes deemed necessary for ongoing monitoring and in consultation with stakeholders and Traditional Owners.

Post closure access will remain to the Turee Creek and Channar borefields and associated infrastructure for maintenance requirements. The terrain is rugged to the north of the site and the potential for alternative vehicular access routes is limited. The most viable opportunity for access by off-road vehicles is from the south where topography is relatively flat in comparison. While Eastern Range does not overlie pastoral station tenure it is possible that cattle may access the area post closure.

19.5.2 Traditional owner and monitoring access

During the OoM study, a review was undertaken to define post closure access requirements for Traditional Owners, particularly to heritage sites, and also for post closure monitoring needs until site relinquishment. Access routes will need to be planned with consideration given to industry safety requirements for closed mine pits. Features outlined in Table 26 are sites of archaeological and/or ethnographic significance for which access should be retained post closure as a minimum where possible. These do not represent the full suite of heritage sites across Eastern Range as referred to in Section 16.2, rather those which are known to be of high significance. They are also presented visually in Figure 38.

At this stage of planning it has been proposed that access to heritage sites will be provided via the unsealed heavy vehicle road to the south of the existing sealed Channar access road. This road is proposed to be retained for maintenance access to the Turee Creek and Channar borefields. The management approach to this road when production at Paraburdoo ceases will be determined in consultation with relevant stakeholders and documented in the Paraburdoo Closure Plan. All other road access is proposed to be removed. Consultation with Yinhawangka during the OoM study indicated that this road would provide driving access to a point and from there access would continue on foot via drainage channels i.e. creeklines. This is how access to the area occurred prior to mining infrastructure being constructed. These access routes should be considered indicative at this stage and will continue to be refined in future study phases based on stakeholder feedback.

Table 26: Areas of cultural significance where access should be retained

Field site no.	Site identification	Date recorded	Status
ERC02-02	19545	2002	Protected
ERC02-44	19578	2002	Protected
PB12_ 11	-	2012	Protected
ERC02-03W	19584	2002	Protected
ERP21A	17058	1998	Protected
ERP21B	17058	1998	Protected
ERP21C	17058	1998	Protected
P05639	7293	1984	Protected
Pool	-	2001	Protected
Rock hole	-	1997	Protected
ERC02-01W	19582	2002	Protected
ERC02-02W	19583	2002	Protected
P05635-1A	19363	1985	Protected
P05635-1AI	19363	1985	Protected
P05635-5	19368	1985	Protected

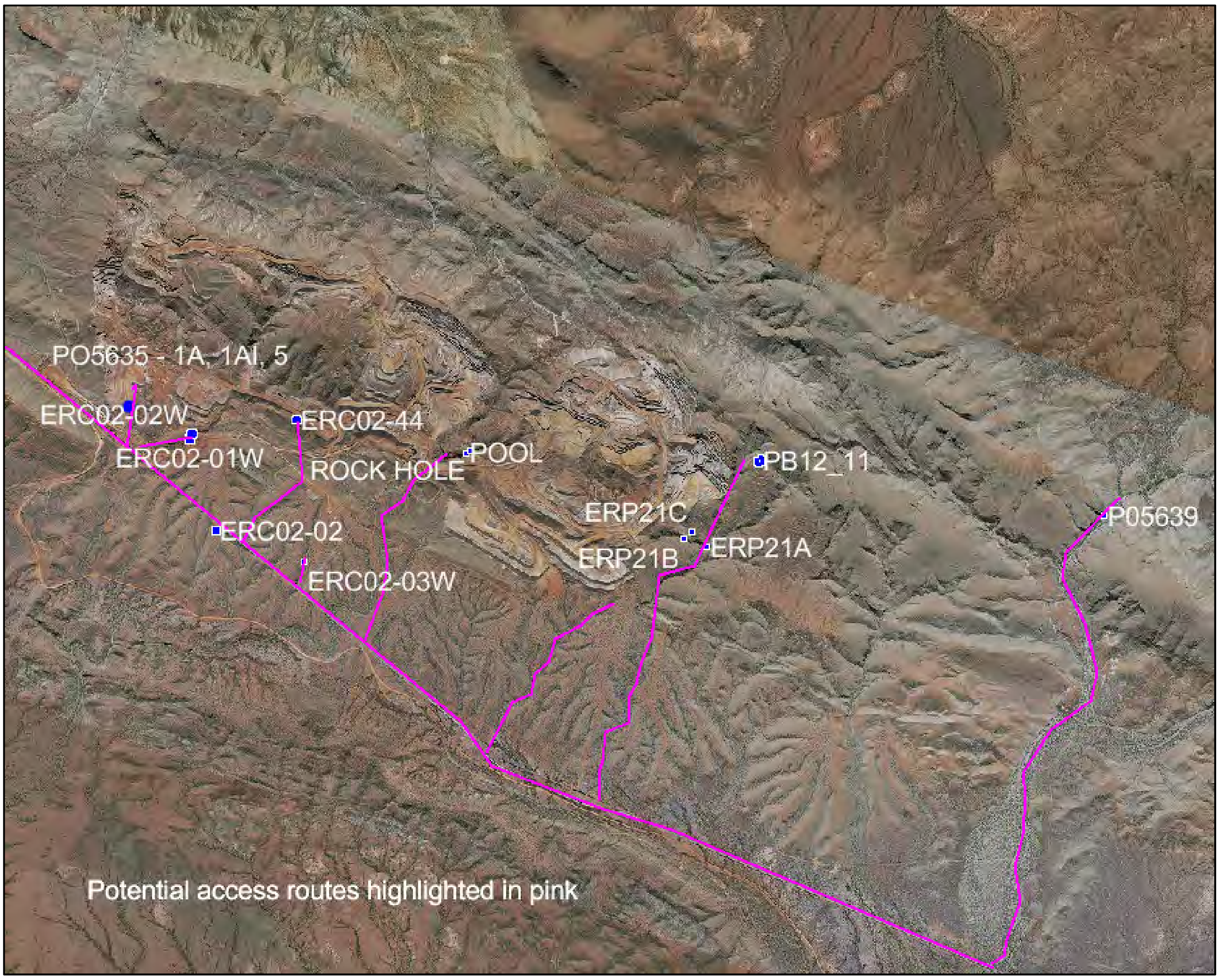


Figure 38: High significance heritage sites at Eastern Range and proposed access routes

19.5.3 Management of inadvertent pit access

The DMIRS[26] Safety Bund Walls Around Open Pit Mines Guideline is currently the industry recognised document which prescribes the requirements for restricting inadvertent access to mine pit voids once they are mined out. This document prescribes a methodology for defining the PUPEZ and then constructing an earthen safety bund (also described as an abandonment bund) which is 2m high and 5m wide at the base beyond this area (10m minimum offset from the unstable zone) as a measure to restrict inadvertent access to this area, as shown in Figure 39.

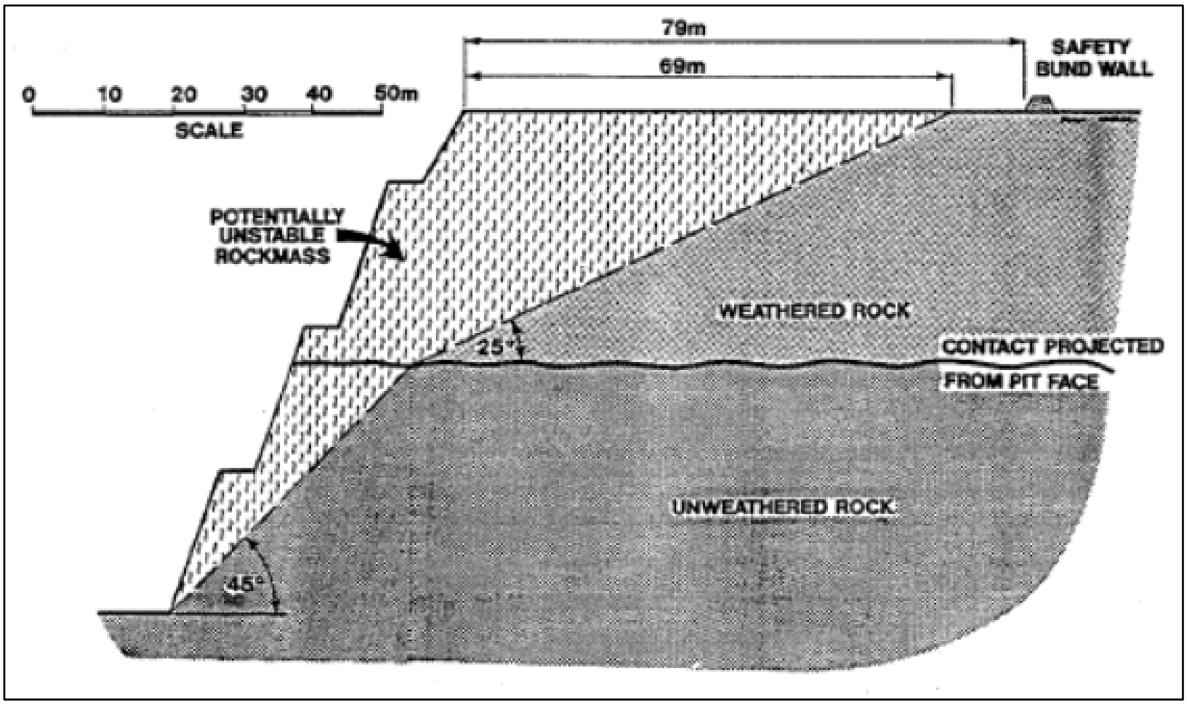


Figure 39: Example of safety bund location assessment

During the OoM an assessment of safety bund placement was undertaken. Built landforms and natural surfaces with similar low slope angles were not considered as a means of facilitating access restriction in determining the appropriate placement. The preliminary bund location, shown in Figure 41, is further outside the PUPEZ than required in most locations due to topographical constraints. This location would prevent access to all of the above detailed heritage sites except for P05639, ERC02-02 and ERC02-03W. In the PFS the approach to restricting inadvertent access while also retaining access to key heritage sites will continue to be developed in consultation with key stakeholders. Alternate methods of preventing access may include:

- natural topography providing a physical barrier to access;
- removal or blocking of roads where appropriate (e.g. windrows);
- use of large rocks to prevent vehicular access but allowing surface water flows;
- creating safe access to specific areas where required (e.g. sites of cultural heritage significance), such as through buttressing of pit walls to reduce the PUPEZ;
- installation of gates along roads that need to be accessed (e.g. to facilitate monitoring) and/or installation of appropriate signage.

[26] Department of Industry and Resources, 1997. *Safety Bund Walls Around Open Pit Mines Guideline.*

Note: DoIR became Department of Mines and Petroleum in 2009 and then became the Department of Mines, Industry Regulation and Safety in 2017.

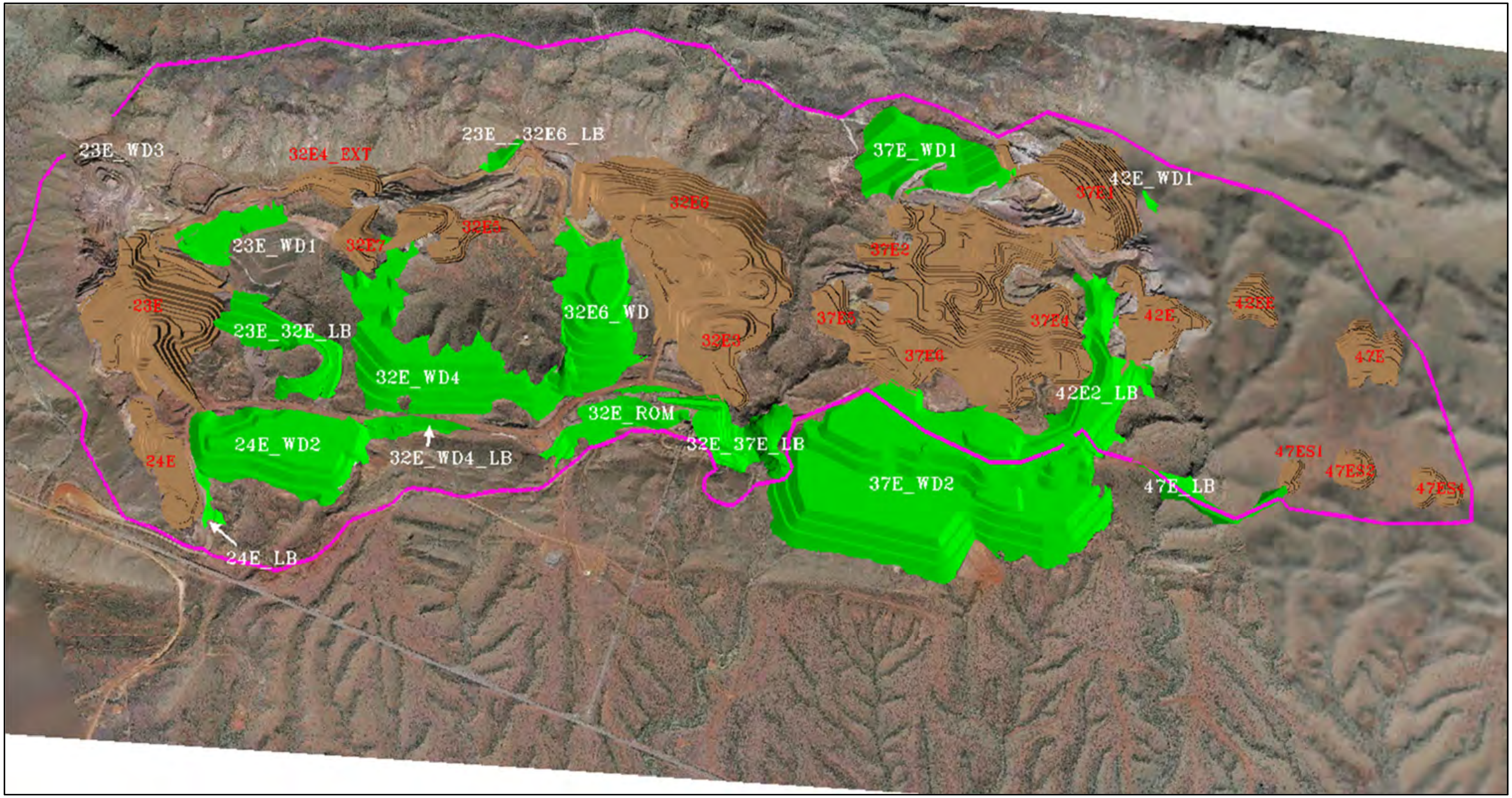


Figure 40: Preliminary safety bund location shown in pink

19.6 Hazardous and unsafe facilities

The infrastructure at Eastern Range is in a remote location and at the time of closure will be in excess of 20 years old in some cases. It is therefore considered unlikely that the State would seek to retain this infrastructure. However this will be determined during consultation with the State at an appropriate time prior to removal/decommissioning.

For the OoM it has been assumed that all infrastructure and buildings at Eastern Range will be decommissioned and demolished prior to rehabilitation. All structures and footings above surface or within 1 m of the final land surface will be removed to an on-site inert waste landfill (at this stage designated as 37E6 pit), which will be covered with inert material and rehabilitated. This has been assumed for cost estimation purposes only at this stage as this pit is not currently licenced as an inert landfill and will require approval. In the PFS options for reuse at other sites as well as salvage for on sale or recycling will be assessed and built into planning processes where appropriate. Major infrastructure to be demolished includes:

- primary crushing facilities;
- fuel facilities;
- crib huts, operation centre and workshops;
- conveyor CV601 and CV602;
- secondary crushing TS602/603;
- conveyor CV603 and TS603/CV555;
- conveyor CV604;
- substations and powerlines;
- water pipelines and tanks; and
- roads and tracks.

The location of this infrastructure is shown in Figure 41 and inset in Figure *42* and Figure *43* to show further detail.

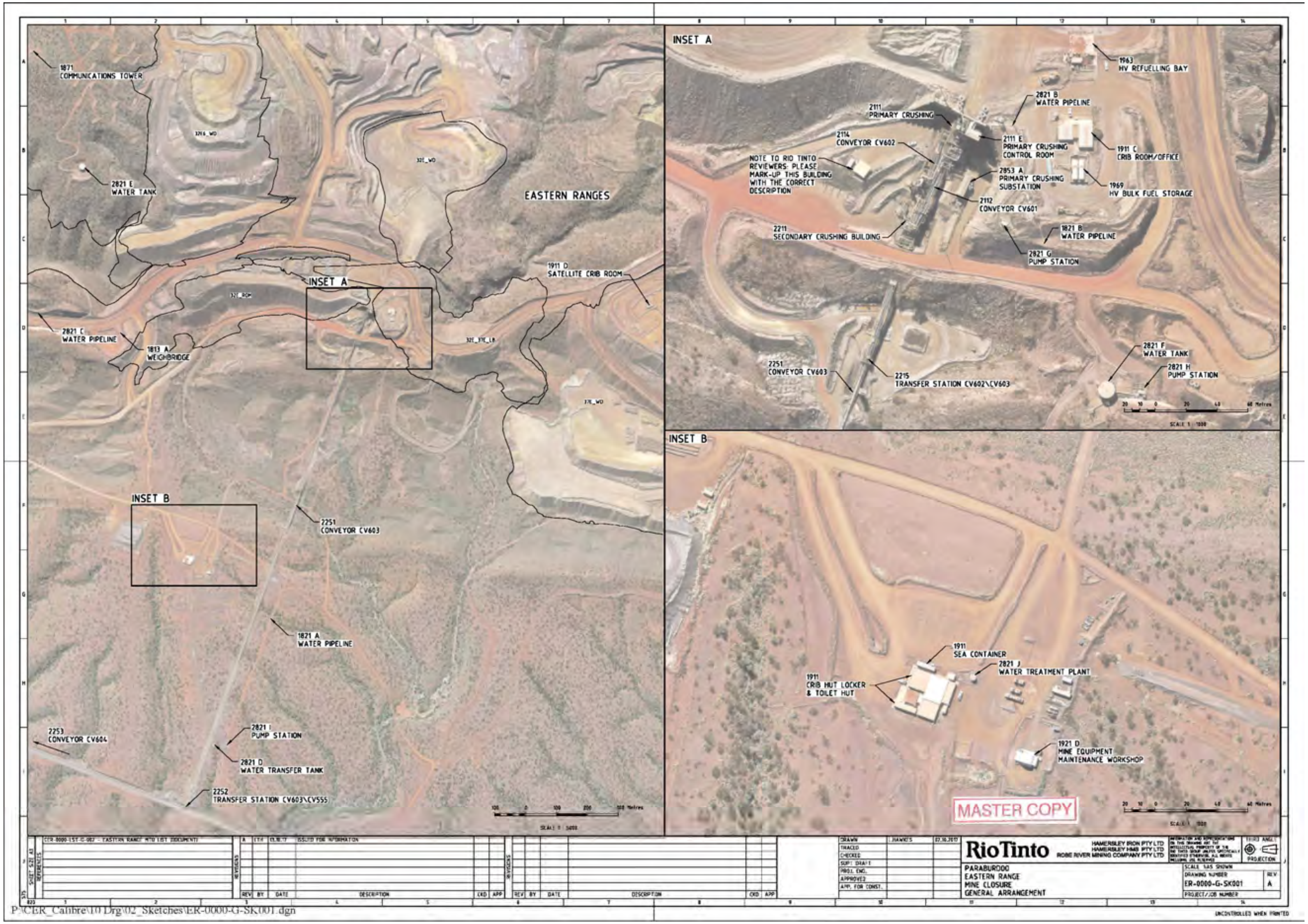


Figure 41: Key infrastructure at Eastern Range

Figure 42: Eastern Range infrastructure (inset A)

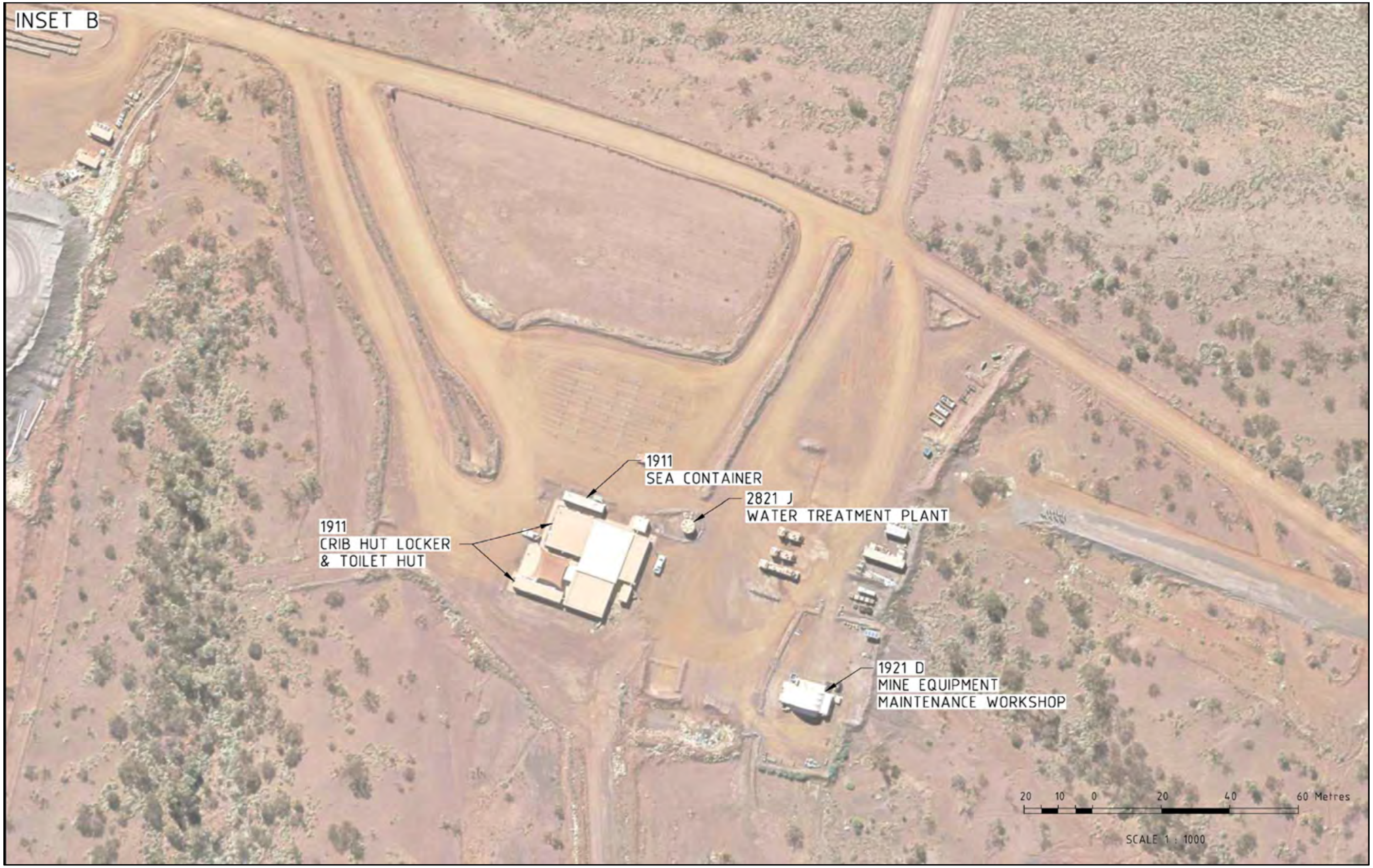


Figure 43: Eastern Range infrastructure (inset B)

19.6.1 Decommissioning and rehabilitation management

At cessation of mining, the operations team will de-energise, flush and clean all tanks, chutes, bins, hoppers and pipelines in order to make these safe for access by the demolition contractor. This includes materials in laydown yards such as spare parts, drill samples and scrap. Hazardous materials (e.g. hydrocarbons) will be removed in accordance with Controlled Waste Regulations.

Infrastructure decommissioning includes the removal of all structures and footings above surface or within 1 m of the final land surface. However, discrete items may be left in-situ and backfilled to have a minimum cover of 1 m, where removal is impractical. For example, the concrete structures related to the primary crusher vault will remain in place; here the voids will be filled and the top of the area will be capped and blended into the surrounding areas.

19.6.2 Infrastructure remaining in place

The Turee Creek borefield will remain in place to continue to supply Channar, Paraburdoo and possible future regional deposits and is included in the Paraburdoo Closure Plan. The bore water transfer lines, electrical supply and communications tower servicing these bores will also remain in place.

The sealed access road from Paraburdoo to Channar, forms part of the Channar infrastructure and is not covered in the Eastern Range closure scope of work.

19.7 Flora and fauna diversity and threatened species

The gorge habitats present at Eastern Range are considered important as refugia on a local scale due to the significant microhabitats they provide, such as caves and diversity of microhabitats (logs, debris, occasional tree hollows and isolated pods of soft soils). Surface water is more likely to persist in the gorge habitats after it has evaporated elsewhere, providing a refuge for fauna. The gorges are considered suitable habitat for MNES species; specifically the Pilbara Leaf-nosed Bat, Northern Quoll, Ghost Bat and Pilbara Olive Python. This habitat type is located in the north-eastern corner, within the two gorge systems in the centre of the current mine footprint and in the north-west corner of the Eastern Range area (Figure 44). This habitat zone will continue to be present in both disturbed and undisturbed areas outside of the mine and are not restricted at the local, subregional or bioregional scale.

The high value gorge habitat areas are subject to specific management measures to limit disturbance during operations and closure. Clearing in these areas for the purpose of light vehicle access tracks, maintaining existing tracks, monitoring activities, inadvertent fly rock, remedial and safety works and rehabilitation activities is acceptable under CPS 4032/4. Local catchments within the Eastern Range mining operation have been reduced due to mining activity and the construction of land bridges and waste dumps. There is potential for indirect impacts to pools and vegetation communities in the gorges resulting from changes to surface water flow regimes caused through the altered landform. This is discussed in further detail in the following Section 19.10.

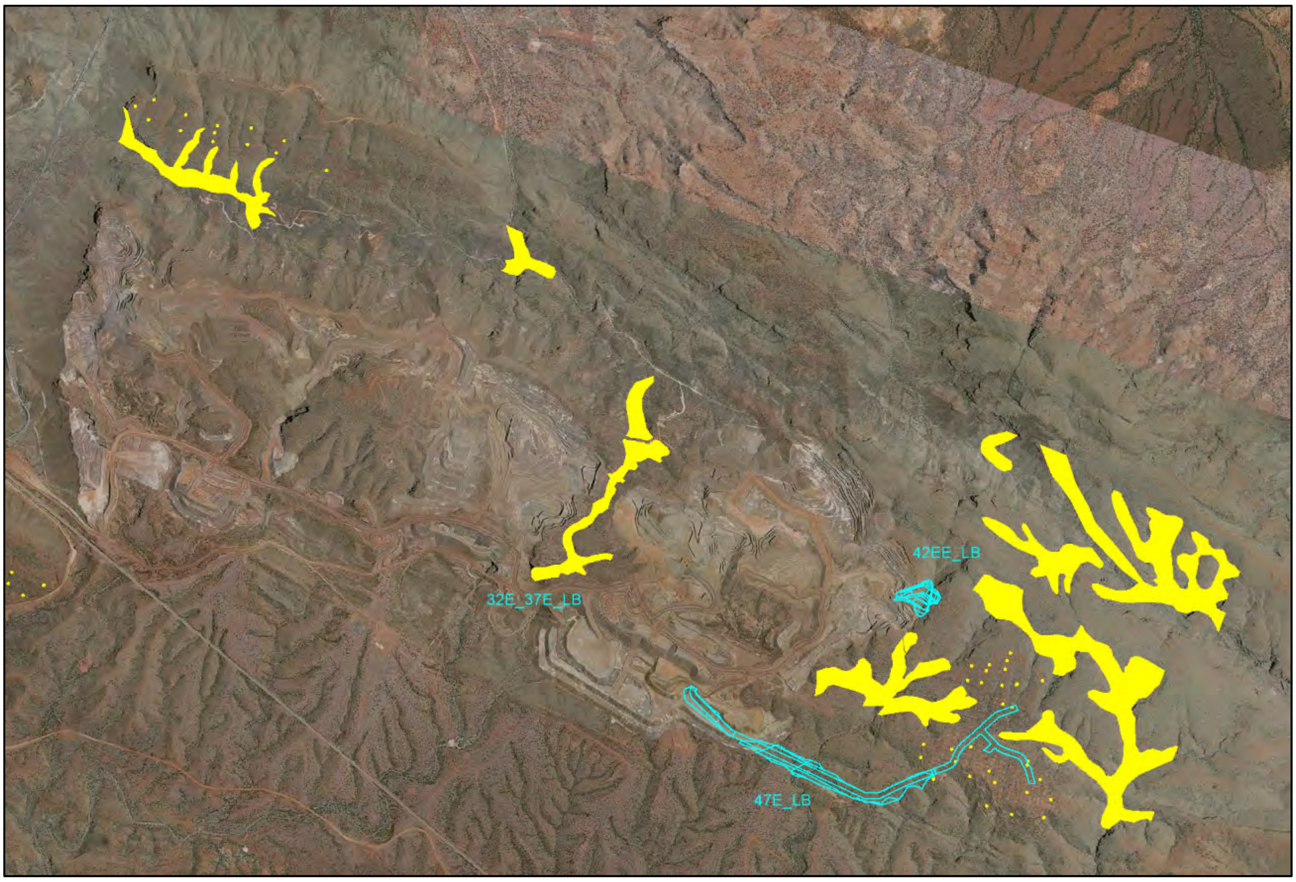


Figure 44: Significant fauna habitat at Eastern Range (shown in yellow shaded areas). Landbridges proposed for removal of valley fill sections to the extent safe and practical are highlighted in blue.

19.7.1 Management of flora and fauna diversity

The closure strategies for individual landforms were subject to multi-criteria evaluation during the OoM study (Section 22), with one of the selection criteria being the minimisation of environmental impact. Final waste landforms will be rehabilitated with consideration given to the change in topography and associated water flow generated. Landbridges terminating catchments have been investigated to determine if removal of the feature is required and/or practical in order to minimise impacts on local surface water flows. The Eastern Range pits at completion will be internally draining and it is likely that small ephemeral pools will form after heavy rainfall events but will naturally dissipate. No permanent pit lakes are expected to form as mining is restricted to above the water table. Where possible, existing surface water flows will be maintained and clearing of riparian vegetation avoided. It is likely that rehabilitation of some disturbed drainage line habitat will be required with, or as part of, local drainage controls. In these areas drainage line flora species may be included in rehabilitation seed mixes of these areas to ensure the conditions of the native vegetation clearing permit (CPS 4032/4) are met.

The re-introduction or translocation of fauna into rehabilitated areas is not proposed as part of the closure plan. Instead, natural migration of fauna species into rehabilitated land is encouraged by creating habitats with similar composition to pre-mining communities adjacent to existing natural habitats. Habitat elements that are considered as part of the rehabilitation design to encourage fauna use include:

- the use of local provenance seed;
- retaining and replacing woody debris where present;
- retention of leaf litter using small-scale topography (e.g. furrows created from ripping);
- introducing or leaving in situ rocky features such as oversized waste burden or scree slopes;

- providing areas with friable soil (or suitable mineral wastes) to encourage burrowing fauna;
- maintaining the quality of adjacent unmined habitats; and
- during the operational period and post closure monitoring period, managing feral predators and herbivores across both reference and rehabilitated areas.

Fauna and fauna habitat monitoring currently occur as part of Rio Tinto's rehabilitation monitoring as outlined in Section 25.2.1. This will continue in the closure implementation and post closure periods in conjunction with rehabilitation monitoring.

19.8 Visual amenity

Changes to the physical landscape as a result of mining can impact on the visual amenity of an area. Although Eastern Range is remote from any town centre or major service routes, these changes have the potential to have an ethnographic impact for the Yinhawangka people. Consultation with Yinhawangka representatives during the OoM study queried important landscape features to be considered and these discussions are planned to continue during PFS. Provision has been made in the closure cost estimate to undertake a visual impact assessment during the PFS and again post implementation. The assessment undertaken prior to closure will overlay final landform designs and be utilised in stakeholder consultation to determine appropriateness.

19.9 Heritage issues

Management of cultural heritage values will be conducted through processes established under the Claim Wide Participation Agreement and strategies incorporated into Cultural Heritage Management Plans as detailed in Section 16.

Closure planning considers how salvaged artefacts will be managed long term. The intent for artefact material salvaged from Eastern Range at closure has not been determined at this point. This was discussed with Yinhawangka representatives during OoM study consultation and the group has committed to providing Rio Tinto with an indication of their preferences as closure planning progresses.

During the OoM study, it also remained unclear if any heritage sites will be impacted as a result of closure implementation i.e. footprint encroachment. As options on engineering and rehabilitation designs are narrowed during the PFS stage, any potential for sites to be impacted will be identified and managed in accordance with appropriate procedures. Heritage surveys, and any future assessments or clearances that are required to facilitate closure implementation, will be conducted in collaboration with the Yinhawangka People in alignment with the Heritage Protocol set out in the Participation Agreement between Yinhawangka and Rio Tinto.

As detailed in Section 19.5.2 the current high level plans for safety bunding will impede access to heritage sites post closure. This issue will continue to be assessed in future stages of closure planning to ensure acceptable and safe access is available.

19.10 Alteration of the hydrology and flow of surface waters

An assessment was undertaken during the OoM to evaluate the effect of the modified post closure landform on local surface flow paths and catchment flow paths (as shown in Figure 45). At a local scale, catchment areas are reduced for several minor local creeks, including creeks and gorges hosting pools of environmental and heritage significance (Sections 12.1, 13.3, 16.2). At a broader scale, the reduction in the catchment of the Turee Creek regional catchment (Figure 17) is minimal (<0.5%).

A suite of hydraulic models were run during the OoM based on a range of direct rainfall events to assess flood behaviour in the proposed post closure landform. Design rainfall intensities were derived from a number of sources including:

- Bureau of Meteorology design rainfall depths for events ranging from 12 exceedances per year to 1% Annual Exceedance Probability (AEP);
- CRC FORGE (2012) used for 1:100 to 1:2000 AEP for durations 24 hours and greater;
- Jordan et al (2005) growth curves for short duration rainfall events. Used for 1:100 to 1:2000 AEP for durations shorter than 24 hours; and
- Generalised Short Duration Method used to estimate Probable Maximum Precipitation (PMP) depths for durations less than 24 hours.

Floodplain mapping showing maximum rainfall runoff depths and peak velocity values for a 1 in 500 year average reoccurrence interval is shown in Figure 46 and Figure 47. The peak depth map (Figure 46) shows that water will temporarily pool in pits after large rainfall events and that waste dumps and landbridges will receive surface water flows from surrounding topography. The velocities that correspond to such an event are strongest where water is funnelled into narrow areas, such as gorge habitats and in areas where built landforms intersect the natural landscape (Figure 47), which could result in scouring and erosion. This information will be refined in the PFS to better inform rehabilitation designs and surface water control measures.

19.10.1 Hydrology management

Changes to flow paths as well as overtopping potential and flood impacts were considered during the landform strategy evaluation and are a key driver for the proposed removal of the 32E-37E, 42EE and 47E cross valley fill landbridges to the extent that is safe and practical, to enable reinstatement of surface flow paths in these locations. For the remaining landbridges, the intent is for these to be rehabilitated in-situ, as outlined in Table 29. Assessment will continue during the remaining life of mine for the site to inform the final selection of appropriate closure scenarios for individual landforms and refine rehabilitation designs as required.

19.11 Community

Rio Tinto Iron Ore recognises the close relationship between the Paraburdoo town and the Greater Paraburdoo mining operations. A Pilbara Town Strategy is currently under development. Once finalised, the strategy will inform the Paraburdoo town aspects relating to closure. Communities associated with Eastern Range are specifically excluded from the scope of the operational closure plan as they are considered within the Pilbara Town Strategy. Detailed workforce planning, baseline studies and social impact assessments will be undertaken to determine potential social impact to these communities during the Town Strategy work.

Notwithstanding this, during the OoM closure study, engagement commenced with community stakeholders regarding the closure of Eastern Range, including the Shire of Ashburton and Yinhawangka representatives. During the PFS, the engagement focus will be expanded to ensure all relevant parties within the town are consulted as appropriate.